24-h actigraphic monitoring of motor activity, sleeping and eating behaviors in underweight, normal weight, overweight and obese children.


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PURPOSE: Within a chronobiological perspective, the present study aimed to describe 24 h of sleep–wake cycle, motor activity, and food intake patterns in different body mass index (BMI) categories of children through 7 days of actigraphic recording.

METHODS: Height and weight were objectively measured for BMI calculation in a sample of 115 Italian primary schoolchildren (10.21 ± 0.48 years, 62.61 % females). According to BMI values, 2.60 % were underweight, 61.70 % were of normal weight, 29.60 % were overweight and 6.10 % were obese. Participants wore a wrist actigraph continuously for 7 days to record motor activity and describe sleep–wake patterns. In addition, participants were requested to push the event-marker button of the actigraph each time they consumed food to describe their circadian eating patterns.

RESULTS: BMI group differences were found for sleep quantity (i.e.
midpoint of sleep and amplitude), while sleep quality, 24-h motor activity and food intake patterns were similar between groups. Regression analyses showed that BMI was negatively predicted by sleep duration on schooldays. BMI was also predicted by motor activity and by food intake frequencies recorded at particular times of day during schooldays and at the weekend.

CONCLUSIONS: The circadian perspective seems to provide promising insight into childhood obesity, but this aspect needs to be further explored.

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24-h activity rhythm and sleep in depressed outpatients.

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Disturbances in sleep and circadian rest-activity rhythms are key features of depression. Actigraphy, a non-invasive method for monitoring motor activity, can
be used to objectively assess circadian rest-activity rhythms and sleep patterns. While recent studies have measured sleep and daytime activity of depressed patients using wrist-worn actigraphy, the actigraphic 24-h rest-activity rhythm in depression has not been well documented. We aimed to examine actigraphically measured sleep and circadian rest-activity rhythms in depressed outpatients. Twenty patients with DSM-IV major depressive episode and 20 age- and sex-matched healthy controls participated in this study. Participants completed 7 consecutive days of all-day actigraphic activity monitoring while engaging in usual activities. For sleep parameters, total sleep time, wake after sleep onset, and sleep fragmentation index were determined. Circadian rhythms were estimated by fitting individual actigraphy data to a cosine curve of a 24-h activity rhythm using the cosinor method, which generated three circadian activity rhythm parameters, i.e., MESOR (rhythm-adjusted mean), amplitude, and acrophase. Subjective sleep was also assessed using a sleep diary and the Pittsburgh Sleep Quality Index. Patients showed significantly lower MESOR and more dampened amplitude along with significant sleep disturbances. Logistic regression analysis revealed that lower MESOR and more fragmented sleep emerged as the significant predictors of depression. Correlations between subjectively and actigraphically measured parameters demonstrated the validity of actigraphic measurements. These results indicate marked disturbances in sleep and circadian rest-activity rhythms of depression. By simultaneously measuring sleep and rest-activity rhythm parameters, actigraphy might serve as an objective diagnostic aid for depression.

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24-HOUR ACTIVITY RHYTHM AND SLEEP DISTURBANCES IN DEPRESSION AND ANXIETY: A POPULATION-BASED STUDY OF MIDDLE-AGED AND OLDER PERSONS.


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BACKGROUND: Disturbed circadian rhythms have been associated with depression and anxiety, but it is unclear if disturbances in the 24-hr activity rhythm and sleep are independently and specifically related to these disorders.

METHODS: In 1,714 middle-aged and elderly participants of the Rotterdam Study, we collected actigraphy recordings of at least 96 hr (138 ± 14 hr, mean ± standard deviation). Activity rhythms were quantified calculating the fragmentation of the rhythm, stability of the rhythm over days, and timing of the rhythm. Total sleep time, sleep onset latency, and wake after sleep onset were also estimated with actigraphy. Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression scale, persons with clinically relevant depressive symptoms
were interviewed to diagnose DSM-IV-depressive disorder. Anxiety disorders were determined with the Munich version of the Composite International Diagnostic Interview.

RESULTS: More fragmented rhythms were associated with clinically relevant depressive symptoms (odds ratio (OR): 1.27, 95% confidence interval (CI): 1.04;1.54) and anxiety disorders (OR: 1.39, 95% CI: 1.14;1.70) after covariate adjustment. Less stable rhythms, longer sleep onset latency, and more wake after sleep onset were related to clinically relevant depressive symptoms or anxiety disorders only if not adjusted for covariates and other activity rhythm and sleep indicators.

CONCLUSIONS: Our study in middle-aged and elderly persons suggests that fragmentation of the 24-hr activity rhythm is associated with depression and anxiety. Moreover, this association also largely accounts for the effect of disturbed sleep on these psychiatric disorders.

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25-Hydroxyvitamin D status, light exposure and sleep quality in UK dwelling South Asian and Caucasian postmenopausal women.

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There is a lack of research into 25-hydroxyvitamin D (25(OH)D) status, light exposure and sleep patterns in South Asian populations. In addition, results of research studies are conflicting as to whether there is an association between 25(OH)D status and sleep quality. We investigated 25(OH)D status, self-reported and actigraphic sleep quality in n = 35 UK dwelling postmenopausal women (n = 13 South Asians, n = 22 Caucasians), who kept daily sleep diaries and wore wrist-worn actiwatch (AWL-L) devices for 14 days. A subset of n = 27 women (n = 11 South Asian and n = 16 Caucasian) also wore a neck-worn AWL-L device to measure their light exposure. For 25(OH)D concentration, South Asians had a median ± IQR of 43.8 ± 28.2 nmol/L, which was significantly lower than Caucasians (68.7 ± 37.4 nmol/L)(P = 0.001). Similarly, there was a higher sleep fragmentation in the South Asians (mean ± SD 36.9 ± 8.9) compared with the Caucasians (24.7 ± 7.1)(P = 0.002). Non-parametric circadian rhythm analysis of rest/activity patterns showed a higher night-time activity (L5) (22.6 ± 14.0 vs. 10.5 ± 4.4; P = 0.0008) and lower relative amplitude (0.85 ± 0.07 vs. 0.94 ± 0.02; P < 0.0001) in the South Asian compared with the Caucasian women.
More South Asians (50%) met the criteria for sleep disorders (PSQI score >5) than did Caucasians (27%) (P = 0.001, Fishers Exact Test). However, there was no association between 25(OH)D concentration and any sleep parameter measured (P > 0.05) in either ethnic group. South Asians spent significantly less time in illuminance levels over 200 lx (P = 0.009) than did Caucasians. Overall, our results show that postmenopausal South Asian women have lower 25(OH)D concentration than Caucasian women. They also have higher sleep fragmentation, as well as a lower light exposure across the day. This may have detrimental implications for their general health and further research into sleep quality and light exposure in the South Asian ethnic group is warranted.

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3-D motion capture for long-term tracking of spontaneous locomotor behaviors and circadian sleep/wake rhythms in mouse.

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BACKGROUND: Locomotor activity provides an index of an animal's behavioral state. Here, we report a reliable and cost-effective method that allows long-term (days to months) simultaneous tracking of locomotion in mouse cohorts (here consisting of 24 animals).

NEW METHOD: The technique is based on a motion capture system used
mainly for human movement study. A reflective marker was placed on the head of each mouse using a surgical procedure and labeled animals were returned to their individual home cages. Camera-recorded data of marker displacement resulting from locomotor movements were then analyzed with custom built software. To avoid any data loss, data files were saved every hour and automatically concatenated. Long-term recordings (up to 3 months) with high spatial (<1mm) and temporal (up to 100Hz) resolution of animal movements were obtained.

RESULTS: The system was validated by analyzing the spontaneous activity of mice from post-natal day 30–90. Daily motor activity increased up to 70 days in correspondence with maturational changes in locomotor performance. The recorded actigrams also permitted analysis of circadian and ultradian rhythms in cohort sleep/wake behavior.

COMPARISON WITH EXISTING METHOD(S): In contrast to traditional session-based experimental approaches, our technique allows locomotor activity to be recorded with minimal experimenter manipulation, thereby minimizing animal stress.

CONCLUSIONS: Our method enables the continuous long-term (up to several months) monitoring of tens of animals, generating manageable amounts of data at minimal costs without requiring individual dedicated devices. The actigraphic data collected allows circadian and ultradian analysis of sleep/wake behaviors to be performed.

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45-hour continuous quintuple-site actimetry: relations between trunk and limb movements and effects of circadian sleep–wake rhythmicity.
Diurnal and nocturnal trunk and limb motor activity of 20 healthy individuals was evaluated by actimetry for 45 consecutive hours. Sleep was assessed by sleep logs. Overall, motor activity significantly (p < .05) decreased in the order wrist, ankle, and trunk. There was significantly more motor activity in the dominant wrist during the diurnal period. Motor activity was significantly affected by the 24-hr sleep-wake cycle, with lower levels and prolonged immobility during the night. Time series analyses revealed different but significant correlations between motor activity at all sites. These data imply that (a) motor activity should be recorded at the dominant wrist when the highest level of motor activity is of importance, (b) recordings at the nondominant wrist are better indicators of trunk movement than are dominant wrist recordings, and (c) sites other than the conventional nondominant wrist recording site should be evaluated to improve the validity of motor activity-based sleep-wake scoring.

PMID: 9090270 [Indexed for MEDLINE]
OBJECTIVE: A high rate of sleep disturbances has been reported in individuals with Williams syndrome (WS) but the underlying aetiology has yet to be identified. Melatonin and cortisol levels display circadian rhythmicity and are known to affect and regulate sleep/wake patterns. The current study examined the levels of these two endocrine markers and explored a possible relationship with sleep patterns in children with WS.

METHODS: Twenty-five children with WS and 27 typically developing age- and gender-matched comparison children were recruited. Saliva was collected from each child at three time points: 4-6 pm, before natural bedtime, and after awakening. The levels of salivary melatonin and cortisol were analysed by specific enzyme-linked immunoassays. Sleep patterns were examined using actigraphy and the Children's Sleep Habit Questionnaire.

RESULTS: The WS group had shallower drops in cortisol and less pronounced increase in melatonin at bedtime compared to the controls. Furthermore, they also had significantly higher levels of cortisol before bedtime.

CONCLUSIONS: Increased bedtime cortisol and less pronounced rise in melatonin levels before sleep may play a role in the occurrence of sleep disturbances, such as delayed sleep onset, observed in children with WS. As both markers play a significant role in our circadian rhythm and sleep/wake cycle, it is...
necessary to examine sleep using multi-system analysis.

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Abnormal sleep-wake cycles in patients with tuberculous meningitis: a case-control study.

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BACKGROUND: Patients with tuberculous meningitis (TBM) have been frequently observed to have excessive sleep during the day and frequent awakenings during night. We undertook this study to evaluate sleep related abnormalities in patients with TBM since there is no published literature pertaining to the same.

AIMS AND OBJECTIVES: To study sleep wake cycles in patients with tuberculous meningitis by actigraphy and sleep logs and compare these with age and sex matched controls.

METHODS: Consecutive patients admitted with tuberculous meningitis were studied clinically and with three days of continuous wrist actigraphy and sleep/wake parameters were compared to those of age and gender matched normal healthy controls.

RESULTS: Forty three patients with tuberculous meningitis were enrolled in the study. Of these, twenty-eight patients (15 females, 13 males; mean age 31.64 years) who were able to complete adequate actigraphy were compared with an equal number of controls (15 females, 13 males; mean age 30.93 years).
Patients were found to have greater sleep time (p<0.0005) and more sleep episodes (p<0.0005) during the day while during the night they had less sleep (p<0.0005) with more frequent (p=0.019) and longer (p<0.0005) awakenings as compared to normal controls. Majority of the patients had reversal of sleep/wake cycles. There was poor co-relation between sleep parameters measured by actigraphy and sleep logs.

CONCLUSIONS: Tuberculous meningitis is associated with significant alteration of sleep-wake circadian cycles. This needs to be further characterized through studies involving polysomnography. There is a need to address these specific sleep difficulties to improve the quality of life of the patient as well as the care-giver.

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Accelerometer-measured sleep duration and clinical cardiovascular risk factor scores in older women.

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BACKGROUND: Evidence suggests that short and long sleep durations are potential lifestyle factors associated with cardiovascular disease (CVD). Research on sleep duration and CVD risk is limited by use of self-report sleep measures, homogeneous populations, and studies on individual CVD risk factors. For women, risk of CVD and inadequate sleep duration increases with age. We hypothesized that accelerometer-measured sleep duration was associated with 10-year predicted probability of future CVD risk in a cohort of aging women.

METHODS: This cross-sectional analysis included 3367 older women (mean age 78.9 years; 53.3% White), from the Objective Physical Activity and Cardiovascular Health Study, ancillary study to the Women's Health Initiative. Women wore ActiGraph GT3X+ accelerometers on the hip for 24 hours/7 days. A 10-year predicted probability of future CVD risk, the Reynolds Risk Score (RRS), was computed using age, systolic blood pressure, high-sensitivity C-reactive protein (CRP), total and HDL cholesterol, diabetes mellitus status, smoking status, and family history of CVD. Average nightly sleep duration was derived from accelerometer data. Adjusted linear regression models investigated the association between sleep duration and RRS.

RESULTS: Results suggested a U-shaped relationship between sleep duration and RRS, with both short and long sleep associated with higher RRS (p <0.001). The association remained significant after adjustments for race/ethnicity, education, lifestyle factors and health status indicators.

CONCLUSION: In older women, actigraphy-ascertained sleep duration was associated
with a 10-year predicted probability of future CVD risk. This study supports sleep duration as a modifiable risk factor for CVD in older women.

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Accommodating adolescent sleep-wake patterns: the effects of shifting the timing of sleep on training effectiveness.

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STUDY OBJECTIVE: This study evaluated the effect of accommodating adolescent sleep-wake patterns by altering the timing of the major sleep period of US Army recruits.

DESIGN: The quasi-experimental study compared recruits assigned to one of two training companies: one with a customary sleep regimen (20:30 to 04:30) while the other employed a phase-delayed sleep regimen (23:00 to 07:00), the latter aligning better with biologically driven sleep-wake patterns of adolescents.

SETTING: The study was conducted during Basic Combat Training (BCT) at Fort Leonard Wood, Missouri. TRAINEES: The study included 392 trainees: 209 received the intervention, while 183 composed the Comparison group.

MEASUREMENTS AND RESULTS: Demographic and psychophysiological measures were collected on all trainees. Weekly assessments of subjective fatigue and mood, periodic physical fitness, marksmanship scores, and attrition rates from BCT were studied. Actigraphy was collected on approximately 24% of trainees.
Based on actigraphy, trainees on the phase-delayed sleep schedule obtained 31 m more sleep/night than trainees on the customary sleep schedule. The Intervention group reported less total mood disturbance relative to baseline. Improvements in marksmanship correlated positively with average nightly sleep during the preceding week when basic marksmanship skills were taught. No differences were seen in physical fitness or attrition rates. In contrast to the Intervention group, the Comparison group was 2.3 times more likely to experience occupationally significant fatigue and 5.5 times more likely to report poor sleep quality.

CONCLUSIONS: Accommodating adolescent sleep patterns significantly improves mental health and performance in the training environment.

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Actigraph analysis of diurnal motor fluctuations during dopamine agonist therapy.

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BACKGROUND: Generally, clinicians use rating scales or descriptive writing to characterize diurnal changes in motor signs and symptoms in Parkinson's disease (PD); however, these ratings are subjective and are not easily reproducible.

OBJECTIVE: To examine the usefulness of actigraphy as an objective indicator of akinesia by long-term, continuous measurement of limb motor activity (MA), visualize 24-hour circadian profiles of akinesia, and quantitatively detect
cabergoline (CBG) efficacy in both hospitalized patients and outpatients with Parkinson's disease.

METHODS: MA was continuously recorded with a wrist-worn activity monitor (actigraph) in 29 hospitalized PD patients without tremor or abnormal involuntary movements. In another series consisting of 8 outpatients, the response duration of CBG was measured by using averaged actigraphy.

RESULTS: By averaging data gathered every 24 h over several days, it was possible to quantify the circadian patterns of akinesia. These cumulative evaluations of the patients' motor status determined 4 types of akinesia: (1) a wearing-off pattern seen in advanced efficacy stages, (2) stable response, (3) afternoon akinesia, and (4) morning akinesia. Following CBG therapy, the MA increased significantly throughout the daytime, i.e.: by 40% in the morning (8:00 a.m. to 12:00 noon), by 60% in the afternoon (12:00 noon to 6:00 p.m.), and by 60% in the next early morning (from time to get up until 8:00 a.m.).

CONCLUSION: In averaged motor activity, the charting of cumulative evaluations of motor status revealed the long-acting efficacy of CBG in ameliorating existing motor fluctuations throughout the daytime and even promoting sleep benefit in the next morning. Averaged actigraphy is considered to be useful in the quantitative detection of drug responses to parkinsonian akinesia and its circadian variations. This enables titration of the lowest dose of drugs needed to alleviate akinesia.

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BACKGROUND: Distinguishing pediatric bipolar disorder (BD) from attention-deficit hyperactivity disorder (ADHD) can be challenging. Hyperactivity is a core feature of both disorders, but severely disturbed sleep and circadian dysregulation are more characteristic of BD, at least in adults. We tested the hypothesis that objective measures of activity, sleep, and circadian rhythms would help differentiate pediatric subjects with BD from ADHD and typically developing controls.

METHODS: Unmedicated youths (N = 155, 97 males, age 5-18) were diagnosed using DSM-IV criteria with Kiddie-SADS PL/E. BD youths (n = 48) were compared to typically developing controls (n = 42) and children with ADHD (n = 44) or ADHD plus comorbid depressive disorders (n = 21). Three-to-five days of minute-to-minute belt-worn actigraph data (Ambulatory Monitoring Inc.), collected during the school week, were processed to yield 28 metrics per subject, and assessed for group differences with analysis of covariance. Cross-validated machine learning algorithms were used to determine the predictive accuracy of a four-parameter model, with measures reflecting sleep, hyperactivity, and circadian dysregulation, plus Indic's bipolar vulnerability index.
RESULTS: There were prominent group differences in several activity measures, notably mean 5 lowest hours of activity, skewness of diurnal activity, relative circadian amplitude, and VI. A predictive support vector machine model discriminated bipolar from non-bipolar with mean accuracy of 83.1 ± 5.4%, ROC area of 0.781 ± 0.071, kappa of 0.587 ± 0.136, specificity of 91.7 ± 5.3%, and sensitivity of 64.4 ± 13.6%.

CONCLUSIONS: Objective measures of sleep, circadian rhythmicity, and hyperactivity were abnormal in BD. Wearable sensor technology may provide bio-behavioral markers that can help differentiate children with BD from ADHD and healthy controls.

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Actigraph measures of sleep among female hospital employees working day or alternating day and night shifts.


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Sleep disturbance is common among shift workers, and may be an important factor in the effect of shift work on chronic disease development. In this cross-sectional study, we described sleep patterns of 294 female
hospital workers
(142 alternating day-night shift workers, 152 day workers) and determined associations between shift work and sleep duration. Rest–activity cycles were recorded with the ActiGraph GT3X+ for 1 week. Analyses were stratified by chronotype of shift workers. Using all study days to calculate average sleep duration, shift workers slept approximately 13 min less than day workers during main sleep periods, while 24-h sleep duration did not differ between day workers and shift workers. Results from age-adjusted models demonstrated that all shift workers, regardless of chronotype, slept 20–30 min less than day workers on day shifts during main and total sleep. Early and intermediate chronotypes working night shifts slept between 114 and 125 min less than day workers, both with regard to the main sleep episode and 24-h sleep duration, while the difference was less pronounced among late chronotypes. When sleep duration on free days was compared between shift workers and day workers, only shift workers with late chronotypes slept less, by approximately 50 min, than day workers during main sleep. Results from this study demonstrate how an alternating day-night shift work schedule impacts sleep negatively among female hospital workers, and the importance of considering chronotype in sleep research among shift workers.

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Actigraphic assessment of circadian activity and sleep patterns in bipolar disorder.

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OBJECTIVES: Theoretical accounts and psychological interventions for bipolar disorder indicate that disruption of circadian rhythms is important, both in affective episodes and as a vulnerability factor in subsyndromal periods. This study aims at assessing both circadian activity and sleep patterns using actigraphy within a bipolar sample experiencing low levels of subsyndromal symptoms. It is hypothesized that such participants will display circadian activity disruption in spite of low levels of symptoms.

METHODS: This study employed a mixed design with cross-sectional assessment of mood and week-long (7-day) recording of actigraphy data. All clinical participants were psychiatric outpatients within a UK NHS Hospital. Nineteen bipolar patients and 19 age- and gender-matched controls wore an actigraph for 7 days to obtain sleep and circadian activity data. SCID was used to confirm DSM-IV diagnostic status. Self-report measures of mood were obtained from both groups.

RESULTS: Bipolar patients were found to have less stable and more variable circadian activity patterns than controls. Regression analysis indicated that variability alone was a significant independent predictor of diagnostic group. There was evidence from raw activity data that bipolar patients were also less active than controls. These differences were not associated with levels of subsyndromal symptoms. Bipolar patients did not differ from controls on any of the sleep indices used.

CONCLUSIONS: Circadian activity disruption is apparent in bipolar patients even when not acutely ill. This finding is not associated with the presence of sleep disturbance. Should such patterns be replicated interventions to address both circadian instability and individual attributions for the effects of such instability are likely to be relevant to successful psychological...


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OBJECTIVES: We measured subjectively evaluated depression and anxiety, and objectively measured daily sleep–activity patterns in inpatients and outpatients with advanced non-small cell lung cancer (NSCLC) and determined whether cancer–associated depression and anxiety are accompanied by characteristic circadian rhythm abnormalities.

METHODS: Equal numbers of inpatients (n=42) and outpatients (n=42) with advanced NSCLC were studied. Baseline depression and anxiety, assessed by the Hospital Anxiety and Depression Scale (HADS), and actigraphy were recorded before chemotherapy initiation. The effects of the presence and severity of chronic obstructive pulmonary disease (COPD) on depression, anxiety, and actigraphy were assessed only among the 42 outpatients.

RESULTS: Anxiety occurred in 40% and depression in 25% of these lung cancer patients, equally among inpatients and outpatients. All patients suffer extremely disturbed daily sleep–activity cycles but each patient also maintains some degree of circadian organization. Outpatients maintain more robust daily
activity patterns and longer, more consolidated nighttime sleep compared with inpatients.
The more disrupted the daily sleep-activity rhythm, the worse the depression and/or anxiety scores for outpatients. These relationships are obscured among inpatients. COPD has no independent measurable effects on the daily organization of sleep-activity, depression, or anxiety.
CONCLUSIONS: Lung cancer patients whose diurnal activity is disturbed by prolonged and frequent sedentary episodes and whose sleep is disturbed by frequent and prolonged waking are most anxious and depressed. These findings and relationships are masked by hospitalization. Since diurnal exercise improves both sleep and mood, it is reasonable to test whether enhancing daytime activity and nighttime sleep can diminish cancer-associated depression.

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Actigraphic assessment of sleep-wake rhythm during the first 6 months of life.
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OBJECTIVES: To examine the validity of the "Gaehwiler" actigraph (Gaehwiler Electronics, model Z80-32k V(1)) for the assessment of sleep-wake (S/W) rhythm and sleep structure in infants during the first 6 months of life using an algorithm developed in our laboratory to differentiate sleep and wake states.
METHODS: A continuous 72 h actigraphic recording was performed in 10 healthy infants at 1, 3 and 6 months of age. The actigraphic data were matched
to direct observation of the infants' behavioural states. Using discriminant function analysis a scoring algorithm for automatic identification of S/W states from raw activity data was developed. The chi-square periodogram analysis was performed to estimate periodic components of S/W rhythm.

RESULTS: The overall agreement rates between the actigraphic and observer scoring for S/W were between 87 and 95% for the infants after the third month of life, while for the 1-month-old infants they never exceeded 72%. The actigraphic discrimination between active and quiet sleep was the best in 3-month-old infants. The circadian influence on S/W rhythm was already present by the end of the first month of life.

CONCLUSIONS: Using the "Gaehwiler" actigraph in our study, valid discrimination between sleep and wake states was obtained in infants during 3 and 6 months. The actigraph, however, did not provide valid active vs. quiet sleep state measures. The circadian rhythm of S/W was observed as early as during the first month of life.

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Actigraphic assessment of the circadian rest-activity rhythm in elderly patients hospitalized in an acute care unit.

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Hospitalization for acute illness is a major risk factor of rest-activity rhythm disturbance among elderly subjects. The rest-activity rhythm is disturbed by the
acute illness, aging and hospital environment. The purpose of this study is to assess the rest-activity rhythm and light exposure (using a wrist worn actigraph) of 10 patients (mean age 81 years, seven females) admitted on an acute care unit, suffering from cardiac, respiratory or renal acute disease. A non-parametric method was used to analyze activity data. With an improvement of the underlying diseases, the mean relative amplitude of rhythm increased from 0.31 +/- 0.19 for the first 5-day period after admission to 0.54 +/- 0.21 for the second period before discharge (P < 0.05). The amount of time at night spent above a lighting threshold of 50 lux decreased from 31.4 to 12.3 min between the two periods. The rhythm of elderly subjects hospitalized in the acute care unit is severely altered during the initial period and is progressively resynchronized following clinical improvement. Under the acute underlying disease and/or aging, environmental conditions (light, noise) should be considered to maintain regular rest-activity rhythm.

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Actigraphic estimates of circadian rhythms and sleep/wake in older schizophrenia patients.

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Twenty-four hour circadian activity rhythms and light-exposure levels of 28 older schizophrenia patients (mean age=58years) were examined using an Actillume recorder. Sleep and wake were scored using the algorithm of the
ACTION3 software which revealed that the patients slept for 67% of the night and napped for 9% of the day. Patients with more disturbed sleep and less robust circadian rhythms performed more poorly on neuropsychological tests. Patients with higher cognitive functioning and fewer extrapyramidal symptoms were more alert during the day. Few patients were exposed to high levels of illumination during the day, and older age was associated with lower levels of light exposure. Duration of antipsychotic use and higher antipsychotic doses were associated with decreased daytime alertness and less robust circadian activity rhythms. Patients taking antipsychotics were more sleepy both during the day and night than patients not taking antipsychotics. The circadian rhythm disturbances found in these patients did not seem to be due solely to low levels of illumination exposure. Life-style factors, behavioral factors, psychiatric symptoms and medications were likely contributors to the disturbed rhythms. The effects of the sleep disturbances did not seem to be benign. There were strong relationships between sleep and circadian rhythms and functioning.

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PMCID: PMC2758687
PMID: 11163547 [Indexed for MEDLINE]


Actigraphic estimates of sleep and the sleep-wake rhythm, and 6-sulfatoxymelatonin levels in healthy Dutch children.

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Sleep and the sleep-wake rhythm are essential for children's health and well-being, yet reference values are lacking. This study therefore aimed to assess actigraphic estimates of sleep and the 24-h sleep-wake rhythm, as well as 6-sulfatoxymelatonin (aMT6s) levels in healthy children of different age groups. Additionally, relationships between the outcomes and sex, highest parental educational level (as an indication of socioeconomic status (SES)), and body-mass-index (BMI) were explored. In this cross-sectional study, healthy Dutch children (2-18 years) wore an actigraph (GT3x) for 7 consecutive days, collected first-morning void urine and completed a sleep log and sociodemographic questionnaire. Actigraphically estimated sleep variables were sleep onset latency (SOL), sleep efficiency (SE), total sleep time (TST), and wake after sleep onset (WASO). Non-parametric sleep-wake rhythm variables were intradaily variability (IV); interdaily stability (IS); the activity counts and timing of the least active 5-h period (L5counts and midpoint) and of the most active 10-h period (M10 counts and midpoint); and the relative amplitude (RA), i.e. the ratio of the difference and the sum of M10 and L5 counts. Finally, creatinine-corrected aMT6s levels were obtained by isotope dilution mass spectrometry. Effects of age group (preschool 2-5 years/school-aged 6-12 years/teenager 13-18 years), sex, highest parental educational level and BMI (Z-scores) were explored. Ninety-four children participated, equally divided across age groups (53% boys). Teenagers slept less,
but more efficiently, than younger children, while their 24 h sleep-wake rhythm was the least stable and most fragmented (likely due to fragmentation of daytime activity). Additionally, aMT6s levels significantly declined over the age groups. Children from highly educated parents had lower sleep efficiency, but a more stable sleep-wake rhythm. Finally, sex or increase in BMI was not associated with any of the outcomes in this study. In conclusion, this study provides reference values of healthy children across different age groups and different sociodemographic factors. In the future, this information may help to better interpret outcomes in clinical populations.

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PMID: 32126835


Actigraphic investigation of circadian rhythm functioning and activity levels in children with mucopolysaccharidosis type III (Sanfilippo syndrome).

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BACKGROUND: Sleep disturbance is part of the behavioural phenotype of the rare genetic condition mucopolysaccharidosis (MPS) type III. A growing body of evidence suggests that underlying disturbance in circadian rhythm functioning may explain sleep problems within the MPS III population.

METHODS: Actigraphic data were recorded in eight children with MPS III
over 7-10 days and compared to age-matched typically developing controls. Parameters of circadian rhythmicity and activity levels across a 24-h period were analysed.

RESULTS: Statistically and clinically significant differences between the two groups were noted. Analysis indicated that children with MPS III showed significantly increased fragmentation of circadian rhythm and reduced stability with external cues (zeitgebers), compared to controls. Average times of activity onset and offset were indicative of a phase delayed sleep-wake cycle for some children in the MPS III group. Children with MPS III had significantly higher activity levels during the early morning hours (midnight-6 am) compared to controls.

CONCLUSIONS: Results are consistent with previous research into MPS III and suggest that there is an impairment in circadian rhythm functioning in children with this condition. Implications for clinical practice and the management of sleep difficulties are discussed.

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PMID: 26388955


Actigraphic measurements in opioid detoxification with methadone or buprenorphine.


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The objective of the present naturalistic study was to assess the differential effects of opioid detoxification with methadone or buprenorphine on
activity, circadian rhythm, and sleep. Forty-two consecutive inpatients with opiate addiction were switched to either methadone or buprenorphine and gradually tapered down over the course of 2 to 3 weeks. There were no significant differences in comedication (lofexidine, quetiapine, and valproic acid) between the methadone and buprenorphine groups. Patients in the methadone group showed 11% lower activity and were 24 minutes phase delayed as compared with buprenorphine-treated patients, whereas the latter had 2.5% lower sleep efficiency and 9% shorter actual sleep time. These significant group differences were most pronounced for the lowest doses (≤20% of maximum individual daily dose, ie, at the end of withdrawal representing late withdrawal effects). Furthermore, for the total sample, we found a significant decrease in the relative amplitude of the sleep-wake cycle and worsening of all actigraphic sleep parameters from the higher (100% to 20%) to the lowest doses (20% to 0%). The acrophase of the circadian rhythm displayed a phase advance (~88 minutes) from the highest (100% to 80%) to the lower doses (80% to 0%) in methadone-treated patients. Opioid tapering with methadone or buprenorphine leads to characteristic changes of the rest-activity cycle, but further study is required to validate these results.

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Actigraphic monitoring (actigraphy) of circadian locomotor activity in schizophrenic patients with acute neuroleptic-induced akathisia.


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BACKGROUND: Actigraphy is a quantitative method for measurement of motor activity. In the present study we used actigraphy to examine diurnal variations in locomotor activity of schizophrenic patients with neuroleptic-induced akathisia (NIA).

METHOD: Thirty-two schizophrenic patients, 16 with NIA and 16 without (DSM-IV criteria) underwent 24-h actigraphic monitoring. Clinical assessments of NIA were conducted with Barnes Akathisia Scale (BAS) at 08:00, 12:00, 16:00 and 20:00. Sleep parameters (duration, latency, continuity and efficacy) were assessed by actigraphy. Sleep quality was evaluated by a self-rated sleep questionnaire.

RESULTS: NIA patients demonstrated persistent higher daytime motor activity from 11:30 to 14:15 and from 18:00 to 21:00 than controls. There were no differences between the groups in nighttime motor activity, confirming clinical observations that NIA tends to disappear during sleep. Subject's sleep assessments were similar in the two groups.

CONCLUSIONS: Actigraphy seems to be a reliable, non-invasive, method of measuring motor activity in patients with NIA. Its sensitivity and specificity as an objective quantitative diagnostic instrument in patients with NIA merits further investigation.

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Actigraphy, the long-term assessment of wrist movements, is used in
several research fields, among which are included sleep and circadian rhythms. Actigraphs record movements using accelerometers. The present paper addresses some basic problems and their solutions in the actigraphic assessment of movement, motor symptoms, circadian rest-activity rhythms, and nocturnal agitation in healthy elderly and elderly suffering from a neurodegenerative disease (i.e., Parkinson's disease or Alzheimer's disease) and summarizes the results of previous and ongoing research. First, we have investigated how to filter the accelerometer signal in order to minimize the contribution of accelerations induced by positional changes in the gravitational field—a strong source of artefacts. A bandpass filter from 0.5 to 11 Hz appropriately assesses movement induced accelerations while minimizing gravitational artefact. The application of a bandpass filter from 0.25 to 2 or 3 Hz, as is used in some of the commercially available actigraphs, results in artefacts and moreover biases the slower part of the movement spectrum. It is therefore far from optimal for research on aging, which is associated with a generalized motor slowing. Second, we have proposed an alternative to traditional methods of signal processing in actigraphy, in order to assess both the duration and intensity of movements, and in order to distinguish Parkinsonian tremor. Based on this algorithm, new types of actigraphs have been designed. Third, we have proposed sensitive variables in order to quantify rest-activity rhythm disturbances in healthy elderly subjects and Alzheimer patients, who often present with symptoms of nocturnal restlessness. Since, in these subjects, research protocols applying enforced phase shifts or time-free environments are unfeasible and not justifiable from an ethical point of view, the variables were specifically designed to assess the functionality of the circadian timing system from actigraphic recordings made in the
natural environment of subjects. Examples of the application of actigraphy are given, including studies on symptom fluctuations and medication responses in Parkinson patients, and studies on circadian rhythm disturbances and possible remedies in elderly and Alzheimer patients.

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Actigraphic monitoring of sleep and circadian rhythms.

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Actigraphic monitoring of the activity-rest behavior of preterm and full-term infants at 20 months of age.

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Differences in the activity-rest behavior of preterm and full-term infants provide an important contribution to the analysis of the ontogeny of circadian rhythms. In this study, we recorded the activity-rest behavior of 17 preterm and 8 full-term infants at the approximate age of 20 months over an
average of 10 days by means of actigraphic monitoring (Actiwatch, Cambridge Neurotechnology Ltd.). At the same time, the parents of the infants kept a daily diary. The activity-rest rhythm, the nighttime sleep duration, the daytime rest duration, as well as the sleep quality of the infants were analyzed. Preterm and full-term infants at the age of 20 months show a circadian rhythm with a period length between 23 h 32 min (23:32 h) and 24 h 23 min (24:23 h). It can be concluded that the preterm and full-term infants all reached a vital developmental step by showing the dominant circadian rhythm in the spectrum. The daytime rest duration of preterm infants is significantly shorter than that of full-term infants. The sleep quality of preterm infants is significantly lower than that of full-term infants, which means that the preterm infants have a larger percentage of less restful nighttime sleep. In other studies preterm infants show an over-proportional frequency of attention deficit hyperactivity disorder (ADHD). For this reason, future analyses should reveal whether or not actigraphic monitoring is a suitable means for an early identification of activity-rest behavior in children who may develop ADHD.

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Actigraphic patterns, impulsivity and mood instability in bipolar disorder, borderline personality disorder and healthy controls.

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OBJECTIVES: To differentiate the relation between the structure and timing of rest–activity patterns and symptoms of impulsivity and mood instability in bipolar disorder (BD), borderline personality disorder (BPD) and healthy controls (HC).

METHODS: Eighty-seven participants (31 BD, 21 BPD and 35 HC) underwent actigraph monitoring for 28 days as part of the Automated Monitoring of Symptom Severity (AMoSS) study. Impulsivity was assessed at study entry using the BIS-11. Mood instability was subsequently longitudinally monitored using the digital Mood Zoom questionnaire.

RESULTS: BPD participants show several robust and significant correlations between non-parametric circadian rest–activity variables and worsened symptoms. Impulsivity was associated with low interdaily stability ($r = -0.663$) and weak amplitude ($r = -0.616$). Mood instability was associated with low interdaily stability ($r = -0.773$), greater rhythm fragmentation ($r = 0.662$), weak amplitude ($r = -0.694$) and later onset of daily activity ($r = 0.553$). These associations were not present for BD or HCs. Classification analysis using actigraphic measures determined that later L5 onset reliably distinguished BPD from BD and HC but did not sufficiently discriminate between BD and HC.

CONCLUSIONS: Rest–activity pattern disturbance indicative of perturbed sleep and circadian function is an important predictor of symptom severity in BPD. This appears to validate the greater subjective complaints of BPD individuals that are sometimes regarded as exaggerated by clinicians. We suggest that treatment strategies directed towards improving sleep and circadian entrainment may in the future be investigated in BPD.

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Actigraphic recordings of activity-rest rhythms of neonates born by different delivery modes.

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Activity-rest behavior of 20 neonates born vaginally, 18 neonates born by medically planned Cesarean section (C-section), and 19 neonates born by medically required C-section after labor onset (all born in the thirty-seventh to forty-second week of gestation) was monitored for six successive days starting in the first week of life. Actigraphy was used to record and show time patterns of activity and rest in neonates by using small wristwatch-like Actiwatch actometers. Nursing/feeding times were recorded by using the actometers' integrated event marker button. Recordings in both C-section groups were performed in the hospital; for neonates born vaginally and for some born by C-section, recordings were carried out in the hospital and in their homes. In addition to the actigraphic recordings, a standardized diary was kept regularly. To assess periodic characteristics, frequency components of activity-rest behavior were analyzed using fast Fourier transformation. Amount of sleep time during daytime, nighttime, and 24 h, as well as sleep bouts during the daytime and nighttime, were compared. The majority of vaginally born neonates showed a distinct circadian frequency in their spectra. In contrast, both groups of neonates born by C-section showed significantly less distinct
circadian frequencies in their spectra. All three groups showed a significant difference in amount of nighttime sleep vs. daytime sleep, with more sleep at nighttime. There were no differences in the amount of nighttime sleep, daytime sleep, and sleep time during 24 h between the groups born by different delivery modes.

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PMID: 15129826 [Indexed for MEDLINE]


Actigraphic sleep characteristics among older Americans.

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OBJECTIVES: To date, there has been no evidence about objectively measured sleep characteristics from a representative national probability sample of
adults in the United States. We used actigraphy to measure the sleep characteristics of older Americans.

**DESIGN:** Cross-sectional study.

**SETTING:** Sleep sub-study within Wave 2 (2010–2011) of the ongoing National Social Life, Health and Aging Project (NSHAP).

**PARTICIPANTS:** Seven hundred and thirty-nine NSHAP participants aged 62–90.

**INTERVENTION:** Not applicable.

**MEASUREMENTS:** Study participants wore a wrist actigraph for 72 hours and sleep properties were compared across demographic, socioeconomic, and health-behavior related lines.

**RESULTS:** Actigraph-estimated sleep time averaged 7.2 hours (SE 0.06 hr) each night; the majority of the sample (80%) slept between 5.8 and 8.6 hours/night. Average time spent awake after sleep onset (WASO) was 39 minutes (SE 1.2 min). Women had significantly more total sleep time and lower sleep fragmentation compared to men. Total sleep time increased significantly with age although sleep percentage decreased with age. Compared with White participants, African American participants had significantly more WASO (9.2 minutes, p < 0.01) and greater sleep fragmentation (2.3 percentage points, p < 0.001). WASO was significantly higher and sleep percentage significantly lower among those with less education.

**CONCLUSIONS:** Both short sleepers and long sleepers – often conventionally defined as obtaining <6 and >9 hrs/night, respectively – are relatively rare among older Americans when sleep is estimated by actigraphy. Sleep quality is significantly poorer among men, African Americans, and those with less education.

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Conflict of interest statement: Conflicts of interest: None declared.

Actigraphic Sleep Patterns of U.S. Hispanics: The Hispanic Community Health Study/Study of Latinos.

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Study objective: To assess the extent to which objective sleep patterns vary among U.S. Hispanics/Latinos.
Methods: We assessed objective sleep patterns in 2087 participants of the Hispanic Community Health Study/Study of Latinos from 6 Hispanic/Latino subgroups aged 18–64 years who underwent 7 days of wrist actigraphy.

Results: The age- and sex-standardized mean (SE) sleep duration was 6.82 (0.05), 6.72 (0.07), 6.61 (0.07), 6.59 (0.06), 6.57 (0.10), and 6.44 (0.09) hr among individuals of Mexican, Cuban, Dominican, Central American, Puerto Rican, and South American heritage, respectively. Sleep maintenance efficiency ranged from 89.2 (0.2)% in Mexicans to 86.5 (0.4)% in Puerto Ricans, while the sleep fragmentation index ranged from 19.7 (0.3)% in Mexicans to 24.2 (0.7)% in Puerto Ricans. In multivariable models adjusted for age, sex, season, socioeconomic status, lifestyle habits, and comorbidities, these differences persisted.

Conclusions: There are important differences in actigraphically measured sleep across U.S. Hispanic/Latino heritages. Individuals of Mexican heritage have longer and more consolidated sleep, while those of Puerto Rican heritage have shorter and more fragmented sleep. These differences may have clinically important effects on health outcomes.

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An actigraphic study comparing community dwelling poor sleepers with non-demented care home residents.

Meadows R(1), Luff R, Eyers I, Venn S, Cope E, Arber S.
Sleep disturbances are a common problem among institutionalized older people. Studies have shown that this population experiences prolonged sleep latency, increased fragmentation and wake after sleep onset, more disturbed circadian rhythms, and night-day reversal. However, studies have not examined the extent to which this is because of individual factors known to influence sleep (such as age) or because of the institutional environment. This article compares actigraphic data collected for 14 days from 122 non-demented institutional care residents (across ten care facilities) with 52 community dwelling poor sleepers >65 yrs of age. Four dependent variables were analyzed: (i) "interdaily stability" (IS); (ii) "intradaily variability" (IV); (iii) relative amplitude (RA) of the activity rhythm; and (iv) mean 24 h activity level. Data were analyzed using a fixed-effect, single-level model (using MLwiN). This model enables comparisons between community and institutional care groups to be made while conditioning out possible "individual" effects of "age," "sex," "level of dependency," "level of incontinence care," and "number of regular daily/prescribed medications." After controlling for the effects of a range of individual level factors, and after controlling for unequal variance across groups (heteroscedascity), there was little difference between community dwelling older adults and institutional care residents in IS score, suggesting that the stability of day-to-day patterns (such as bed get-up, lunch times, etc.) is similar within these two resident groups. However, institutional care residents experienced more fragmented rest/wake patterns (having significantly higher IV scores and significantly lower mean activity values). Our findings
strongly suggest that the institutional care environment itself has a negative association with older people's rest/wake patterns; although, longitudinal studies are required to fully understand any causal relationships.

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Actigraphically-defined sleep disturbance in Parkinson's disease is associated with differential aspects of cognitive functioning.

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The frequency of sleep disturbance and cognitive impairment in Parkinson's disease has led to the suggestion that these processes might share common neural circuitry. This study aimed to identify the relationships between measures of cognitive functioning and an objective measure of sleep disturbance. Ninety-five patients with idiopathic Parkinson's disease and 48 healthy controls underwent neurological and neuropsychological examination. They wore an actigraphy watch for 2 weeks, from which a measure of nocturnal sleep efficiency was calculated. Multiple regression models showed that working memory and verbal memory consolidation were significantly associated with sleep efficiency, as
well as education and age. By contrast, verbal fluency and attentional set-shifting were not associated with sleep efficiency, after accounting for age and education. These findings reveal that nocturnal sleep disturbance in Parkinson's disease is associated with specific cognitive difficulties, rather than a global pattern of cognitive dysfunction. This may in part reflect common neural underpinnings.

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Actigraphy: a means of assessing circadian patterns in human activity.
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Twenty-three diurnally active (0705-2333), healthy persons between 22 and 54 years of age and without history of sleep abnormality were monitored continuously for 120 consecutive hr (five days) by wrist actigraphy. Circadian rhythms of high amplitude were detected by cosinor analysis for each participant and for the groups of 10 males and 13 females with the average span of heightened activity timed between approximately 1330 and 1605. The circadian peak-trough difference in wrist movement was marked, equalling approximately 75% of the 24-hr mean level. In 19 of 23 participants, the 24-hr mean of wrist activity varied between 140-180 movements/min, with four persons exhibiting lesser means of 110-140 movements/min. With respect to the daytime span of activity, the mean wrist movement of individual participants ranged from 155-265 movements/min, with the majority (20/23) varying between 185-245 movements/min. During
nocturnal sleep
the mean wrist activity level was quite low, varying between
individuals from 5
to 25 movements/min for 21 of 23 persons. Wrist actigraphy proved to be
well-accepted and was a most reliable means of monitoring aspects of body
movement during activity and sleep in ambulatory persons adhering to usual life
habits and pursuits.

DOI: 10.3109/07420529009056964
PMID: 2242506  [Indexed for MEDLINE]


Actigraphy as a diagnostic aid for REM sleep behavior disorder in Parkinson's
disease.

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BACKGROUND: Rapid eye movement (REM) sleep behavior disorder (RBD) is a common
parasomnia in Parkinson's disease (PD) patients. The current International
Classification of Sleep Disorders (ICSD-II) requires a clinical interview
combined with video polysomnography (video-PSG) to diagnose. The latter is time
consuming and expensive and not always feasible in clinical practice. Here we
studied the use of actigraphy as a diagnostic tool for RBD in PD patients.
METHODS: We studied 45 consecutive PD patients (66.7% men) with and without
complaints of RBD. All patients underwent one night of video-PSG and eight
consecutive nights of actigraphy. Based on previous studies, the main outcome
measure was the total number of bouts classified as "wake", compared between
patients with (PD + RBD) and without RBD (PD- RBD).

RESULTS: 23 (51.1%) patients had RBD according to the ICSD-II criteria. The total number of wake bouts was significantly higher in RBD patients (PD + RBD 73.2 ± 40.2 vs. PD-RBD 48.4 ± 23.3, p = .016). A cut off of 95 wake bouts per night resulted in a specificity of 95.5%, a sensitivity of 20.1% and a positive predictive value of 85.7%. Seven patients were suspected of RBD based on the interview alone, but not confirmed on PSG; six of whom scored below 95 wake bouts per night on actigraphy.

CONCLUSION: PD patients with RBD showed a significantly higher number of bouts scored as "wake" using actigraphy, compared to patients without RBD. In clinical practice, actigraphy has a high specificity, but low sensitivity in the diagnosis of RBD. The combination of actigraphy and previously reported RBD questionnaires may be a promising method to diagnose RBD in patients with PD.

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PMID: 24708629 [Indexed for MEDLINE]


Actigraphy assessments of circadian sleep-wake cycles in the Vegetative and Minimally Conscious States.

Cruse D(1), Thibaut A, Demertzi A, Nantes JC, Bruno MA, Gossseries O, Vanhaudenhuyse A, Bekinschtein TA, Owen AM, Laureys S.

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Erratum in

Comment in

BACKGROUND: The Vegetative and Minimally Conscious States (VS; MCS)
are characterized by absent or highly disordered signs of awareness alongside preserved sleep-wake cycles. According to international diagnostic guidelines, sleep-wake cycles are assessed by means of observations of variable periods of eye-opening and eye-closure. However, there is little empirical evidence for true circadian sleep-wake cycling in these patients, and there have been no large-scale investigations of the validity of this diagnostic criterion.

METHODS: We measured the circadian sleep-wake rhythms of 55 VS and MCS patients by means of wrist actigraphy, an indirect method that is highly correlated with polysomnographic estimates of sleeping/waking.

RESULTS: Contrary to the diagnostic guidelines, a significant proportion of patients did not exhibit statistically reliable sleep-wake cycles. The circadian rhythms of VS patients were significantly more impaired than those of MCS patients, as were the circadian rhythms of patients with non-traumatic injuries relative to those with traumatic injuries. The reliability of the circadian rhythms were significantly predicted by the patients' levels of visual and motor functioning, consistent with the putative biological generators of these rhythms.

CONCLUSIONS: The high variability across diagnoses and etiologies highlights the need for improved guidelines for the assessment of sleep-wake cycles in VS and MCS, and advocates the use of actigraphy as an inexpensive and non-invasive alternative.

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Actigraphy-based evaluation of sleep quality and physical activity in individuals
with spinal cord injury.

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Study design: Cross-sectional study.
Background: Sleep disturbances are frequently reported by individuals with spinal cord injury (SCI) and are associated both with poor quality of life and reduced ability to participate in rehabilitation and daily life activities. Objectives: This study investigated sleep quality based on self-reports and actigraphy in individuals with SCI as compared to able-bodied. We also explored the relationship between sleep quality, physical activity, and neuropathic pain.
Setting: Institute Guttmann, Neurorehabilitation Hospital, Badalona, Barcelona, Spain.
Methods: Fourteen SCI patients (12 males, 43.10 ± 10.59 y.o.) and 10 healthy individuals (7 males, mean age 46.21 ± 12.58 y.o.) were enrolled in the study. Participants wore wrist actigraphs for 7 consecutive days to characterize their sleep-wake cycle, rest-activity circadian rhythm and physical activity. Sleep quality, chronotype, daytime sleepiness, neuropathic pain severity and interference were assessed based on questionnaires.
Results: SCI individuals reported poorer sleep quality compared to healthy individuals. Actigraphy-based sleep measurements revealed that patients woke up later, spent more time in bed and slept longer compared to the healthy controls but did not differ significantly in the estimated sleep efficacy and number of awakenings from the able-bodied controls. In individuals with SCI greater physical activity predicted higher sleep efficacy and less awakening episodes as well as shorter sleep latency and lower sleep disturbance.
Conclusions: The actigraphy-based sleep estimates indicate that patients with SCI spent more time in bed and slept longer but their sleep efficacy was similar to able-bodied controls. Maintaining regular physical activity could improve pain control and sleep quality.

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Conflict of interest statement: The authors declare that they have no conflict of interest. This study was approved by the Clinical Research Ethics Committee of the Institute Guttmann and has been conducted in accordance with the Declaration of Helsinki for ethical conduct and report of research.


Actigraphy-based scratch detection using logistic regression.

Petersen J, Austin D, Sack R, Hayes TL.

Incessant scratching as a result of diseases such as atopic dermatitis causes skin break down, poor sleep quality, and reduced quality of life for affected individuals. In order to develop more effective therapies, there is a need for objective measures to detect scratching. Wrist actigraphy, which detects wrist movements over time using micro-accelerometers, has shown great promise in detecting scratch because it is lightweight, usable in the home environment, can record longitudinally, and does not require any wires. However, current actigraphy-based scratch-detection methods are limited in their ability to discriminate scratch from other nighttime activities. Our previous work demonstrated the separability of scratch from both walking and restless sleep using a clustering technique which employed four features derived from the
actigraphic data: number of accelerations above 0.01 gs, epoch variance, peak frequency, and autocorrelation value at one lag. In this paper, we extended these results by employing these same features as independent variables in a logistic regression model. This allows us to directly estimate the conditional probability of scratching for each epoch. Our approach outperforms competing actigraphy-based approaches and has both high sensitivity (0.96) and specificity (0.92) for identifying scratch as validated on experimental data collected from 12 healthy subjects. The model must still be fully validated on clinical data, but shows promise for applications to clinical trials and longitudinal studies of scratch.

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Actigraphy-based Sleep Parameters and Rest-activity Circadian Rhythm in a Young Scoliotic Patient Treated with Rigid Bracing: A Case Study.

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The correct expression of circadian rhythmicity, together with a good sleep behavior, are key factors for the body homeostasis. Rest-activity circadian rhythms (RARs) are involved in the control of the sleep-wake cycle and altered RARs could lead to a compromised health status. Therefore, we aimed to investigate the existence of RAR and to study actigraphy-based sleep behavior in
a 14-year-old male patient affected by severe idiopathic scoliosis and treated with a rigid brace 23 hours per day. RAR and sleep parameters were studied through actigraphy for seven consecutive days in July 2018. The mean cosinor analysis revealed the presence of a significant RAR (p < 0.001), specifically:

the percentage of rhythm was 23.4%, the mean MESOR was 84.6 Activity Count (AC),
the amplitude registered a mean value of 74.4 AC's, and the acrophase occurred at 17:56 h. The subject reached a good sleep quantity: 507.9 ± 30.2 minutes of Time in Bed with a mean Total Sleep Time of 450.7 ± 20.1 minutes; Similarly, Sleep Efficiency was equal to 83.3 ± 7.2% and the Fragmentation Index was 27.3 ± 12.8%.

We observed that both RAR and sleep behavior had normal trends in a 14-year-old patient treated with a rigid brace for a severe adolescent idiopathic scoliosis (AIS). Improved assessment of sleep in routine clinical practice can help to identify and manage health-related problems that could potentially affect some clinical outcomes, such as pain, mood state, and recovery process.

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Actigraphy-Derived Daily Rest-Activity Patterns and Body Mass Index in Community-Dwelling Adults.


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Study Objectives: To examine associations between 24-hour rest-activity patterns and body mass index (BMI) among community-dwelling US adults. Rest-activity patterns provide a field method to study exposures related to circadian rhythms.

Methods: Adults (N = 578) wore an actigraph on their non-dominant wrist for 7 days. Intradian variability and interdaily stability (IS), M10 (most active 10-hours), L5 (least active 5-hours), and relative amplitude (RA) were derived using non-parametric rhythm analysis. Mesor, acrophase, and amplitude were calculated from log-transformed count data using the parametric cosinor approach.
Results: Participants were 80% female and mean (standard deviation) age was 52 (15) years. Participants with higher BMI had lower values for magnitude, RA, IS, total sleep time (TST), and sleep efficiency. In multivariable analyses, less robust 24-hour rest-activity patterns as represented by lower RA were consistently associated with higher BMI: comparing the bottom quintile (least robust) to the top quintile (most robust 24-hour rest-activity pattern) of RA, BMI was 3-kg/m² higher (p = .02). Associations were similar in magnitude to an hour less of TST (1-kg/m² higher BMI) or a 10% decrease in sleep efficiency (2-kg/m² higher BMI), and independent of age, sex, race, education, and the duration of rest and/or activity.

Conclusions: Lower RA, reflecting both higher night activity and lower daytime activity, was associated with higher BMI. Independent of the duration of rest or activity during the day or night, 24-hour rest, and activity patterns from actigraphy provide aggregated measures of activity that associate with BMI in community-dwelling adults.

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Actigraphy for Assessing Light Effects on Sleep and Circadian Activity Rhythm in Alzheimer's Dementia: A Narrative Review.

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BACKGROUND: Alzheimer's Disease (AD) is often accompanied by severe sleep problems and circadian rhythm disturbances which may to some extent be attributed to a dysfunction in the biological clock. The 24-h light/dark cycle is the strongest Zeitgeber for the biological clock. People with AD, however, often live in environments with inappropriate photic Zeitgebers. Timed bright light exposure may help to consolidate sleep- and circadian rest/activity rhythm problems in AD, and may be a low-risk alternative to pharmacological treatment.

OBJECTIVE & METHODS: In the present review, experts from several research disciplines summarized the results of twenty-seven light intervention studies which used wrist actigraphy to measure sleep and circadian activity in AD patients.

RESULTS: Taken together, the findings remain inconclusive with regard to beneficial light effects. However, the considered studies varied substantially with respect to the utilized light intervention, study design, and usage of actigraphy. The paper provides a comprehensive critical discussion of these issues.

CONCLUSION: Fusing knowledge across complementary research disciplines has the potential to critically advance our understanding of the biological input of light on health and may contribute to architectural lighting designs in hospitals, as well as our homes and work environments.
An actigraphy heterogeneous mixture model for sleep assessment.

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Wrist actigraphy is a well established procedure to monitor human activity. Among other areas, it has a special relevance in sleep studies where its lightweight and non-intrusive nature make it a valuable tool to access the circadian cycle.

While there are several methods to extract information from the data, the differentiation between sleep and wakefulness states is still an open discussion. In this paper, the characteristics of the movements in the different states are assumed to be intrinsically different. These differences are not simply related with magnitude and movement counting, but due to real differences on the statistical distributions describing the actigraphy data. Thus it is possible to refine the discrimination level when detecting these states. The proposed methodology to characterize the actigraphy data is based on a mixture of three canonical distributions; i) Exponential, ii) Rayleigh and iii) Gaussian. It is shown that the weights and parameters estimated in each state are organized into almost separable clusters on the feature space. This suggests the ability of the method to discriminate these states based only on the movements recorded on actigraphy data.
Actigraphy in brain-injured patients — A valid measurement for assessing circadian rhythms?


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BACKGROUND: Actigraphy has received increasing attention in classifying rest-activity cycles. However, in patients with disorders of consciousness (DOC), actigraphy data may be considerably confounded by passive movements, such as nursing activities and therapies. Consequently, this study verified whether circadian rhythmicity is (still) visible in actigraphy data from patients with DOC after correcting for passive movements.

METHODS: Wrist actigraphy was recorded over 7–8 consecutive days in patients with DOC (diagnosed with unresponsive wakefulness syndrome [UWS; n = 19]
and [exit] minimally conscious state [MCS/EMCS; n = 11]). The presence and actions of clinical and research staff as well as visitors were indicated using a tablet in the patient's room. Following removal and interpolation of passive movements, non-parametric rank-based tests were computed to identify differences between circadian parameters of uncorrected and corrected actigraphy data.

RESULTS: Uncorrected actigraphy data overestimated the interdaily stability and intradaily variability of patients' activity and underestimated the deviation from a circadian 24-h rhythm. Only 5/30 (17%) patients deviated more than 1 h from 24 h in the uncorrected data, whereas this was the case for 17/30 (57%) patients in the corrected data. When contrasting diagnoses based on the corrected dataset, stronger circadian rhythms and higher activity levels were observed in MCS/EMCS as compared to UWS patients. Day-to-night differences in activity were evident for both patient groups.

CONCLUSION: Our findings indicate that uncorrected actigraphy data overestimates the circadian rhythmicity of patients' activity, as nursing activities, therapies, and visits by relatives follow a circadian pattern itself. Therefore, we suggest correcting actigraphy data from patients with reduced mobility.

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PMID: 32393256


Actigraphy in patients with seasonal affective disorder and healthy control subjects treated with light therapy.


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BACKGROUND: Abnormalities of the circadian rest-activity cycle are hypothesized to accompany the clinical picture of seasonal affective disorder (SAD). The purpose of this study was to investigate if bright light therapy (BLT) is able to reverse these disturbances.

METHODS: Seventeen SAD outpatients and 17 sex- and age-matched healthy control subjects were treated with BLT administered in the morning for 4 weeks. Activity levels were measured with wrist actigraphy.

RESULTS: SAD patients had 33% lower total (p = .031) and 43% lower daylight activity (p = .006) in week 1 compared with control subjects. The relative amplitude of the sleep-wake cycle was attenuated by 6% in patients (p = .025); they were phase delayed by 55 minutes (p = .023) and had significantly lower sleep efficiency (p = .030). Total (p = .002) and daylight activity (p = .001) increased after 4 weeks of treatment in SAD patients. Moreover, BLT led to increase of relative amplitude (p = .005), advance of delayed rhythms (p = .036), and improved sleep efficiency (p = .011) in patients. Intradaily stability, measuring the strength of coupling of the rhythm to external zeitgebers, increased by 9% both in patients and healthy control subjects (p = .032).

CONCLUSIONS: Treatment with BLT normalizes disturbed activity patterns and restores circadian rhythms in SAD patients. BLT might also stabilize the circadian rhythm in nondepressed individuals during the fall-winter season.

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Actigraphy in patients with treatment-resistant depression undergoing electroconvulsive therapy.


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Depressive disorder is frequently accompanied by changes in psychomotor activity and disturbances of the sleep-wake cycle. The chronobiological effects of electroconvulsive therapy (ECT) in patients with treatment-resistant depression (TRD) are largely unknown. The objective of the current study was to measure the influence of ECT on patients' activity and sleep. 15 patients with unipolar TRD were treated with ECT. Activity levels were measured with wrist actigraphy before and after ECT. Remission rate (score on the 17-item Hamilton Depression Rating Scale lower than 8 points) was 40.0%. Remitters had increases of 56.0% on light activity, 49.8% on total activity, and 70.2% on circadian amplitude, while there was no significant change of these variables in subjects who did not experience remission. The circadian acrophase and actigraphic sleep-parameters were not significantly affected by treatment.

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PMID: 24998016 [Indexed for MEDLINE]

Actigraphy is a method that utilizes a miniaturized computerized wristwatch-like device to monitor and collect data generated by body movements over extended periods of time. It allows estimation of sleep and wakefulness based on motor activity. It provides a noninvasive, objective, and longitudinal method for the diagnostic and post-treatment evaluation of patients with sleep disorders in the ambulatory setting. It has been used for researchers to study sleep disturbances in a variety of populations, most frequently for the evaluation of insomnia, paradoxical insomnia, and circadian rhythm sleep disorders. In addition, it is particularly useful in populations where polysomnography would be difficult to record, such as in patients with dementia and delirium. Actigraphy should be extensively carried out in sleep medicine as well as sleep research.

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Actigraphy-measured sleep disruption as a predictor of survival among women with advanced breast cancer.

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BACKGROUND: Poor sleep, prevalent among cancer survivors, is associated with disrupted hormonal circadian rhythms and poor quality of life. Using a prospective research design, this study aimed to clarify the relationship between objective measures of sleep efficiency and sleep disruption with survival among women with advanced breast cancer.

METHOD: We examined sleep quality and duration via wrist-worn actigraphy and sleep diaries for 3 days among 97 women in whom advanced breast cancer was diagnosed (age = 54.6 ± 9.8 years). Sleep efficiency was operationalized using actigraphy as the ratio of total sleep time to total sleep time plus wake after sleep onset.

RESULTS: As hypothesized, better sleep efficiency was found to predict a significant reduction in overall mortality (hazard ratio [HR], 0.96; 95% confidence interval [CI], 0.94–0.98; P < 0.001) at median 6 y follow-up. This relationship remained significant (HR, 0.94; 95% CI, 0.91–0.97; P < 0.001) even after adjusting for other known prognostic factors (age, estrogen receptor status, cancer treatment, metastatic spread, cortisol levels, and depression). Secondary hypotheses were also supported (after adjusting for baseline prognostic factors) showing that less wake after sleep onset (HR, 0.41; 95% CI, 0.25–0.67; P < 0.001), fewer wake episodes, (HR, 0.93; 95% CI, 0.88–0.98; P = 0.007); and shorter wake episode duration (HR, 0.29; 95% CI, 0.14–0.58; P < 0.001) also contributed to reductions in overall mortality.

CONCLUSIONS: These findings show that better sleep efficiency and less sleep disruption are significant independent prognostic factors in women with advanced breast cancer. Further research is needed to determine whether treating sleep disruption with cognitive behavioral and/or pharmacologic therapy
could improve survival in women with advanced breast cancer.

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PMCID: PMC3985107
PMID: 24790261 [Indexed for MEDLINE]


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STUDY OBJECTIVES: To investigate the cross-sectional relationship between objectively measured sleep characteristics and multiple indices of adiposity in racially/ethnically diverse older adults within the MESA Sleep study (n = 2,146).

METHODS: 7-day actigraphy was used to assess sleep duration, sleep efficiency, and night-to-night variability. Body mass index (BMI), waist circumference, and total body fat were modeled continuously and according to obesity cut-points. Models were adjusted for demographic, socioeconomic, and behavioral variables.
RESULTS: Participants who slept less than 6 hours a night had significantly higher BMI, waist circumference, and body fat relative to those who slept 7-8 hours. Those who slept less than 5 hours had a 16% higher prevalence of general obesity (BMI ≥ 30 vs. < 25 kg/m^2) (95% [CI]: 0.08-0.24) and a 9% higher prevalence of abdominal obesity (waist circumference: women ≥ 88 centimeters, men ≥ 102 centimeters; 95% CI: 0.03-0.16) compared to those who slept 7-8 hours. Results were similar for sleep efficiency and night-to-night sleep variability.

CONCLUSIONS: Among an older multi-ethnic cohort, we found robust associations across multiple indices of sleep and adiposity. Targeting sleep characteristics may be of benefit in obesity interventions, but more research is needed to rule out reverse causality.

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Actigraphy pattern analysis for outpatient monitoring.

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The actigraphy is a cost-effective method for assessing specific sleep disorders such as diagnosing insomnia, circadian rhythm disorders, or excessive sleepiness. Due to recent advances in wireless connectivity and motion activity sensors, the new actigraphy devices allow the non-intrusive and non-stigmatizing monitoring of outpatients for weeks or even months facilitating treatment outcome
measure in daily life activities. This possibility has propitiated new studies suggesting the utility of actigraphy to monitor outpatients with mood disorders such as major depression, or patients with dementia. However, the full exploitation of data acquired during the monitoring period requires the use of automatic systems and techniques that allow the reduction of inherent complexity of the data, the extraction of most informative features, and the interpretability and decision-making. In this study we purpose a set of techniques for actigraphy patterns analysis for outpatient monitoring. These techniques include actigraphy signal pre-processing, quantification, nonlinear registration, feature extraction, detection of anomalies, and pattern visualization. In addition, techniques for daily actigraphy signals modelling and simulation are included to facilitate the development and test of new analysis techniques in controlled scenarios.

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Actigraphy to measure day structure as a therapeutic variable in the treatment of schizophrenic patients.

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OBJECTIVE: A component of social skills is the ability to adapt to the social rhythms of the environment. Patients with schizophrenia are often disabled in this adaptation. Thus, structuring activities throughout the day has long been known as part of psychosocial treatments. Actigraphy as a tool to measure activity and circadian rhythms may even serve as an indicator for the day-structuring of schizophrenic patients.
METHOD: Actigraphy was used in a patient with affective disorder and one with chronic schizophrenia for more than 2 weeks.
RESULTS: In comparison to a regular 24-hour rest-activity cycle in a depressed patient, the actigraph of the patient with schizophrenia presents active phases at night, irregular activity levels at day and signs of a delayed-sleep-phase syndrome.
CONCLUSION: Actigraphy could serve as a tool to investigate activity levels and circadian rest-activity phases, even in schizophrenia. There may be some further benefit of actigraphy as a tool in psychosocial treatments.

DOI: 10.1034/j.1600-0447.2000.00018.x
PMID: 11261650  [Indexed for MEDLINE]

[Actimetry: simplified analysis of wake-sleep rhythms in the newborn. Preliminary results].
[Article in French]
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Actimetry in newborns is relevant if two actimeters are placed, one on each ankle. This study has been conducted on nine normal three days old newborns. It has shown an indisputable link between the lack of activity and the observed sleep during the night that was missing during the day. The longest period of wake was recorded during the day and the longest period of sleep or inactivity was during the night. This study has confirmed the existence of an ultradian rhythm of quiet sleep and wake. It is also possible that a beginning of a circadian rest-activity rhythm exists already in the neonatal period,
that is
still discussed in the literature.

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Activity and Circadian Rhythm of Sepsis Patients in the Intensive Care Unit.

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Early mobilization of critically ill patients in the Intensive Care Unit (ICU) can prevent adverse outcomes such as delirium and post-discharge physical impairment. To date, no studies have characterized activity of sepsis patients in the ICU using granular actigraphy data. This study characterizes the activity of sepsis patients in the ICU to aid in future mobility interventions. We have compared the actigraphy features of 24 patients in four groups: Chronic Critical Illness (CCI) sepsis patients in the ICU, Rapid Recovery (RR) sepsis patients in the ICU, non-sepsis ICU patients (control-ICU), and healthy subjects. We used a total of 15 statistical and circadian rhythm features extracted from the patients' actigraphy data collected over a five-day period. Our results show that the four groups are significantly different in terms of activity features. In
addition, we observed that the CCI and control-ICU patients show less regularity in their circadian rhythm compared to the RR patients. These results show the potential of using actigraphy data for guiding mobilization practices, classifying sepsis recovery subtype, as well as for tracking patients’ recovery.

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PMCID: PMC6217819
PMID: 30411088

Activity/inactivity circadian rhythm shows high similarities between young obesity-induced rats and old rats.

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The objective of the present study was to compare differences between elderly rats and young obesity-induced rats in their activity/inactivity circadian rhythm. The investigation was motivated by the differences reported previously for the circadian rhythms of both obese and elderly humans (and other animals), and those of healthy, young or mature individuals. Three groups of rats were
formed: a young control group which was fed a standard chow for rodents; a young obesity-induced group which was fed a high-fat diet for four months; and an elderly control group with rats aged 2.5 years that was fed a standard chow for rodents. Activity/inactivity data were registered through actimetry using infrared actimeter systems in each cage to detect activity. Data were logged on a computer and chronobiological analysis were performed. The results showed diurnal activity (sleep time), nocturnal activity (awake time), amplitude, acrophase, and interdaily stability to be similar between the young obesity-induced group and the elderly control group, but different in the young control group. We have concluded that obesity leads to a chronodisruption status in the body similar to the circadian rhythm degradation observed in the elderly.

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Activity patterns in seven captive lemur species: Evidence of cathemerality in Varecia and Lemur catta?

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Cathemerality, or activity throughout the 24-hr cycle, is rare in primates yet relatively common among lemurs. However, the diverse ecological conditions under which cathemerality is expressed complicates attempts to identify
species-typical behavior. For example, Lemur catta and Varecia have historically been described as diurnal, yet recent studies suggest that they might exhibit cathemeral behavior under some conditions. To investigate this variation, we monitored activity patterns among lemurs that are exposed to similar captive environments. Using MotionWatch 8® actigraphy data loggers, we studied 88 lemurs across seven species at the Duke Lemur Center (DLC). Six species were members of the family Lemuridae (Eulemur coronatus, E. flavifrons, E. mongoz, L. catta, V. rubra, V. variegata), while a seventh was strictly diurnal and included as an out-group (Propithecus coquereli). For each 24-hr cycle (N = 503), we generated two estimates of cathemerality: mean night (MN) activity and day/night (DN) activity ratio (day and night cutoffs were based on astronomical twilights). As expected, P. coquereli engaged in the least amount of nocturnal activity according to both measures; their activity was also outside the 95% confidence intervals of all three cathemeral Eulemur species, which exhibited the greatest evidence of cathemerality. By these estimates, Varecia activity was most similar to Eulemur and exhibited substantial deviations from P. coquereli (β (MN) = 0.22 ± SE 0.12; β (DN) = -0.21 ± SE 0.12). L. catta activity patterns also deviated from P. coquereli (β (MN) = 0.12 ± SE 0.11; β (DN) = -0.15 ± SE 0.12) but to a lesser degree than either Varecia or Eulemur. Overall, L. catta displayed an intermediate activity pattern between Eulemur and P. coquereli, which is somewhat consistent with wild studies. Regarding Varecia, although additional observations in more diverse wild habitats are needed, our findings support the existence of cathemeral behavior in this genus.

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ACTman: Automated preprocessing and analysis of actigraphy data.


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OBJECTIVES: To introduce a novel software-library called Actigraphy Manager (ACTman) which automates labor-intensive actigraphy data preprocessing and analyses steps while improving transparency, reproducibility, and scalability over software suites traditionally used in actigraphy research practice.

DESIGN: Descriptive.

METHODS: Use cases are described for performing a common actigraphy task in ACTman and alternative actigraphy software. Important inefficiencies in actigraphy workflow are identified and their consequences are described. We
explain how these hinder the feasibility of conducting studies with large groups of athletes and/or longer data collection periods. Thereafter, the information flow through the ACTman software is described and we explain how it alleviates aforementioned inefficiencies. Furthermore, transparency, reproducibility, and scalability issues of commonly used actigraphy software packages are discussed and compared with the ACTman package.

RESULTS: It is shown that from an end-user perspective ACTman offers a compact workflow as it automates many preprocessing and analysis steps that otherwise have to be performed manually. When considering transparency, reproducibility, and scalability the design of the ACTman software is found to outperform proprietary and open-source actigraphy software suites. As such, ACTman alleviates important bottlenecks within actigraphy research practice.

CONCLUSIONS: ACTman facilitates the current transition towards larger datasets containing data of multiple athletes by automating labor-intensive preprocessing and analyses steps within actigraphy research. Furthermore, ACTman offers many features which enhance user-convenience and analysis customization, such as moving window functionality and period selection options. ACTman is open-source and thus fully verifiable, in contrast with many proprietary software packages which remain a black box for researchers.

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Acute sleep hygiene strategy improves objective sleep latency following a
late-evening soccer-specific training session: A randomized controlled trial.

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The aim of this study was to evaluate the effects of sleep hygiene (SH) education on sleep quality in soccer players after a late-evening small-sided-game (SSG) training session. Twenty-nine non-professional players were recruited and allocated to either an experimental group (EG, n = 17) that received SH education, or a control group (CG, n = 12). SSG consisted of 3 × 4 min in a 4vs4, with 3 min of recovery and was performed at 8.00 p.m. Sleep quality was monitored via actigraphy and sleep diary entries before (PRE) and two nights after (POST1, POST2) the SSG. Sleep latency (SL) differed between the two groups at POST1 (4.9 ± 5.4 vs. 15.5 ± 16.1 for EG and CG, respectively; p = 0.017, effect size [ES] = 2.0); SL values were lower at POST1 compared to PRE for the EG (-47%; p = 0.021, ES = 0.6). Subjective sleep quality was better in the EG than the CG at POST1 (8.6 ± 1.0 vs. 7.1 ± 2.0 for EG and CG, respectively; p = 0.016, ES = 0.9) with a significant improvement over PRE-values (+11.0%, p = 0.004, ES = 0.8). Although SL and subjective sleep quality did not decrease significantly from POST1 to POST2 values at POST2 no longer differed significantly form baseline and, hence, indicate that observed effects may be short-lasting. No other objective sleep indices were influenced by late-evening training or SH practices implemented by the EG. Soccer players may benefit from acute SH strategies to reduce the time to
sleep onset after late-evening training sessions.

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The added value of cognitive behavioral therapy for insomnia to current best evidence physical therapy for chronic spinal pain: protocol of a randomized controlled clinical trial.

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BACKGROUND: Insomnia is a highly prevalent and debilitating comorbidity that is often not addressed in therapy for chronic spinal pain (CSP). Given the close interaction between insomnia and CSP severity and related disability, targeting sleep problems during therapy could improve treatment outcomes in these patients.

OBJECTIVE: Can cognitive behavioral therapy for insomnia (CBT-I) combined with the modern neuroscience approach (i.e. pain neuroscience education and cognition-targeted exercise therapy) reduce pain and improve sleep, physical activity and function in people with CSP and comorbid insomnia?

METHODS: Participants: One-hundred-twenty participants with chronic spinal pain and comorbid insomnia

Intervention: CBT-I combined with the modern neuroscience approach (experimental) compared to the modern neuroscience approach alone (control). Both interventions start with three sessions of pain neuroscience
education, followed by six sessions of CBT-I and nine sessions of
cognition-targeted exercise therapy in the experimental group, or 15
sessions of
cognition-targeted exercise therapy in the control group.
MEASUREMENTS: Primary outcome measure: self-reported pain severity
(Brief Pain
Inventory).
SECONDARY OUTCOME MEASURES: pain sensitivity (pressure pain
thresholds, and
online questionnaires), sleep-related outcomes (home-based
polysomnography and
online questionnaires), physical activity (actigraphy), and function
(online
questionnaires). Online questionnaires will be completed at baseline, directly
post-treatment, and at 3, 6 and 12 months post-treatment.
Polysomnography,
pressure pain thresholds and actigraphy will be carried out at baseline,
post-treatment and at 12 months follow-up.
DISCUSSION: Findings may provide (1) a novel therapeutic approach for
people with
CSP and comorbid insomnia to improve pain, sleep, physical activity
and function,
and (2) new treatment guidelines for professionals.
TRIAL REGISTRATION: Clinicaltrials.gov NCT03482856

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Adiposity in Adolescents: The Interplay of Sleep Duration and Sleep
Variability.

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OBJECTIVE: To assess whether adiposity measures differed according to joint categories of sleep duration and sleep variability in a sample of Mexican adolescents.

STUDY DESIGN: A sample of 528 Mexico City adolescents aged 9–17 years wore wrist actigraphs for 6–7 days. Average sleep duration was categorized as age-specific sufficient or insufficient. Sleep variability, the standard deviation of sleep duration, was split at the median into stable versus variable. Adiposity measures—body mass index (BMI)—for–age Z score (BMIz), triceps skinfolds, waist circumference, and percent body fat—were collected by trained assistants. We regressed adiposity measures on combined sleep duration and variability categories. Log binomial models were used to estimate prevalence ratios and 95% CI for obesity (>2 BMIz) by joint categories of sleep duration and variability, adjusting for sex, age, and maternal education.

RESULTS: Approximately 40% of the adolescents had insufficient sleep and 13% were obese. Relative to sufficient–stable sleepers, adolescents with insufficient–stable sleep had higher adiposity across all 4 measures.
adjusted difference in BMIz was 0.68; 95% CI, 0.35–1.00) and higher obesity prevalence (prevalence ratio, 2.54; 95% CI, 1.36–4.75). Insufficient-variable sleepers had slightly higher BMIz than sufficient-stable sleepers (adjusted difference, 0.30; 95% CI, 0.00–0.59).

CONCLUSIONS: Adolescents with consistently insufficient sleep could be at greater risk for obesity. The finding that insufficient-variable sleepers had only slightly higher adiposity suggests that opportunities for "catch-up" sleep may be protective.

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Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days.

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STUDY OBJECTIVES: This study examined effects on adolescent sleep patterns, sleepiness, and circadian phase of a school transition requiring an earlier start.

DESIGN AND SETTING: Adolescents were evaluated in 9th and 10th grades; school start time in 9th grade was 0825 and in 10th grade was 0720. Assessments at each point included 2 weeks of actigraphy and sleep diaries at home, followed by a 22-hour laboratory evaluation, including evening saliva samples every 30 minutes in dim light for determination of dim-light salivary melatonin onset
phase (DLSMO), overnight sleep monitoring, and multiple sleep latency test (MSLT).

PARTICIPANTS: Twenty-five females and 15 males, ages 14 to 16.2 were enrolled; 32 completed the study in 9th grade and 26 completed in 10th grade.

INTERVENTIONS: Participants kept their own schedules, except that laboratory nights were scheduled based upon school-night sleep patterns.

MEASUREMENTS AND RESULTS: According to actigraphy, students woke earlier on school days in 10th than in 9th grade, but they did not go to sleep earlier and they slept less. DLSMO phase was later in 10th grade (mean = 2102) than 9th grade (mean = 2024). Sleep latency on MSLT overall was shorter in 10th (mean = 8.5 minutes) than in 9th (mean = 11.4 minutes), particularly on the first test of the morning at 0830 (5.1 vs 10.9 minutes). Two REM episodes on MSLT occurred in 16% of participants in 10th grade; one REM episode occurred in 48%. When those with REM sleep on one or both morning MSLTs (n = 11) were compared to those without morning REM, significant differences included shorter sleep latency on the first test, less slow wave sleep the night before, and later DLSMO phase in those who had morning REM.

CONCLUSIONS: Early start time was associated with significant sleep deprivation and daytime sleepiness. The occurrence of REM sleep on MSLT indicates that clinicians should exercise caution in interpreting MSLT REM sleep in adolescents evaluated on their "usual" schedules. Psychosocial influences and changes in bioregulatory systems controlling sleep may limit teenagers' capacities to make adequate adjustments to an early school schedule.

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Adolescents at clinical–high risk for psychosis: Circadian rhythm disturbances predict worsened prognosis at 1-year follow-up.

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Comment in Schizophr Res. 2018 Feb;192:475-476.

BACKGROUND: Individuals with psychotic disorders experience disruptions to both the sleep and circadian components of the sleep/wake cycle. Recent evidence has supported a role of sleep disturbances in emerging psychosis. However, less is known about how circadian rhythm disruptions may relate to psychosis symptoms and prognosis for adolescents with clinical high-risk (CHR) syndromes. The present study examines circadian rest/activity rhythms in CHR and healthy control (HC) youth to clarify the relationships among circadian rhythm disturbance, psychosis symptoms, psychosocial functioning, and the longitudinal course of illness.

METHODS: Thirty-four CHR and 32 HC participants were administered a
baseline evaluation, which included clinical interviews, 5 days of actigraphy, and a sleep/activity diary. CHR (n=29) participants were re-administered clinical interviews at a 1-year follow-up assessment.

RESULTS: Relative to HC, CHR youth exhibited more fragmented circadian rhythms and later onset of nocturnal rest. Circadian disturbances (fragmented rhythms, low daily activity) were associated with increased psychotic symptom severity among CHR participants at baseline. Circadian disruptions (lower daily activity, rhythms that were more fragmented and/or desynchronized with the light/dark cycle) also predicted severity of psychosis symptoms and psychosocial impairment at 1-year follow-up among CHR youth.

CONCLUSIONS: Circadian rhythm disturbances may represent a potential vulnerability marker for emergence of psychosis, and thus, rest/activity rhythm stabilization has promise to inform early-identification and prevention/intervention strategies for CHR youth. Future studies with longer study designs are necessary to further examine circadian rhythms in the prodromal period and rates of conversion to psychosis among CHR teens.

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Adolescents living in homes without electric lighting have earlier sleep times.

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The aim of this project was to compare circadian rhythmicity of a group of 37 adolescents (14 girls), aged 11 to 16 (mean age = 13.1 +/- 1.7 years),
with and without electricity at home. Twenty students attended morning school (07:30-11:30), and 17 attended evening school classes (19:00-22:30). Eleven adolescents had no electric lighting at home (5 attended morning classes and 6 attended evening classes). They completed a sleep log and wore a wrist actigraph for 5 consecutive days. Saliva samples were collected to assess DLMO. Data were compared by ANOVA and showed later timing and a more extended sleep period for those who attended late classes. Those adolescents without electricity at home had significantly earlier sleep onset on school days. As to DLMO, a trend to a delay was observed in the groups who had electric lighting.

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Adult attention-deficit hyperactivity disorder is associated with alterations in circadian rhythms at the behavioural, endocrine and molecular levels.

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Attention-deficit hyperactivity disorder (ADHD) in adults is associated with impaired sleep, and it has been postulated that this impairment may contribute to the psychopathology of this common condition. One key driver of sleep/wake cycles is the circadian system, which at the molecular level consists of a series of transcriptional feedback loops of clock genes, which in turn produce endocrine, physiological and behavioural outputs with a near 24 h periodicity. We set out to examine circadian rhythms at the behavioural, endocrine and molecular
levels in ADHD. Adults with ADHD as well as age- and sex-matched controls were recruited. Circadian rhythms were measured by means of actigraphy for the determination of gross motor patterns, by self-sampling of oral mucosa for assessment of rhythmic expression of the clock genes BMAL1 and PER2, and by estimation of salivary cortisol and melatonin levels. Actigraphic analysis revealed significant diurnal and nocturnal hyperactivity in the ADHD group, as well as a significant shorter period of best fit for the locomotor circadian rhythm in ADHD. BMAL1 and PER2 showed circadian rhythmicity in controls with this being lost in the ADHD group. Cortisol rhythms were significantly phase delayed in the ADHD group. These findings indicate that adult ADHD is accompanied by significant changes in the circadian system, which in turn may lead to decreased sleep duration and quality in the condition. Further, modulation of circadian rhythms may represent a novel therapeutic avenue in the management of ADHD.

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Advanced Circadian Phase in Mania and Delayed Circadian Phase in Mixed Mania and Depression Returned to Normal after Treatment of Bipolar Disorder.

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Disturbances in circadian rhythms have been suggested as a possible cause of bipolar disorder (BD). Included in this study were 31 mood episodes of 26 BD patients, and 18 controls. Circadian rhythms of BD were evaluated at admission, at 2-week intervals during hospitalization, and at discharge. All participants wore wrist actigraphs during the studies. Saliva and buccal cells were obtained at 8:00, 11:00, 15:00, 19:00, and 23:00 for two consecutive days. Collected saliva and buccal cells were used for analysis of the cortisol and gene circadian rhythm, respectively. Circadian rhythms had different phases during acute mood episodes of BD compared to recovered states. In 23 acute manic episodes, circadian phases were ~7 hour advanced (equivalent to ~17 hour delayed). Phases of 21 out of these 23 cases returned to normal by ~7 hour delay along with treatment, but two out of 23 cases returned to normal by ~17 hour advance. In three cases of mixed manic episodes, the phases were ~6–7 hour delayed. For five cases of
Depressive episodes, circadian rhythms phases were ~4-5 hour delayed. After treatment, circadian phases resembled those of healthy controls. Circadian misalignment due to circadian rhythm phase shifts might be a pathophysiological mechanism of BD.

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Advanced Circadian Timing and Sleep Fragmentation Differentially Impact on Memory Complaint Subtype in Subjective Cognitive Decline.


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BACKGROUND: Increased sleep fragmentation and advanced circadian timing are hallmark phenotypes associated with increased age-related cognitive decline. Subjective cognitive decline (SCD) is considered a prodromal stage of neurodegeneration and dementia; however, little is known about how sleep and circadian timing impact on memory complaints in SCD.

OBJECTIVE: To determine how sleep and circadian timing impact on memory complaint

...
subtypes in older adults with SCD.
METHODS: Twenty-five older adults with SCD (mean age = 69.97, SD = 5.33)
completed the Memory Functioning Questionnaire to characterize their memory
complaints. They also underwent neuropsychological assessment, and completed 1
week of at-home monitoring of sleep with actigraphy and sleep diaries. This was
followed by a two-night laboratory visit with overnight polysomnography and a dim
light melatonin onset assessment to measure circadian timing.
RESULTS: Advanced circadian timing was associated with greater memory complaints,
specifically poorer memory of past events (r = -0.688, p = 0.002), greater
perceived decline over time (r = -0.568, p = 0.022), and increased reliance on
mnemonic tools (r = -0.657, p = 0.004). Increased sleep fragmentation was
associated with reduced self-reported memory decline (r = 0.529, p = 0.014), and
reduced concern about everyday forgetfulness (r = 0.435, p = 0.038).
CONCLUSION: Advanced circadian timing was associated with a number of subjective
memory complaints and symptoms. By contrast, sleep fragmentation was linked to
lowered perceptions of cognitive decline, and less concern about memory failures.
As circadian disruption is apparent in both MCI and Alzheimer's disease, and
plays a key role in cognitive function, our findings further support a circadian
intervention as a potential therapeutic tool for cognitive decline.

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Advanced melatonin onset relative to sleep in women with unmedicated major
depressive disorder.

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Studies on circadian timing in depression have produced variable results, with some investigations suggesting phase advances and others phase delays. This variability may be attributable to differences in participant diagnosis, medication use, and methodology between studies. This study examined circadian timing in a sample of unmedicated women with and without unipolar major depressive disorder. Participants were aged 18–28 years, had no comorbid medical conditions, and were not taking medications. Eight women were experiencing a major depressive episode, nine had previously experienced an episode, and 31 were control participants with no history of mental illness. Following at least one week of actigraphic sleep monitoring, timing of salivary dim light melatonin onset (DLMO) was assessed in light of <1 lux. In currently depressed participants, melatonin onset occurred significantly earlier relative to sleep than in controls, with a large effect size. Earlier melatonin onset relative to sleep was also correlated with poorer mood for all participants. Our results indicate that during a unipolar major depressive episode, endogenous circadian phase is advanced relative to sleep time. This is consistent with the early-morning awakenings often seen in depression. Circadian misalignment may represent a precipitating or perpetuating factor that could be targeted for personalized treatment of major depression.

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Advanced phases and reduced amplitudes are suggested to characterize
the daily rest-activity cycles in depressed adolescent boys.


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Self-reported eveningness has been previously associated with depressed mood among adults and adolescents. Here, we study how circadian indicators based on actigraphic data differ between depressed and healthy adolescent boys. Our sample consisted of 17 medication-free adolescent boys, aged 14.5 to 17.5 years, of which eight had depressive disorder and were currently depressed and nine were healthy comparison participants. Psychiatric assessment was conducted by diagnostic interviews and complemented with observer-rating and self-rating scales. Actigraphic data were collected with wrist actigraphs for a minimum period of 25 consecutive days (range of 25 to 44 days). The behavioral trait of morningness-eveningness was measured with the 19-item Horne-Östberg Morningness-Eveningness Questionnaire. Based on the self-report, the depressed boys were more prone to eveningness than healthy controls, but based on the actigraphic data, they had earlier phases especially on school days and lower activity levels especially on weekends. On weekends, the depressed boys showed a greater shift toward later-timed phases than healthy controls. Our
results confirm a mismatch of the subjective morningness–eveningness preference (late-preference) and the objective rest–activity rhythm (early-prone) during school days in depressed adolescent boys.

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Advanced sleep phase in adolescents born preterm.

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The objective of this article is to evaluate whether sleep patterns and quality differed between adolescents born preterm and term, and to further explore whether differences in sleep patterns were explained by differences in mediating factors such as mood, behavior, or socioeconomic status. Five hundred and one 16–19-year-old children in the longitudinal Cleveland Children's Sleep and Health Study cohort underwent overnight polysomnography (PSG), wore wrist actigraphs, and completed sleep logs for 1 week. The modified Epworth Sleepiness Scale, the Adolescent Sleep Hygiene Scale, and the Adolescent Sleep-Wake Scale were used to further assess sleep. Adolescents born preterm demonstrated significantly (p < .05) earlier bed and wake times and sleep midpoints (approximately 22 min after adjusting for demographic and psychosocial factors) by actigraphy. They also had significantly fewer arousals (by PSG), and reported being more rested and alert in the morning, as well as less sleepiness and fatigue. These findings
support a growing body of evidence that perinatal factors may influence sleep phenotypes later in life. These factors may reflect developmental influences, as well as the influence of parenting styles on children's sleep.

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Advancing the sleep/wake schedule impacts the sleep of African-Americans more than European-Americans.

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There are differences in sleep duration between Blacks/African-Americans and Whites/European-Americans. Recently, we found differences between these ancestry groups in the circadian system, such as circadian period and the magnitude of phase shifts. Here we document the role of ancestry on sleep and cognitive performance before and after a 9-h advance in the sleep/wake schedule similar to flying east or having a large advance in sleep times due to shiftwork, both of which produce extreme circadian misalignment. Non-Hispanic African and European-Americans (N = 20 and 17 respectively, aged 21–43 years) were scheduled to four baseline days each with 8 h time in bed based on their habitual sleep schedule. This sleep/wake schedule was then advanced 9 h earlier for three days. Sleep was monitored using actigraphy. During the last two baseline/aligned days and the first two advanced/misaligned days, beginning 2 h after
waking, cognitive
performance was measured every 3 h using the Automated Neuropsychological Assessment Metrics (ANAM) test battery. Mixed model ANOVAs assessed the effects of ancestry (African-American or European-American) and condition (baseline/aligned or advanced/misaligned) on sleep and cognitive performance. There was decreased sleep and impaired performance in both ancestry groups during the advanced/misaligned days compared to the baseline/aligned days. In addition, African-Americans obtained less sleep than European-Americans, especially on the first two days of circadian misalignment. Cognitive performance did not differ between African-Americans and European-Americans during baseline days. During the two advanced/misaligned days, however, African-Americans tended to perform slightly worse compared to European-Americans, particularly at times corresponding to the end of the baseline sleep episodes. Advancing the sleep/wake schedule, creating extreme circadian misalignment, had a greater impact on the sleep of African-Americans than European-Americans. Ancestry differences in sleep appear to be exacerbated when the sleep/wake schedule is advanced, which may have implications for individuals undertaking shiftwork and transmeridian travel.

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Age-associated difference in circadian sleep-wake and rest-activity rhythms.


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Using actigraphic monitoring of wrist activity, we investigated the
sleep and rest-activity patterns of 65 young, middle-aged, old and the oldest subjects in their natural environmental conditions. To assess the effects of age and gender on sleep and circadian rhythms in activity, multivariate analyses were performed. Age significantly affected circadian sleep and rest-activity rhythms. In the old and oldest groups, the actigraphic estimates of "actual sleep time" and "sleep efficiency" decreased significantly. The estimates of "sleep latency," the number of "nighttime awakening," sleep fragmentation and daytime naps significantly increased in the old and oldest groups. Concerning the circadian patterning of rest and activity, the interdaily stability (IS) was similar in the four age groups, while the old and oldest subjects showed significant increases in intradaily variability (IV) and nighttime activity and a decrease in amplitude (AMP). The present study demonstrated weakened and fragmented circadian sleep and rest-activity rhythms during aging. However, no gender-related difference was found.

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PMID: 12126998 [Indexed for MEDLINE]


Age-related effects on circadian phase in the sleep of patients with depression and insomnia.

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We examined whether an age-related phase advance was present in 60 patients with
depression and insomnia (mean age 41.5 [12.5] years) using diaries and 5 weekdays of actigraphy. Actigraphy was analyzed with functional data analysis. The low point of activity (bathyphase) for each subject was fitted by cosine function with 24-hr cycle time. Linear regression analysis revealed that increasing age was associated with earlier bedtimes (p < 0.001), shorter sleep latencies (p < 0.05), and earlier bathyphase (p < 0.001). These findings are consistent with prior reports of age-dependent phase-advances in sleep behavior in self-reported good sleepers and reinforce the premise that individualized behavioral therapy of older persons with insomnia may require prescription of earlier bedtimes and earlier rise times than would be employed in younger persons with insomnia. Further, we demonstrate that aging of the sleep system, at least as reflected in actigraphy, occurs as early as the third decade.

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PMID: 24654955  [Indexed for MEDLINE]

Agreement between self-reported sleep patterns and actigraphy in fibromyalgia and healthy women.


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and Sports, University Pablo de Olavide, Seville, Spain.

OBJECTIVES: To examine the agreement between objective (accelerometer) and subjective measures of sleep in fibromyalgia women (FW) and healthy women (HW). To identify explanatory variables of the discrepancies between the objective and subjective measures in FW and in HW.

METHODS: 127 diagnosed FW and 53 HW filled the Fibromyalgia Impact Questionnaire (FIQ) and wore the SenseWear Pro Armband (SWA) for 7 days in order to assess sleep over the last week. Participants completed the Pittsburgh Sleep Quality Index (PSQI) when the SWA was returned.

RESULTS: The SWA showed greater total duration (74 vs. 88 min/day) and average duration (7 vs. 9 min) of wake after sleep onset in FW compared with HW. The PSQI showed poorer sleep quality in all the variables studied in FW than in HW (all, p<0.001), except time in bed. There was a lack of inter-method agreement for total sleep time, sleep time without naps and sleep latency in FW. Age and educational status explained the inter-method mean difference in sleep time in FW. High discrepancy in sleep time between the SWA and the PSQI was related to higher FIQ scores (p<0.05).

CONCLUSIONS: The objective measure only showed higher frequency and average duration of wake after sleep onset in FW compared with HW. The agreement between the SWA and the PSQI measures of sleep were poor in the FW group. Age, educational level and the impact of fibromyalgia might be explanatory variables of the inter-method discrepancies in FW.

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Agreement between subjective and objective measures of sleep duration
in a low-middle income country setting.

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OBJECTIVES: Describe sleep duration in adult Sri Lankans and determine the bias and agreement of self-report and actigraphic assessments.

DESIGN: Validation sub-study nested within the Colombo Twin and Singleton Study (2012-2015).

SETTING: Colombo, Sri Lanka.

PARTICIPANTS: 175 adults with actigraphy, randomly selected from 3497 participants with self-reported sleep assessed in a population-based
cohort. MEASUREMENTS: Self-reported sleep duration, ascertained by the Pittsburgh Sleep Quality Index (PSQI), was compared to a minimum of four days of actigraphy. Bias and agreement were assessed using the Bland-Altman method and a novel application of criterion cut-point analysis. Objective measurements of wake after sleep onset (WASO) and sleep efficiency were evaluated.

RESULTS: Sri Lankans have short sleep duration; averaging 6.4h (SD 1.5) self-reported and 6.0h (SD 0.9) actigraphically. Poor sleep quality was prevalent with an average WASO of 49 min., and sleep efficiency <85%. Bias was observed, with self-report consistently over-reporting sleep on average by 27.6 min (95% CI: −0.68, −0.24) compared to objective measures, but wide individual variation in disagreement, ranging from over-reporting by 3.34h to under-reporting by 2.42h. A criterion cut-point method also failed to define agreed definitions of short and long sleep duration.

CONCLUSIONS: Sleep in Sri Lankan adults, whether measured subjectively or objectively, is of short duration and suboptimal objective quality by High Income Country consensus standards. Given the high cardiometabolic morbidity in Sri Lanka and poor measurement agreement observed, this warrants further investigation and supports the need for culturally appropriate, reliable, and valid assessment for analytic epidemiology in non-Western settings.

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PMID: 30442323  [Indexed for MEDLINE]


Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns.

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OBJECTIVES: To describe sleep-wake patterns in kindergarten children by measures derived from questionnaire, diary, and actigraphy and to report rates of agreement between methods according to Bland and Altman.

DESIGN: Cross-sectional study, data from 7 nights of actigraph recordings and sleep diary and from a questionnaire.

SETTING: Children studied in their homes.

PARTICIPANTS: Fifty children, aged 4 to 7 years.

MAIN OUTCOME MEASURES: Sleep start, sleep end, assumed sleep, actual sleep time, and nocturnal wake time derived from different methods.

RESULTS: Differences between actigraphy and diary were +/- 28 minutes for sleep start, +/- 24 minutes for sleep end, and +/- 32 minutes for assumed sleep, indicating satisfactory agreement between methods, whereas for actual sleep time and nocturnal wake time, agreement rates were not sufficient (+/- 106 minutes and +/- 55 minutes, respectively). Agreement rates between actigraphy and questionnaire as well as between diary and questionnaire were insufficient for all variables. Sex and age of children and socioeconomic status did not influence the differences between methods for all variables.

CONCLUSIONS: Actigraphy and diary may be interchangeably used for the assessment of sleep start, sleep end, and assumed sleep but not for nocturnal wake times. The diary is a cost-effective and valid source of information about children's sleep-schedule times, while actigraphy may provide additional information about nocturnal wake times or may be used if parents are unable to report in detail. It is insufficient to collect information by a questionnaire or an interview asking about children's normal sleep patterns.

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Aircrew fatigue in trans-Atlantic morning and evening flights.

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The aim of the investigation was to compare sleepiness and sleep on westward morning and evening flights. Seven morning-crew pilots and seven evening-crew pilots participated. Data were collected before, during, and after outward-bound (westward) and homeward-bound (eastward) flights across six time zones. A sleep/wake diary (with repeated sleepiness and performance ratings) and wrist actigraphy were used for data collection. Maximum sleep was obtained after return and minimum sleep before the outward-bound flights. Actigraphy measures and sleep efficiency over the course of the study showed no significant differences between the morning and evening crews. There was a trend for a significant effect of morning vs. evening flight for time with heavy eyelids, with the homeward-bound flight showing more time with heavy eyelids. There were no significant differences between morning and evening crews with regard to napping during the flight. The duration of wakefulness was longer for the evening flight crew. There were significant interactions for Karolinska sleepiness scale (KSS) self-ratings on both the outward-bound and homeward-bound flights, and KSS was elevated during a considerable portion of the evening flights. Rated performance showed a significant time effect, but there was no difference in self-ratings between morning and evening crews. Evening flights involve higher levels of sleepiness than morning flights, presumably because of the close proximity in time to the circadian trough of alertness.
Alertness management in aviation operations: enhancing performance and sleep.

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INTRODUCTION: Fatigue is an acknowledged safety risk in diverse operational settings. As a result, there has been growing interest in developing and implementing activities to improve alertness, performance, and safety in real-world operations where fatigue is a factor.

METHODS: A comprehensive Alertness Management Program (AMP) that included education, alertness strategies, scheduling, and healthy sleep was implemented in a commercial airline. An operational evaluation was conducted with 29 flight crewmembers, first when flying a standard schedule without AMP components (i.e., standard condition) compared with full AMP implementation, which included flying an innovative schedule that incorporated physiological sleep and alertness principles (i.e., intervention condition). The evaluation included objective measures of sleep quantity (actigraphy), psychomotor vigilance task (PVT) performance, and subjective reports of daily activities and sleep.

RESULTS: The results showed that the 3.5-h educational CD improved pre-education test scores from an average 74% correct to a post-education average of 98%. Alertness strategies showed minimal changes, though the daily diary did not allow for refined evaluation of duration, frequency, and timing of use. The intervention condition was associated with significantly more sleep (1 h, 9 min; p < 0.01) during the trip period compared with the standard schedule.
All performance metrics showed significantly better performance during the intervention condition trip schedule (p < 0.01) compared with the standard condition. DISCUSSION: This first-ever evaluation of a comprehensive AMP showed significantly improved knowledge, support for the use of alertness strategies, and increased sleep and performance during actual operations. The robust and consistent findings support the use of an AMP approach to effectively manage fatigue in operational settings.

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PMID: 17183922 [Indexed for MEDLINE]


Algorithms for sleep-wake identification using actigraphy: a comparative study and new results.

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The aim of this study was to investigate two new scoring algorithms employing artificial neural networks and decision trees for distinguishing sleep and wake states in infants using actigraphy and to validate and compare the performance of the proposed algorithms with known actigraphy scoring algorithms. The study employed previously recorded longitudinal physiological infant data set from the Collaborative Home Infant Monitoring Evaluation (CHIME) study conducted between 1994 and 1998 [http://dccwww.bumc.bu.edu/ChimeNisp/Main_Chime.asp; Sleep26 (1997) 553] at five clinical sites around the USA. The original CHIME data set contains recordings of 1079 infants <1 year old. In our study, we used the overnight
polysomnography scored data and ankle actimeter (Alice 3) raw data for 354 infants from this data set. The participants were heterogeneous and grouped into four categories: healthy term, preterm, siblings of SIDS and infants with apparent life-threatening events (apnea of infancy). The selection of the most discriminant actigraphy features was carried out using Fisher's discriminant analysis. Approximately 80% of all the epochs were used to train the artificial neural network and decision tree models. The models were then validated on the remaining 20% of the epochs. The use of artificial neural networks and decision trees was able to capture potentially nonlinear classification characteristics, when compared to the previously reported linear combination methods and hence showed improved performance. The quality of sleep-wake scoring was further improved by including more wake epochs in the training phase and by employing rescoring rules to remove artifacts. The large size of the database (approximately 337,000 epochs for 354 patients) provided a solid basis for determining the efficacy of actigraphy in sleep scoring. The study also suggested that artificial neural networks and decision trees could be much more routinely utilized in the context of clinical sleep search.

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PMID: 19250177 [Indexed for MEDLINE]


Alteration of circadian periodicity in core body temperatures of patients with acute stroke.

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The effect of brain damage on body temperature rhythm was investigated by spectral analysis using the maximum entropy method. The rectal temperatures of 56 patients with acute stroke were recorded for 1-3 days by actigraphy. Many patients with disturbance of consciousness showed infradian rhythm. Ambulatory patients tended to have circadian rhythm, and non-ambulatory patients tended to show infradian rhythm. The study's findings suggest that impaired physical activity and disturbance of consciousness affect body temperature rhythm in patients with acute stroke.

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PMID: 12047566 [Indexed for MEDLINE]


Alterations in skin temperature and sleep in the fear of harm phenotype of pediatric bipolar disorder.

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In children diagnosed with pediatric bipolar disorder (PBD), disturbances in the quality of sleep and wakefulness are prominent. A novel phenotype of PBD called Fear of Harm (FOH) associated with separation anxiety and aggressive obsessions is associated with sleep onset insomnia, parasomnias (nightmares, night-terrors, enuresis), REM sleep-related problems, and morning sleep inertia. Children with FOH often experience thermal discomfort (e.g. feeling hot, excessive sweating) in neutral ambient temperature conditions, as well as no discomfort during exposure
to the extreme cold, and alternate noticeably between being excessively hot in the evening and cold in the morning. We hypothesized that these sleep- and temperature-related symptoms were overt symptoms of an impaired ability to dissipate heat, particularly in the evening hours near the time of sleep onset. We measured sleep/wake variables using actigraphy, and nocturnal skin temperature variables using thermal patches and a wireless device, and compared these data between children with PBD/FOH and a control sample of healthy children. The results are suggestive of a thermoregulatory dysfunction that is associated with sleep onset difficulties. Further, they are consistent with our hypothesis that alterations in neural circuitry common to thermoregulation and emotion regulation underlie affective and behavioral symptoms of the FOH phenotype.

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PMCID: PMC4270265
PMID: 25530872


Alterations of locomotor activity rhythm and sleep parameters in patients with advanced glaucoma.

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The aim of this study was to evaluate the effect of advanced glaucoma on locomotor activity rhythms and related sleep parameters. Nine normal subjects and nine age-matched patients with bilateral advanced primary open-angle glaucoma,
>10 yrs since diagnosis, were included in this observational, prospective, case-control study. Patients were required to record the timing and duration of their sleep and daily activities, and wore an actigraph on the wrist of the nondominant arm for 20 d. Activity rhythm period, MESOR (24-h time-series mean), amplitude (one-half peak-to-trough variation), and acrophase (peak time), plus long sleep episodes during the wake state, sleep duration, efficiency, and latency, as well as mean activity score, wake minutes, and mean wake episodes during the sleep interval were assessed in controls and glaucomatous patients. Glaucomatous patients exhibited significant decrease in nighttime sleep efficiency, and significant increase in the mean activity score, wake minutes, and mean wake episode during the night. These results suggest that alterations of circadian physiology could be a risk to the quality of life of patients with glaucoma.

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Alterations of the characteristics of the circadian rest-activity rhythm of cancer in-patients.

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The aim of the present study was to evaluate the characteristics of the circadian rest-activity rhythm of cancer patients. Thirty-one in-patients, consisting of 19 males and 12 females, were randomly selected from the Regional Cancer Center, Pandit Jawaharlal Nehru Medical College, Raipur, India. The rest-
activity rhythm 
was studied non-invasively by wrist actigraphy, and compared with 35 
age-matched 
apparently healthy subjects (22 males and 13 females). All subjects 
wore an 
Actiwatch (AW64, Mini Mitter Co. Inc., USA) for at least 4-7 
consecutive days. 
Fifteen-second epoch length was selected for gathering actigraphy 
data. In 
addition, several sleep parameters, such as time in bed, assumed 
sleep, actual 
sleep time, actual wake time, sleep efficiency, sleep latency, sleep 
bouts, wake 
bouts, and fragmentation index, were also recorded. Data were analyzed 
using 
several statistical techniques, such as cosinor rhythmometry, spectral 
analysis, 
ANOVA, Duncan's multiple-range test, and t-test. Dichotomy index (I<0) 
and 
autocorrelation coefficient (r24) were also computed. The results 
validated a 
statistically significant circadian rhythm in rest–activity with a 
prominent 
period of 24 h for most cancer patients and control subjects. Results 
of this 
study further revealed that cancer patients do experience a drastic 
alteration in 
the circadian rest–activity rhythm parameters. Both the dichotomy 
index and r24 
declined in the group of cancer patients. The occurrence of the peak 
(acrophase, 
Ø) of the rest–activity rhythm was earlier (p<0.001) in cancer 
patients than age– 
and gender-matched control subjects. Results of sleep parameters 
revealed that 
cancer patients spent longer time in bed, had longer assumed and 
actual sleep 
durations, and a greater number of sleep and wake bouts compared to 
control 
subjects. Further, nap frequency, total nap duration, average nap, and 
total nap 
duration per 1 h awake span were statistically significantly higher in cancer 
patients than control subjects. In conclusion, the results of the 
present study 
document the disruption of the circadian rhythm in rest–activity of cancer 
in-patients, with a dampening of amplitude, lowering of mean level of 
activity, 
and phase advancement. These alterations of the circadian rhythm
characteristics could be attributed to disease, irrespective of variability due to
gender, sites
of cancer, and timings of therapies. These results might help in
designing
patient-specific chronotherapeutic protocols.

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Altered circadian locomotor activity in APP23 mice: a model for BPSD
disturbances.

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Over the past decade, clinical Alzheimer's disease research has been
challenged
with an increased interest in noncognitive symptomatology, commonly
referred to
as behavioural and psychological signs and symptoms of dementia
(BPSD). In
accordance, major attention is being paid to behavioural alterations
in the
phenotyping of transgenic mouse models. Besides an age-dependent
decline of
cognitive functions, the APP23 model was previously shown to exhibit
cage
activity disturbances, reminiscent of diurnal rhythm disturbances in
Alzheimer
patients. To further scrutinize these observations, circadian patterns
of
horizontal locomotor activity were assessed in 3-, 6- and 12-month-old
APP23 mice
and wild-type littermates in a test paradigm continuously recording
cage activity
over a period ranging from 1 to 3 days. At the age of 3 months, APP23
profiles
resembled the wild-type pattern to a large extent, although minor
differences
were already noticeable. Six-month-old APP23 mice displayed an altered activity profile with a first indication of increased activity during the second half of the active phase, reminiscent of sundowning behaviour in Alzheimer patients. This bimodal overnight activity pattern became even more evident at the age of 12 months. The APP23 model was therefore shown to display an age-dependent development of cage activity disturbances and sundowning-like behaviour. A comparison is made with actigraphic recordings of human Alzheimer patients exhibiting sundowning behaviour. This first report of diurnal rhythm disturbances and sundowning-like phenomena in a transgenic mouse model greatly adds to the validity of the APP23 model.

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Altered circadian rhythms and oscillation of clock genes and sirtuin 1 in a model of sudden unexpected death in epilepsy.


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OBJECTIVES: Circadian rhythms are affected in many neurological disorders. Although sleep disturbances are known in epilepsy, data on circadian rhythm disturbances in epilepsy are sparse. Here, we examined diurnal and circadian rest-activity and sleep-wake patterns in Kcna1-null mice, which exhibit spontaneous recurrent seizures and are a model of sudden unexpected death in epilepsy. Furthermore, we sought to determine whether seizures or aberrant oscillation of core clock genes and a regulator, sirtuin 1 (Sirt1), is associated with disrupted rhythms.

METHODS: We used passive infrared actigraphy to assess rest-activity patterns, electroencephalography for seizure and sleep analysis, and reverse transcription polymerase chain reaction and Western blotting to evaluate expression of clock genes and Sirt1 in Kcna1-null and wild-type mice.

RESULTS: Epileptic Kcna1-null animals have disrupted diurnal and circadian rest-activity patterns, tending to exhibit prolonged circadian periods. Electroencephalographic analysis confirmed disturbances in sleep architecture, with more time spent awake and less asleep. Although all epileptic mice manifested disrupted diurnal and circadian rest-activity patterns, we found no correlation between actual seizure burden and degree of sleep disruption. However, we found attenuated oscillations of several clock genes (ie, Clock, Bmal1, Per1, and Per2) and diurnal Sirt1 mRNA in the anterior hypothalamus.

SIGNIFICANCE: Attenuated oscillation of several core clock genes correlates with, and may underlie, aberrant diurnal and circadian rest-activity and sleep-wake patterns observed in Kcna1-null mice. This could contribute to late complications in epilepsy, such as sudden unexpected death in epilepsy. Sirt1 may represent a useful therapeutic target for rescuing circadian clock gene rhythmicity and sleep patterns in epilepsy.
BACKGROUND AND PURPOSE: Shift work disrupts the body's circadian rhythms and increases the risk of health problems. Despite evidence of neuropsychological disturbances in shift workers (SW), the brain functional status as measured by brain perfusion in chronic shift work has not been evaluated previously. We investigated the regional cerebral blood flow (rCBF) in SW using perfusion MRI (pMRI) and evaluated the relationships between altered rCBF and sleep,
mood, psychometric measures, and quality of life.

METHODS: Fifteen rotational SW and 15 day workers (DW) were enrolled. The participants were all female nurses working at a university-affiliated hospital. During 2 weeks of actigraphy they underwent pMRI scanning and psychometric testing on the last day immediately after working. Demographic characteristics, insomnia, daytime sleepiness, and mood were compared between the groups.

RESULTS: The participants were aged 35.3±2.9 years (mean±SD) and had been performing their current work for more than 2 years. The demographic characteristics did not differ between SW and DW, but the levels of insomnia, anxiety, depression, and hyperactivity-restlessness in psychometric measures were higher in SW than in DW. Cerebral perfusion in SW was significantly decreased in the cuneus, fusiform/parahippocampal gyri, and cerebellum of the right hemisphere, while it was increased in the inferior occipital gyrus of the left hemisphere. Perfusion changes in SW were significantly correlated with depression and insomnia severity. The onset and duration irregularity of sleep among SW were related to insomnia, mood, hyperactivity/restlessness, and quality of life.

CONCLUSIONS: SW experience considerably more insomnia and mood disturbances than do DW, and this is significantly related to perfusion changes in multiple brain areas.

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Altered sleep–wake patterns in blindness: a combined actigraphy and psychometric study.

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OBJECTIVE: Light plays an important role in the synchronization of the internal biological clock and the environmental day/night pattern. Thus, absence of vision is often associated with both increases in reported sleep disturbances and incidence of free-running circadian rhythms. In this study we discuss variability in the sleep–wake pattern between blind and normal–sighted individuals.

METHODS: Thirty–day actigraphy recordings were collected from 11 blind individuals without residual light perception and 11 age– and sex–matched normal–sighted controls. From these recordings, we extracted parameters of sleep and wake, including episodes of rest, day–time and night–time sleep periods, and the number of awakenings throughout sleep. A measure of sleep efficiency was derived from these measures for each night–time sleep episode. We also examined
complementary measures of sleep quality, using the Pittsburgh Sleep Quality Index, and chronotype, using the Morningness–Eveningness Questionnaire.

RESULTS: Although no group differences were found when averaging over the entire recording period, we found a greater variability throughout the 30–days in both sleep efficiency and timing of the night-time sleep episode in blind participants as compared to sighted control participants. We also confirm previous reports of reduced sleep quality in blind individuals. Notably, the variability in sleep efficiency and in the timing of sleep correlated with the severity of sleep disturbances.

CONCLUSION: The timing and physiology of sleep are strongly dependent on the endogenous circadian phase; therefore, observed findings support the hypothesis of free-running circadian rhythms as a dominant factor for the sleep disturbances experienced in blindness.

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Ambulatory circadian monitoring (ACM) based on thermometry, motor activity and body position (TAP): a comparison with polysomnography.


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An integrated variable based on the combination of wrist Temperature, motor Activity and body Position (TAP) was previously developed at our laboratory to evaluate the functioning of the circadian system and sleep–wake rhythm under ambulatory conditions. However, the reliability of TAP needed to be validated with polysomnography (PSG). 22 subjects suffering from sleep disorders were monitored for one night with a temperature sensor (iButton), an actimeter (HOB0) and exploratory PSG. Mean waveforms, sensitivity (SE), specificity (SP), agreement rates (AR) and comparisons between TAP and sleep stages were studied. The TAP variable was optimized for SE, SP and AR with respect to each individual variable (SE: 92%; SP: 78%; AR: 86%). These results improved upon estimates previously published for actigraphy. Furthermore, TAP values tended to decrease as sleep depth increased, reaching the lowest point at phase 3. Finally, TAP estimates for sleep latency (SL: 37±9 min), total sleep time (TST: 367±13 min), sleep efficiency (SE: 86.8±1.9%) and number of awakenings (NA>5 min: 3.3±.4) were not significantly different from those obtained with PSG (SL: 29±4 min; SE: 89.9±1.8%; NA>5 min: 2.3±.4), despite the heterogeneity of the sleep pathologies monitored. The TAP variable is a novel measurement for evaluating circadian system status and sleep–wake rhythms with a level of reliability better to that of actigraphy. Furthermore, it allows the evaluation of a patient's sleep–wake rhythm in his/her normal home environment, and at a much lower cost than PSG. Future studies in specific pathologies would verify the relevance of TAP in those conditions.
Ambulatory estimation of human circadian phase using models of varying complexity based on non-invasive signal modalities.

Gil EA, Aubert XL, Beersma DG.

In this work, we introduce a number of models for human circadian phase estimation in ambulatory conditions using various sensor modalities. Machine learning techniques have been applied to ambulatory recordings of wrist actigraphy, light exposure, electrocardiograms (ECG), and distal and proximal skin temperature to develop ARMAX models capturing the main signal dependencies on circadian phase and evaluating them versus melatonin onset times. The most accurate models extracted heart rate variability features from an ECG coupled with wrist activity information to produce phase estimations with prediction errors of ~30 minutes. Replacing the ECG features with skin temperature from the upper leg led to a slight degradation, while less accurate results, in the order of 1 hour, were obtained from wrist activity and light measurements. The trade-off between highest precision and least obtrusive configuration is discussed for applications to sleep and mood disorders caused by a misalignment of the internal phase with the external solar and social times.
mental disorders.

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BACKGROUND: The nature of sleep-wake abnormalities in individuals with mental disorders remains unclear. The present study aimed to examine the differences in objective ambulatory measures of the sleep-wake and activity cycles across young people with anxiety, mood or psychotic disorders.

METHODS: Participants underwent several days of actigraphy monitoring. We divided participants into 5 groups (control, anxiety disorder, unipolar depression, bipolar disorder, psychotic disorder) according to primary diagnosis.

RESULTS: We enrolled 342 participants aged 12–35 years in our study: 41 healthy controls, 56 with anxiety disorder, 135 with unipolar depression, 80 with bipolar disorder and 30 with psychotic disorders. Compared with the control group, sleep onset tended to occur later in the anxiety, depression and bipolar groups; sleep offset occurred later in all primary diagnosis groups; the sleep period was longer in the anxiety, bipolar and psychosis groups; total sleep time was longer in the psychosis group; and sleep efficiency was lower in the depression group, with a similar tendency for the anxiety and bipolar groups. Sleep parameters were significantly more variable in patient subgroups than in controls. Cosinor analysis revealed delayed circadian activity profiles in the anxiety and bipolar groups and abnormal circadian curve in the psychosis group.
LIMITATIONS: Although statistical analyses controlled for age, the sample included individuals from preadolescence to adulthood. Most participants from the primary diagnosis subgroups were taking psychotropic medications, and a large proportion had other comorbid mental disorders. CONCLUSION: Our findings suggest that delayed and disorganized sleep offset times are common in young patients with various mental disorders. However, other sleep-wake cycle disturbances appear to be more prominent in broad diagnostic categories.

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Analysis of actigraph parameters for relapse prediction in bipolar disorder: a feasibility study.

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The paper presents a framework for early identification of prodromal syndromes of mania or depression in bipolar disorder. The framework may mitigate relapses and improve patient functioning. The methodology consists of long-term actigraphy monitoring and simplified self-assessment tool to determine manic or depression events. Eight patients were involved in the feasibility study, spanning period of 150 months, resulting in 17 relapses and 3 hospitalizations in total. We concluded that the most promising parameter extracted from actigraphy recording is a circadian rhythm's interdaily stability. Using developed trend analysis applied on interdaily stability parameter, we achieved sensitivity and specificity about 65, resp. 68. We hypothesized that this performance is both mainly due to missing values in data and due to small amount of relapses.
OBJECTIVE: To evaluate the effectiveness of sleep education delivered antenatally and at 3 weeks postpartum to prevent infant sleep problems at 6 months of age.

DESIGN: Sleep intervention within a randomised controlled trial for the Prevention of Overweight in Infancy (POI) study.

PARTICIPANTS: 802 families were randomly allocated to one of four groups: usual care (control), sleep intervention (sleep), food, activity and breastfeeding intervention (FAB), and combined group receiving both interventions (combination).

INTERVENTIONS: All groups received standard Well Child care. The sleep intervention groups (sleep and combination) received an antenatal group education session (all mothers and most partners) emphasising infant self-settling and safe sleeping, and a home visit at 3 weeks reinforcing the antenatal sleep education. FAB and combination groups received four contacts providing education and support.
on breast feeding, food and activity up to 4 months postpartum.

OUTCOME MEASURES: Here we report secondary sleep outcomes from the POI study: the prevalence of parent-reported infant sleep problems and night waking, and differences in sleep duration. Additional outcomes reported include differences in infant self-settling, safe sleep practices, and maternal and partner reports of their own sleep, fatigue and depression symptoms.

RESULTS: Linear or mixed linear regression models found no significant intervention effects on sleep outcomes, with 19.1% of mothers and 16.6% of partners reporting their infant's sleep a problem at 6 months. Actigraphy estimated the number of night wakings to be significantly reduced (8%) and the duration of daytime sleep increased (6 min) in those groups receiving the sleep intervention compared with those who did not. However, these small differences were not clinically significant and not observed in 24 hours infant sleep diary data. No other differences were observed.

CONCLUSION: A strategy delivering infant sleep education antenatally and at 3 weeks postpartum was not effective in preventing the development of parent-reported infant sleep problems.

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OBJECTIVE: The endogenous hormone melatonin has previously been shown to exert anticonvulsant effects in a variety of experimental models. Accordingly, we asked whether ramelteon, a synthetic and selective melatonin receptor agonist, might also possess anticonvulsant and/or antiepileptogenic properties. METHODS: The effects of ramelteon (30 or 100 mg/kg intraperitoneally twice daily for 5 days) were evaluated in two animal models of epilepsy. In the rat rapid kindling model, baseline hippocampal afterdischarge properties, kindling progression, and hippocampal excitability in kindled animals were measured. Anti-ictogenic efficacy was assessed after acute administration in untreated kindled rats. In the spontaneously epileptic Kcna1-null mouse model, we determined seizure frequency and periodicity using continuous video/EEG monitoring over 72 hours. Further, circadian rest-activity rhythms in ramelteon-treated animals were studied with actigraphy. RESULTS: In kindled animals, ramelteon reversed kindling-induced hippocampal excitability; however, it did not modify baseline afterdischarge properties, the progression and establishment of the kindled state in the rapid kindling model. However, in Kcna1-null mice, ramelteon (200 mg/kg/day) significantly attenuated seizure periodicity and frequency and improved circadian rest-activity rhythms compared with control animals. CONCLUSIONS: The selective melatonin receptor agonist ramelteon possesses anticonvulsant properties in a chronic epilepsy model. Our findings provide further support for melatonin receptors being potential novel targets for anticonvulsant drug development.

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Application of a Limit-Cycle Oscillator Model for Prediction of Circadian Phase in Rotating Night Shift Workers.


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Practical alternatives to gold-standard measures of circadian timing in shift workers are needed. We assessed the feasibility of applying a limit-cycle oscillator model of the human circadian pacemaker to estimate circadian phase in 25 nursing and medical staff in a field setting during a transition from day/evening shifts (diurnal schedule) to 3–5 consecutive night shifts (night
Ambulatory measurements of light and activity recorded with wrist actigraphs were used as inputs into the model. Model estimations were compared to urinary 6-sulphatoxymelatonin (aMT6s) acrophase measured on the diurnal schedule and last consecutive night shift. The model predicted aMT6s acrophase with an absolute mean error of 0.69 h on the diurnal schedule (SD = 0.94 h, 80% within ±1 hour), and 0.95 h on the night schedule (SD = 1.24 h, 68% within ±1 hour). The aMT6s phase shift from diurnal to night schedule was predicted to within ±1 hour in 56% of individuals. Our findings indicate the model can be generalized to a shift work setting, although prediction of inter-individual variability in circadian phase shift during night shifts was limited. This study provides the basis for further adaptation and validation of models for predicting circadian phase in rotating shift workers.

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Application of Machine Learning Methods to Ambulatory Circadian Monitoring (ACM) for Discriminating Sleep and Circadian Disorders.


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The present study proposes a classification model for the differential diagnosis of primary insomnia (PI) and delayed sleep phase disorder (DSPD), applying machine learning methods to circadian parameters obtained from ambulatory circadian monitoring (ACM). Nineteen healthy controls and 242 patients (PI = 184; DSPD = 58) were selected for a retrospective and non-interventional study from an anonymized Circadian Health Database (https://kronowizard.um.es/). ACM records wrist temperature (T), motor activity (A), body position (P), and environmental light exposure (L) rhythms during a whole week. Sleep was inferred from the integrated variable TAP (from temperature, activity, and position). Non-parametric analyses of TAP and estimated sleep yielded indexes of interdaily stability (IS), intradaily variability (IV), relative amplitude (RA), and a global circadian function index (CFI). Mid-sleep and mid-wake times were estimated from the central time of TAP-L5 (five consecutive hours of lowest values) and TAP-M10 (10 consecutive hours of maximum values), respectively. The most discriminative parameters, determined by ANOVA, Chi-squared, and information gain criteria analysis, were employed to build a decision tree, using machine learning. This model differentiated between healthy controls, DSPD and three insomnia subgroups (compatible with onset, maintenance and mild insomnia), with accuracy, sensitivity, and AUC >85%. In conclusion, circadian parameters can be reliably and objectively used to discriminate and characterize different sleep and circadian disorders, such as DSPD and OI, which are commonly confounded, and between different subtypes of PI. Our findings highlight the
importance of considering circadian rhythm assessment in sleep medicine.


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An approach to studying circadian rhythms of adolescent humans.

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The "long nights" protocol was designed to evaluate sleep processes and circadian rhythm parameters in young humans. A total of 19 children (10 boys, ages 11.2 to 14.1 years [mean = 12.7 +/- 1.0], and 9 girls, ages 12.2 to 14.4 years [mean = 13.1 +/- 0.7]) took part in the study. Sleep/wake initially was assessed at home using actigraphy and diary for 1 week on each child's self-selected schedule followed by an 8-night fixed light-dark (LD) condition, while sleeping from 22:00 to 08:00 h and wearing an eye mask to exclude as much light as possible. Phase measurements included 4-night mean actigraphically estimated sleep onset and offset as well as 1-night dim light salivary melatonin onset (DLSMO) phase at the end of each condition. Subjects then lived in the laboratory for 6 consecutive cycles: Day 1 LD = 14:10 h, lights out 22:00 to 08:00 h; Days 2-4 LD = 6:18 h, lights out 18:00 to 12:00 h; Days 5-6 = constant routine in continuous dim light (about 20 lux); Night 6 = 14 h recovery sleep. Phase markers (sleep
onset, sleep offset, DLSMO) were significantly less dispersed after the fixed LD as compared to the self-selected condition, indicating efficacy of the LD protocol. Phase markers were correlated at the self-selected assessment (sleep onset vs. sleep offset r = .72; DLSMO vs. sleep onset r = .82; DLSMO vs. sleep offset r = .76) but not on the fixed schedule, probably due to restricted range. The constant routine provided additional phase markers, melatonin offset and midphase. Offset phase of melatonin secretion was significantly correlated with age (r = .62) and Tanner stage (r = .62). In conclusion, these preliminary data indicate a relationship between adolescent development and circadian phase. Thus, the long nights protocol is a feasible way in which to assess circadian parameters in young humans as well as to examine intrinsic sleep processes.

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Arabian Oryx (Oryx leucoryx) Respond to Increased Ambient Temperatures with a Seasonal Shift in the Timing of Their Daily Inactivity Patterns.

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The Arabian oryx inhabits an environment where summer ambient
temperatures can exceed 40 °C for extended periods of time. While the oryx uses a suite
of adaptations that aid survival, the effects of this extreme environment on
inactivity are unknown. To determine how the oryx manages inactivity seasonally,
we measured the daily rhythm of body temperature and used fine-grain actigraphy,
in 10 animals, to reveal when the animals were inactive in relation to ambient
temperature and photoperiod. We demonstrate that during the cooler winter months,
the oryx was inactive during the cooler parts of the 24-h day (predawn hours),
showing a nighttime (nocturnal) inactivity pattern. In contrast, in
the warmer summer months, the oryx displayed a bimodal inactivity pattern, with
major inactivity bouts (those greater than 1 h) occurring equally during both the
coldest part of the night (predawn hours) and the warmest part of the
day (afternoon hours). Of note, the timing of the daily rhythm of body
temperature did not vary seasonally, although the amplitude did change, leading to a seasonal
alteration in the phase relationship between inactivity and the body
temperature rhythm. Because during periods of inactivity the oryx were presumably asleep for
much of the time, we speculate that the daytime shift in inactivity may allow the
oryx to take advantage of the thermoregulatory physiology of sleep, which likely
occurs when the animal is inactive for more than 1 h, to mitigate environmentally
induced increases in body temperature.


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The Arizona Twin Project is an ongoing longitudinal study designed to elucidate gene-environment interplay underlying the development of risk and resilience to common mental and physical health problems during infancy, childhood and adolescence. Specificity of risk is carefully examined across mental and physical health and how these influences vary across socioeconomic and sociocultural environments. Participants are a sample of approximately 700 twins (31% Latinx) recruited from birth records in the state of Arizona, USA. Twins are 32% monozygotic twins, 36% same-sex dizygotic (DZ), 32% opposite-sex DZ, currently 10–11 years of age. Primary caregivers were interviewed on twins' development and early physical and social environments when twins were 1, 2 and 5 years of age. In-depth objective measurement commenced in middle childhood, with in-person assessments at 8–11 years of age, with plans to continue to follow the sample across adolescence. Middle childhood measures focus on children's physical and mental health, including diurnal cortisol, actigraphy-based measures
of sleep and activity, cold pressor task assessing acute pain, and reaction time tasks assessing executive functioning. Preliminary findings illustrate that objective assessments of children's health are highly heritable, but they do not always share genetic etiology with more commonly used subjective assessments. Exposure to early adversity moderates genetic influences on both executive functioning and health, with higher heritability typically seen under adverse conditions. Future directions include an examination of how pubertal stage affects genetic and environmental influences on diurnal cortisol, sleep, chronic pain, and mental health.

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An ASMT variant associated with bipolar disorder influences sleep and circadian rhythms: a pilot study.


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Patients with bipolar disorder (BD) experience persistent circadian rhythm and sleep abnormalities during periods of remission, and biological studies have shown that these patients have abnormal melatonin secretion profiles or reactivity to light. We previously reported the association with BD of a common
polymorphism (rs4446909) of the promoter of the acetylserotonin O-methyltransferase (ASMT) gene, encoding one of the two enzymes involved in melatonin biosynthesis. This variant was associated with weaker transcription and lower levels of ASMT activity in lymphoblastoid cell lines. Actigraphy, based on the use of a mobile portable device for the analysis of sleep/wake cycles in natural conditions, may be useful for studies of carriers of the at-risk allele. We studied the association between the ASMT rs4446909 variant and sleep/activity, as assessed with the Pittsburgh Sleep Quality Index (PSQI) and by actigraphy, in 53 subjects (25 patients with BD in remission and 28 healthy controls). The two groups were similar for age, sex ratio, current mood symptoms, body mass index and risk of sleep apnea syndrome. In the total sample, the GG at-risk genotype was associated with longer sleep duration (P = 0.03), greater activity in active periods of sleep (P = 0.015) and greater interday stability (P = 0.003). These associations remained significant when disease status was included in the model. Only the association with interday stability remained significant after correction for multiple testing. This pilot study thus shows that a BD-associated functional variant involved in the melatonin synthesis pathway influences sleep and circadian rhythms in bipolar patients in remission and controls.

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Assessing the Dim Light Melatonin Onset in Adults with Autism Spectrum Disorder and No Comorbid Intellectual Disability.
This study assessed melatonin levels and the dim light melatonin onset (DLMO) in adults with Autism Spectrum Disorder (ASD) and also investigated the relationships between melatonin and objectively measured sleep parameters. Sixteen adults with ASD (ASD-Only), 12 adults with ASD medicated for comorbid diagnoses of anxiety and/or depression (ASD-Med) and 32 controls participated in the study. Although, the timing of the DLMO did not differ between the two groups, advances and delays of the melatonin rhythm were observed in individual profiles. Overall mean melatonin levels were lower in the ASD-Med group compared to the two other groups. Lastly, greater increases in melatonin in the hour prior to sleep were associated with greater sleep efficiency in the ASD groups.

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Assessment for the possibility of a first night effect for wrist actigraphy in adolescents.
OBJECTIVES: Evidence of a 'first night effect' has been documented for polysomnography. The possibility of this has not been previously assessed in wrist actigraphy, yet may have important implications for the study design of future sleep research. We sought to examine potential evidence of a 'first night effect' for wrist actigraphy in adolescents across weekdays and weekend nights for multiple sleep outcomes.

DESIGN: 3-year prospective cohort study (Midlands Adolescent Schools Sleep Education Study).

SETTING: 8 secondary schools in the Midlands region of the UK.

PARTICIPANTS: Adolescents (aged 11-13 years at baseline) were recruited to the study and were requested to wear a wrist actigraph for 7 consecutive days/ nights at baseline and then annually for 2 years during the second term of the academic year.

PRIMARY OUTCOME MEASURES: We compared multiple sleep outcomes (total sleep time, wake after sleep onset, sleep efficiency, sleep onset latency, number of awakenings, length of awakenings, sleep onset time) when the device was worn on a weekday and weekend and compared these to other nights to identify possible evidence of a 'first night effect' for wrist actigraphy.

RESULTS: No significant differences were found between any sleep outcomes when the first night of wrist actigraphy was on a weekday compared with other weekdays. When the first night was measured on a weekend (Friday), average total sleep time was significantly greater (486±5 min) compared with the
second night
(Saturday; 469±6 min), p=0.01.
CONCLUSIONS: We found no evidence to support a 'first night effect' for wrist actigraphy in our adolescent sample. The first night of actigraphy data should not be disregarded in future studies that deploy this technique to measure sleep over prolonged time periods.

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Assessment of a new dynamic light regimen in a nuclear power control room without windows on quickly rotating shiftworkers--effects on health, wakefulness, and circadian alignment: a pilot study.

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The aim of the study was to test whether a new dynamic light regime would improve alertness, sleep, and adaptation to rotating shiftwork. The illumination level in a control room without windows at a nuclear power station was ~200 lux (straight-forward horizontal gaze) using a weak yellow light of 200 lux, 3000 K (Philips Master TLD 36 W 830). New lighting equipment was installed in one area of the control room above the positions of the reactor operators. The new lights were shielded from the control group by a distance of >6 m, and the other
operators worked at desks turned away from the new light. The new lights were designed to give three different light exposures: (i) white/blue strong light of 745 lux, 6000 K; (ii) weak yellow light of 650 lux, 4000 K; and (iii) yellow moderate light of 700 lux, 4000 K. In a crossover design, the normal and new light exposures were given during a sequence of three night shifts, two free days, two morning shifts, and one afternoon shift (NNN + MMA), with 7 wks between sessions. The operators consisted of two groups; seven reactor operators from seven work teams were at one time exposed to the new equipment and 16 other operators were used as controls. The study was conducted during winter with reduced opportunities of daylight exposure during work, after night work, or before morning work. Operators wore actigraphs, filled in a sleep/wake diary, including ratings of sleepiness on the Karolinska Sleepiness Scale (KSS) every 2 h, and provided saliva samples for analysis of melatonin at work (every 2nd h during one night shift and first 3 h during one morning shift). Results from the wake/sleep diary showed the new light treatment increased alertness during the 2nd night shift (interaction group × light × time, p < .01). Time of waking was delayed in the light condition after the 3rd night shift (group × light, p < .05), but the amount of wake time during the sleep span increased after the 2nd night shift (p < .05), also showing a tendency to affect sleep efficiency (p < .10). Effects on circadian phase were difficult to establish given the small sample size and infrequent sampling of saliva melatonin. Nonetheless, it seems that appropriate dynamic light in rooms without windows during the dark Nordic season may promote alertness, sleep, and better adaptation to quickly rotating shiftwork.

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Assessment of chronotype in four- to eleven-year-old children: reliability and validity of the Children's Chronotype Questionnaire (CCTQ).

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Individual differences in circadian phase preference ("chronotype") are linked to sleep schedule variability, psychosocial functioning, and specific properties of the circadian clock. While much is known about the development, distribution, and variability of chronotype in adolescents and adults, assessment in prepubertal children has been hindered by a lack of appropriate, reliable, and valid measures. This study presents a detailed description of the assessment of children's chronotype by the Children's ChronoType Questionnaire (CCTQ). The CCTQ is a parent-report, 27-item mixed-format questionnaire resulting in multiple measures of chronotype in 4- to 11-yr-old children: the midsleep point on free days (MSF), a morningness/eveningness scale (M/E) score, and a five-point chronotype (CT) score. The study provides validity data using actigraphy as well as test-retest reliability data for all three chronotype measures and sleep/wake parameters. Overall, the findings indicate moderate to strong agreement between the three measures, adequate associations between chronotype measures and sleep/wake parameters assessed by actigraphy, and excellent temporal stability (reliability).

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Assessment of circadian rhythms by actimetry in healthy subjects and patients with advanced colorectal cancer.

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Circadian rhythms can be altered in severe illness such as cancer; the rest-activity circadian cycle has been used as a reference for the administration of chemotherapy at specific times in order to improve tolerability and efficacy. We assessed the feasibility of the method in our center in a sample of patients with metastatic colorectal cancer selected for chronomodulated chemotherapy. Activity of the circadian rhythms were measured non-invasively in 10 patients with metastatic colorectal cancer by wrist actimetry, and compared to healthy subjects. Patients and healthy subjects were requested to wear an actigraph, a wristwatch that records the number of accelerations per minute, for 3 days. Healthy subjects exhibited high activity levels during daytime, followed by low activity levels during the night. In patients, the contrast between daytime activity and nocturnal sleep was noticeably less marked, and a wide inter-patient variability was observed. All the patients wore the actigraph with a total compliance. Actimetry may provide a simple and innovative tool to study the circadian system and may be considered as an objective and accurate method to evaluate the individual health status ("conditions of life") in cancer patients, independently of all ("quality of life" questionnaires.
Assessment of circadian rhythms of both skin temperature and motor activity in infants during the first 6 months of life.


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The authors developed a method useful for home measurement of temperature, activity, and sleep rhythms in infants under normal-living conditions during their first 6 mos of life. In addition, parametric and nonparametric tests for assessing circadian system maturation in these infants were compared. Anthropometric parameters plus ankle skin temperature and activity were evaluated in 10 infants by means of two data loggers, Termochron iButton (DS1291H, Maxim Integrated Products, Sunnyvale, CA) for temperature and HOBO Pendant G (Hobo Pendant G Acceleration, UA-004-64, Onset Computer Corporation, Bourne, MA) for motor activity, located in special baby socks specifically designed for the study. Skin temperature and motor activity were recorded over 3 consecutive days at 15 days, 1, 3, and 6 mos of age. Circadian rhythms of skin temperature and motor activity appeared at 3 mos in most babies. Mean skin temperature decreased significantly by 3 mos of life relative to previous measurements (p = .0001), whereas mean activity continued to increase during the first 6 mos. For most of the parameters analyzed, statistically significant changes occurred at 3–6 mos relative to 0.5–1 mo of age. Major differences were found using
nonparametric tests. Intradaaily variability in motor activity decreased significantly at 6 mos of age relative to previous measurements, and followed a similar trend for temperature; interdaily stability increased significantly at 6 mos of age relative to previous measurements for both variables; relative amplitude increased significantly at 6 mos for temperature and at 3 mos for activity, both with respect to previous measurements. A high degree of correlation was found between chronobiological parametric and nonparametric tests for mean and mesor and also for relative amplitude versus the cosinor-derived amplitude. However, the correlation between parametric and nonparametric equivalent indices (acrophase and midpoint of M5, interdaily stability and Rayleigh test, or intradaaily variability and P(1)/P(ultradian)) despite being significant, was lower for both temperature and activity. The circadian function index (CFI index), based on the integrated variable temperature-activity, increased gradually with age and was statistically significant at 6 mos of age. At 6 mos, 90% of the infants' rest period coincided with the standard sleep period of their parents, defined from 23:00 to 07:00 h (dichotomic index I < 0; when I < 0 = 100%, there is a complete coincidence between infant nocturnal rest period and the standard rest period), whereas at 15 days of life the coincidence was only 75%. The combination of thermometry and actimetry using data loggers placed in infants' socks is a reliable method for assessing both variables and also sleep rhythms in infants under ambulatory conditions, with minimal disturbance. Using this methodological approach, circadian rhythms of skin temperature and motor activity appeared by 3 mos in most babies. Nonparametric tests provided more reliable information than cosinor analysis for circadian rhythm assessment in infants.
Assessment of diurnal melatonin, cortisol, activity, and sleep-wake cycle in patients with and without diabetic retinopathy.


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OBJECTIVE: To assess the diurnal melatonin, cortisol, and activity/rest levels, as well as sleep quality, in patients with and without nonproliferative diabetic retinopathy (DR).

METHODS: We included 25 diabetic patients with DR and 29 without DR. A total of 21 healthy subjects constituted the control group. We assessed the circadian rhythm by actigraphy and diurnal salivary melatonin and cortisol measurements. Sleep quality was evaluated by actigraphy and the Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) questionnaires. Light exposure was quantified by actigraphy. The primary outcome was peak salivary melatonin level. Secondary outcomes were mean melatonin and cortisol levels during dark
hours, activity-rest rhythm, sleep quality, as well as level of white, red, green, and blue light exposure.

RESULTS: Peak melatonin concentration at 04:00 and mean nocturnal melatonin level were significantly reduced in all diabetic patients, regardless of retinopathy stage (p < 0.001). Levels of light exposures during dark hours were not significantly different in patients with and without DR and healthy controls. Only patients with DR showed increased intradaily variability in their activity-rest interval, indicating circadian misalignment (p = 0.04). Neither the objective actigraphic sleep quality parameters nor the subjective PSQI or ESS scores were significantly different between healthy controls and diabetic patients.

CONCLUSIONS: Reduced nocturnal melatonin concentration and increased fragmentation of activity-rest intervals revealed circadian rhythm disturbance in diabetic patients with DR.

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Assessment of Fractal Characteristics of Locomotor Activity of Geriatric In-Patients With Alzheimer's Dementia.


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Introduction: Many physiological signals yield fractal characteristics, i.e., finer details at higher magnifications resemble details of the whole. Evidence has been accumulating that such fractal scaling is basically a consequence of interaction-dominant feedback mechanisms that cooperatively generate those signals. Neurodegenerative diseases provide a natural framework to evaluate this paradigm when this cooperative function declines. However, methodological issues need to be cautiously taken into account in order to be able to provide reliable as well as valid interpretations of such signal analyses.

Methods: Two conceptually different fractal analyses, i.e., detrended fluctuation analysis (DFA) and analysis of cumulative distributions of durations (CDDs), are applied to actigraphy data of 36 geriatric in-patients diagnosed with dementia. The impact of the used time resolution for data acquisition on the assessed fractal outcome parameters is particularly investigated. Moreover, associations between these parameters and scores from the Mini-Mental-State-Examination and circadian activity parameters are explored.

Results: Both analyses yield significant deviations from (mono-)fractal scaling over the entire considered time range. DFA provides robust measures for the observed break-down of fractal scaling. In contrast, analysis of CDDs results in measures which highly fluctuate with respect to the time resolution of the assessed data which affects also further derived quantities such as scaling exponents or associations with other (clinically relevant) assessed parameters.

Discussion: To scrutinize actigraphic signal characteristics and especially their (deviations from) fractal scaling may be a useful tool for aiding diagnosis, characterization, and monitoring of dementia. However, results may,
besides contextual aspects, also substantially depend on specific methodological choices. In order to arrive at both reliable and valid interpretations, these complications need to be carefully elaborated in future research.

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Assessment of physical activity and sleep by actigraphy: examination of gender differences.

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Research evidence suggests that actigraphy is a very important instrument in documenting sleep/wake patterns of people with a variety of sleep disorders or motor dysfunctions. The present actigraphic investigation examined physical activity and sleep profiles as a function of gender in volunteers monitored in their natural environment. Irrespective of age, women exhibited better sleep quality than did men. This was demonstrated by higher sleep efficiency index and lower frequency of transitions between sleep and wakefulness. Additionally, women slept more than men and had shorter sleep onset latency. However, no significant gender effect on daytime activity level and circadian activity amplitude was observed.

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Assessment of sleep in children with mucopolysaccharidosis type III.

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Sleep disturbances are prevalent in mucopolysaccharidosis Type III (MPS III), yet there is a lack of objective, ecologically valid evidence detailing sleep quantity, quality or circadian system. Eight children with MPS III and eight age-matched typically developing children wore an actigraph for 7-10 days/nights. Saliva samples were collected at three time-points on two separate days, to permit analysis of endogenous melatonin levels. Parents completed a sleep questionnaire and a daily sleep diary. Actigraphic data revealed that children with MPS III had significantly longer sleep onset latencies and greater daytime sleep compared to controls, but night-time sleep duration did not differ between groups. In the MPS III group, sleep efficiency declined, and sleep onset latency increased, with age. Questionnaire responses showed that MPS III patients had significantly more sleep difficulties in all domains compared to controls. Melatonin concentrations showed an alteration in the circadian system in MPS III, which suggests that treatment for sleep problems should attempt to
synchronise
the sleep–wake cycle to a more regular pattern. Actigraphy was
tolerated by
children and this monitoring device can be recommended as a measure of
treatment
success in research and clinical practice.

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5.

The association between chronotype and sleep problems in preschool
children.

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OBJECTIVE: Adolescents and adults who are evening-types exhibit shorter sleep duration and more sleep problems than individuals with an earlier chronotype. We hypothesized that already at a preschool age, evening-types would exhibit more sleep problems relative to children who are morning or intermediate chronotypes. The aim of this study was to examine the association between chronotype and sleep problems among preschool children.

METHODS: We studied a subset of typically-developing 4.5-year-olds taking part in the Growing Up in Singapore Towards healthy Outcomes birth cohort study (n=244). The Children's Chronotype Questionnaire (CCTQ) was used to categorize children into morning-, intermediate-, and evening-types. Sleep problems were measured using the Children's Sleep Habits Questionnaire (CSHQ), with higher scores corresponding to greater sleep problems. The relation between chronotype, sleep-wake timing, and nocturnal sleep time was also evaluated in a subsample of 117 children using actigraphy recordings with parent-reported sleep diaries.

RESULTS: After controlling for potential confounders (maternal education, child's sex, birth order, and ethnicity), a significant main effect of chronotype on sleep problems was observed, in which evening-types exhibited greater CSHQ scores compared to morning- and intermediate-types (all p < 0.001). Actigraphy data in the subsample confirmed that evening-types had later bedtimes (p < 0.001) and get-up times (p = 0.02) during weekdays and weekends, but shorter nocturnal sleep time (p = 0.034) only during weekdays, compared to children who had earlier chronotypes.

CONCLUSIONS: In preschool children, sleep problems were greater in evening-types
compared to morning- and intermediate-types, suggesting that chronotype could be a contributing factor to sleep disturbances in early childhood.

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The association between circadian rest-activity patterns and the behavioral and psychological symptoms depending on the cognitive status in Japanese nursing-home residents.

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BACKGROUND: Limited information is available on the relationship between sleep disturbances during nighttime and the behavioral and psychological symptoms of dementia in older nursing-home residents. However, a few reports on the association between the circadian rest-activity rhythm and the behavioral and psychological symptoms of dementia in older residents have been published. The main objective of the present study was to examine the association among the circadian rest-activity rhythm, behavioral and psychological symptoms, and the cognitive function status among older individuals living in facilities.

METHOD: The investigation was conducted from September 2017 to
February 2018, and participants were recruited from five nursing homes in Akita prefecture, Japan, after obtaining patient agreement to participate in the study. To measure nonparametric circadian rest-activity parameters such as interdaily stability, intradaily variability, relative amplitude, mean of the least active 5-h period, and mean of the most active 10-h period, Actigraph devices were worn on the participants' nondominant wrists continuously for seven days. The score or classification of the cognitive status and the severity of the behavioral and psychological symptoms of dementia (BPSD) were assessed using the clinical dementia rating (CDR) and the dementia behavior disturbance scale (DBD), respectively. The binomial logistic regression model was applied to clarify which kinds of circadian rest-activity parameters predicted the cognitive status in nursing home residents as well as the BPSD outcome. A multi-level model was also used to examine the association between the nonparametric rest-activity parameters and the BPSD outcome explained by the cognitive status among older individuals in facilities.

RESULTS: Seventy-seven participants (49 residents with dementia, and 28 residents without dementia) were included in this study. According to the binomial logistic regression analysis after adjusting for covariates, the classification of the cognitive status for older residents was associated with the DBD score (odds ratio, 1.22; 95% confidence interval [CI], 1.08, 1.38; \( p < 0.001 \)), the IS (odds ratio, 0.01; 95% CI, 0.00, 1.00; \( p = 0.05 \)) and the L5 (odds ratio, 0.99; 95% CI, 0.99, 1.00; \( p = 0.05 \)). The results of a multi-level model also indicated that the IV at individual-level was significantly associated with the DBD score for nursing home residents, with the CDR score at cluster-level as an explanatory variable. As well, a significant association between the RA at individual level
and the DBD score was observed in a multi-level model explained by the CDR score at cluster-level.

CONCLUSION: Of these models, the multi-level model provided grounds for our proposal that the fragmentation or the amplitude of rest-activity parameters might be associated with the outcome of BPSD, considering the cognitive status of older individuals in different facilities. The findings offer practical insight into the prevention of BPSD and the improvement of rest-activity rhythms in rehabilitative care in nursing homes.

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Association between circadian rhythms, sleep and cognitive impairment in healthy older adults: an actigraphic study.

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There is increasing evidence for the relationship between circadian rhythm disturbance and cognitive decline in the older adult. This study measured circadian activity rhythms in a small group of healthy community-dwelling older adults (n = 26). Each participant completed a battery of neuropsychological tests and completed sleep diaries and 6 days of actigraphy. Ten participants were identified as having very early signs of cognitive decline as indicated by their performance on the memory tests. Results showed minimal differences on the sleep/activity and circadian parameters across the two groups (declined vs. intact), although there was a significant difference in the acrophase
between the declined and intact groups. These findings, although exploratory, suggest that very subtle changes in circadian rhythm may be detected in older adults showing pre-clinical changes in cognitive performance.

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Association between coffee, tobacco, and alcohol daily consumption and sleep/wake cycle: an actigraphy study in euthymic patients with bipolar disorders.


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Individuals with bipolar disorder (BD) have higher than average rates of coffee, tobacco and alcohol use. These substances may have deleterious effects on sleep quality and quantity, which may destabilize sleep/wake cycles and negatively impact the clinical course and prognosis of BD. The use of these substances may also be perceived as a self-medication attempt, for example, to induce sleep or to increase vigilance during the day. The objective of the current study was to investigate associations between the self-reported daily use of coffee, tobacco, and alcohol, and objective measures of sleep and activity patterns in adult individuals with BD. A sample of 147 euthymic individuals with BD were assessed for daily coffee, tobacco and alcohol consumption and 21 days of actigraphy monitoring. Actigraphic measures of sleep quantity and daytime activity were compared between groups classified as coffee+/coffee-, tobacco+/tobacco- and alcohol+/alcohol-, defined according to their current daily use. Then, we examined potential correlations between sleep/wake cycle parameters and the amount of daily consumption of each substance. Multivariable analyses identified associations between the use of coffee, tobacco, and alcohol and several sleep and activity parameters, such as between coffee, alcohol, and the relative amplitude of activity (respectively, p = .003 and p = .005), between alcohol and
M10 onset (onset time of the 10 most active hours during the 24-h cycle) \( (p = .003) \), and between coffee and sleep duration \( (p = .047) \). This study supports the hypothesis that there is a relationship, whose direction would be bidirectional, between the daily use of these substances and the sleep/wake cycle in euthymic individuals with BD. These preliminary results require replications in other retrospective and prospective samples. They may have a clinical impact on psycho-education strategies to be proposed to individuals with BD.

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The association between higher body mass index and poor school performance in high school students.

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BACKGROUND/OBJECTIVE: This study aimed to examine the association between body mass index (BMI) and school performance in high school students by controlling for relevant mediators such as sleep quality, sleep duration and socioeconomic status.

METHODS: Thirty-seven high school students (mean age: 18.16 ± 0.44 years) attending the same school type, i.e. 'liceo scientifico' (science-based high school), were enrolled. Students' self-reported weight and height were used to calculate BMI. Participants wore an actigraph to objectively assess the quality
and duration of sleep. School performance was assessed through the actual grade obtained at the final school-leaving exam, in which higher grades indicate higher performance.

RESULTS: BMI, get-up time, mean motor activity, wake after sleep onset and number of awakenings were negatively correlated with the grade, while sleep efficiency was positively correlated. When performing a multiple regression analysis, BMI proved the only significant (negative) predictor of grade.

CONCLUSIONS: When controlling for sleep quality, sleep duration and socioeconomic status, a higher BMI is associated with a poorer school performance in high school students.

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Association between light exposure at night and insomnia in the general elderly population: the HEIJO-KYO cohort.

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Chronic circadian misalignment between the internal and environmental rhythms, which is typically related to night-shift work and clock-gene variants, is associated with disruption of suprachiasmatic nucleus function and increased risk of insomnia. Under controlled laboratory conditions, light at night (LAN) suppresses melatonin secretion, delays the internal biological rhythm, and reduces sleepiness. Therefore, LAN exposure may cause circadian
misalignment and insomnia, though it remains unclear in real-life situations whether LAN exposure is associated with insomnia. To evaluate an association between LAN exposure and sleep quality in home settings, we conducted a cross-sectional community-based study in 857 elderly individuals (mean age, 72.2 years). We evaluated bedroom light intensity using a light meter and subjectively and objectively measured sleep quality using the Pittsburgh Sleep Quality Index and an actigraph, respectively, along with urinary 6-sulfatoxymelatonin excretion. Compared with the lowest quartile group of LAN intensity, the highest quartile group revealed a significantly higher odds ratio (OR) for subjective insomnia in a multivariate model adjusted for age, gender, body mass index, daytime physical activity, urinary 6-sulfatoxymelatonin excretion, bedtime, rising time, and day length (adjusted OR, 1.61, 95% confidence interval, 1.05-2.45, p=0.029). In addition, higher OR for subjective insomnia was significantly associated with the increase in quartiles of LAN intensity (ptrend=0.043). Consistently, we observed significant association trends between the increase in quartiles of LAN intensity and poorer actigraphic sleep quality, including decreased sleep efficiency, prolonged sleep-onset latency, increased wake-after-sleep onset, shortened total sleep time, and delayed sleep-mid time in multivariate models adjusted for the covariates mentioned above (all ptrend<0.001). In conclusion, we demonstrated that LAN exposure in home settings is significantly associated with both subjectively and objectively measured sleep quality in a community-based elderly population.

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Circadian misalignment between internal and environmental rhythms dysregulates blood pressure (BP) variability because of disruption of the biological clock, resulting in increased nighttime BP. Although exposure to light-at-night is associated with the circadian misalignment, it remains unclear whether exposure to light-at-night in home settings is associated with nighttime BP. In this cross-sectional analysis of 528 elderly individuals (mean age: 72.8 years), we measured bedroom light intensity at 1-min intervals on two consecutive nights along with ambulatory BP, overnight urinary melatonin excretion and actigraphy. With regard to adjusted mean comparisons using analysis of covariance, the light-at-night group (average: ≥5 lux; n = 109) showed significantly higher nighttime systolic BP (SBP; adjusted mean: 120.8 vs. 116.5 mmHg, p = 0.01) and diastolic BP (70.1 vs. 67.1 mmHg, p < 0.01) compared with the Darker group (average: <5 lux; n = 419) independently of potential confounding factors including overnight urinary melatonin excretion and actigraphic sleep quality. We observed consistent associations between light-at-night and nighttime BP in different cutoff values for light-at-night intensity (i.e. 3 and 10 lux). In conclusion, exposure to light-at-night in home settings is significantly associated with increased nighttime BP in elderly individuals independently of
overnight urinary melatonin excretion. A 4.3 mmHg increase in nighttime SBP is associated with a 6.1% increase in total mortality, which corresponds to approximately 10,000 annual excess deaths in Japanese elderly population.

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Association between sleep disturbance and nocturnal blood pressure profiles by a linear mixed model analysis: the Nagahama study.

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OBJECTIVES: We aimed to analyze associations of sleep disturbance, including
sleep disordered breathing, sleep fragmentation, and sleep efficiency, with abnormal nocturnal blood pressure (BP) profiles that may be risk factors for adverse cardiovascular outcomes.

METHODS: The study included 5854 community residents with 20,725 multi-day measurements. Sleep fragmentation and efficiency were evaluated using a wrist-worn activity monitor. Sleep disordered breathing was assessed using the 3% oxygen desaturation index corrected for actigraphy-determined sleep duration. A timer-equipped standard cuff-oscillometric device was used for home and sleep BP monitoring.

RESULTS: Mean nocturnal systolic BP (SBP) change was $-8.6 \pm 9.7\%$ ($-11.1 \pm 12.6$ mmHg), and inter-day correlation coefficient of the nocturnal SBP change was 0.443. Results of a linear mixed model analysis using daily measured values identified lower sleep efficiency (coefficient = $-0.130$, $p < 0.001$) as a determinant for decreased nocturnal SBP dipping beyond the interday variations of these parameters. Number of nocturnal urinations was another strong determinant (coefficient = 1.191, $p < 0.001$), although the association of sleep efficiency was independent of nocturnal urination, awake SBP, and sleep disordered breathing (coefficient = $-0.102$, $p < 0.001$). Sleep efficiency was also independently associated with sleep SBP level (coefficient = $-0.138$, $p < 0.001$). Estimated differences in nocturnal SBP dipping and sleep SBP level as a function of the degree of sleep efficiency (less than 80%) reached 1.63% (1.09-2.17%) and 2.16 mmHg (1.49-2.82%), respectively.

CONCLUSION: More attention should be paid to sleep efficiency as a factor in maintaining circadian BP rhythm.

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Chronotype refers to individuals' preferences for timing of sleep and wakefulness. It can be quantified by measuring the midpoint time between the start and end of sleep during free days. Measuring chronotype is helpful to diagnose circadian rhythm sleep-wake disorders. The Munich Chronotype Questionnaire (MCTQ) is a self-reported measure of chronotype that calculates the midpoint of sleep on free days based on self-reported bed and wake times. Self-reports of sleep are prone to bias. The objective was to examine the agreement between the MCTQ-derived midpoint and an objective measure obtained using wrist actigraphy. The sleep of 115 participants aged 18-34 (mean = 24, SD = 4.6) was monitored with actigraphy for 4 to 6 consecutive nights. The corrected midpoint of sleep on free days was derived from sleep start and end times on both free days and scheduled days. The corrected midpoint of sleep on free days as measured by the MCTQ was 4:56 (SD = 1:16) and by actigraphy was 4:51 (SD = 1:23). They were not significantly different (t(87) = 0.66, p = 0.51). A strong correlation was found between these two measurements (r(88) = 0.73, p < 0.001). The 95% limits of agreement were between -1:37:19 and 2:14:38. MCTQ and actigraphy provide similar results for the corrected midpoint of sleep on free
The Association of Ambient Air Pollution with Sleep Apnea: The Multi-Ethnic Study of Atherosclerosis.


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RATIONALE: Air pollution may influence sleep through airway inflammation or autonomic nervous system pathway alterations. Epidemiological studies may provide evidence of relationships between chronic air pollution exposure and sleep apnea.

OBJECTIVES: To determine whether ambient-derived pollution exposure is associated with obstructive sleep apnea and objective sleep disruption.

METHODS: We analyzed data from a sample of participants in MESA (Multi-Ethnic
Study of Atherosclerosis) who participated in both the Sleep and Air studies. Mean annual and 5-year exposure levels to nitrogen dioxide (NO2) and particulate matter ≤ 2.5 μm in aerodynamic diameter (PM2.5) were estimated at participants' homes using spatiotemporal models based on cohort-specific monitoring. Participants completed in-home full polysomnography and 7 days of wrist actigraphy. We used multivariate models, adjusted for demographics, comorbidities, socioeconomic factors, and site, to assess whether air pollution was associated with sleep apnea (apnea-hypopnea index ≥ 15) and actigraphy-measured sleep efficiency.

RESULTS: The participants (n = 1,974) were an average age of 68 (±9) years, 46% male, 36% white, 24% Hispanic, 28% black, and 12% Asian; 48% had sleep apnea and 25% had a sleep efficiency of ≤88%. A 10 ppb annual increase in NO2 exposure was associated with 39% greater adjusted odds of sleep apnea (95% confidence interval [CI], 1.03–1.87). A 5 μg/m3 greater annual PM2.5 exposure was also associated with 60% greater odds of sleep apnea (95% CI, 0.98–2.62). Sleep efficiency was not associated with air pollution levels in fully adjusted models.

CONCLUSIONS: Individuals with higher annual NO2 and PM2.5 exposure levels had a greater odds of sleep apnea. These data suggest that in addition to individual risk factors, environmental factors also contribute to the variation of sleep disorders across groups, possibly contributing to health disparities.

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Association of Childhood Trauma Exposure with Inflammatory Biomarkers Among Midlife Women.

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Background: Childhood abuse has been associated with poor health outcomes in adulthood. However, the physiologic pathways by which abuse is linked to health are not fully elucidated. Inflammation plays a significant role in the pathophysiology of multiple chronic diseases. We tested whether childhood trauma exposure was related to increased systemic inflammation in midlife women.

Materials and Methods: Participants were 304 nonsmoking perimenopausal and postmenopausal women aged 40 to 60 years and free of cardiovascular disease. They completed questionnaires assessing psychosocial and behavioral factors, including childhood trauma, anthropometric measures, wrist actigraphy sleep measurements, and a fasting blood draw for inflammatory markers high-sensitivity C-reactive protein (hsCRP) and interleukin-6 (IL-6). Associations between childhood trauma and inflammatory markers were tested in linear regression models controlling for age, race/ethnicity, education, body mass index, anti-inflammatory medication use, and alcohol consumption. Other covariates considered included sleep continuity and depressive symptoms. Results: A total of 44.8% of the sample experienced at least one type of childhood abuse/neglect. Women with a history of emotional abuse had higher IL-6 levels than women without this history in multivariate models (β = 0.077, standard error = 0.032, p = 0.017). Results were not accounted for by covariates and persisted additionally controlling for depressive symptoms and sleep. Childhood abuse/neglect was not related to hsCRP.
Conclusions: Childhood emotional abuse was associated with higher levels of IL-6 in midlife women. Assessing childhood trauma exposure along with inflammatory markers may be important for the development of prevention strategies at midlife to prevent chronic diseases later in life.

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The Association of Daytime Maternal Napping and Exercise With Nighttime Sleep in First-Time Mothers Between 3 and 6 Months Postpartum.

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OBJECTIVE: This study investigated the relationship of daytime maternal napping, exercise, caffeine, and alcohol intake to objective and subjective sleep indices.

PARTICIPANTS: Sixty healthy, nondepressed, first-time mothers between 3 and 6 months postpartum.

METHODS: Seven consecutive days of online behavior diaries, sleep diaries, and wrist actigraphy, collecting Total Sleep Time (TST), Sleep Onset Latency (SOL), and Wake After Sleep Onset (WASO).

RESULTS: After controlling for infant age, employment status, infant feeding method, and infant sleeping location, mixed linear models showed that longer average exercise durations were associated with longer average TST, and longer average nap durations were associated with longer average WASO.
durations. Significant within-person differences in TST and SOL were also observed, such that, on days when participants exercised and napped longer than average, their respective TST and SOL durations that night were longer.

CONCLUSION: Shorter nap durations and longer exercise durations were associated with longer TST, shorter SOL, and reduced WASO. Even small changes in daily exercise and napping behaviors could lead to reliable improvements in postpartum maternal sleep.

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Association of functioning and quality of life with objective and subjective measures of sleep and biological rhythms in major depressive and bipolar disorder.

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OBJECTIVE: Disruptions in biological rhythms and sleep are a core aspect of mood disorders, with sleep and rhythm changes frequently occurring prior to and during mood episodes. Wrist-worn actigraphs are increasingly utilized to measure ambulatory activity rhythm and sleep patterns.

METHODS: A comprehensive study using subjective and objective measures of sleep and biological rhythms was conducted in 111 participants (40 healthy volunteers [HC], 38 with major depressive disorder [MDD] and 33 with bipolar disorder [BD]). Participants completed 15-day actigraphy and first-morning urine samples to measure 6-sulfatoxymelatonin levels. Sleep and biological rhythm questionnaires were administered: Biological Rhythms Interview of Assessment in Neuropsychiatry (BRIAN), Munich Chronotype Questionnaire (MCTQ), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS). Actigraph data were analyzed for sleep and daily activity rhythms, light exposure and likelihood of transitioning between rest and activity states.

RESULTS: Mood groups had worse subjective sleep quality (PSQI) and biological rhythm disruption (BRIAN) and higher objective mean nighttime activity than controls. Participants with BD had longer total sleep time, higher circadian quotient and lower 6-sulfatoxymelatonin levels than HC group. The MDD group had longer sleep onset latency and higher daytime probability of transitioning from rest to activity than HCs. Mood groups displayed later mean timing of light exposure. Multiple linear regression analysis with BRIAN scores, circadian quotient, mean nighttime activity during rest and daytime probability
of transitioning from activity to rest explained 43% of variance in quality-of-life scores. BRIAN scores, total sleep time and probability of transitioning from activity to rest explained 52% of variance in functioning (all p < 0.05).

CONCLUSIONS: Disruption in biological rhythms is associated with poorer functioning and quality of life in bipolar and MDD. Investigating biological rhythms and sleep using actigraphy variables, urinary 6-sulfatoxymelatonin and subjective measures provide evidence of widespread sleep and circadian system disruptions in mood disorders.

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Association of morning illumination and window covering with mood and sleep among post-menopausal women.

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The antidepressant and sleep-promoting effects of light exposure might be useful for treating age-related mood and sleep disorders. In view of recent evidence suggesting beneficial effects of morning light, this study examined the
associations of mood and sleep with morning light exposure, 24 h environmental illumination, and the degree to which the volunteers' bedroom windows were covered in the morning. We examined 459 postmenopausal women participating an ancillary study of the Women's Health Initiative conducted at the University of California, San Diego Clinical Center, San Diego, CA, USA. At baseline, volunteers completed a 4-week sleep-recall questionnaire. Volunteers were then assessed for 5-7 days in their home environments with actigraphic wrist monitors. During home recording, self-reported mood was assessed. Morning illumination during the first 4 h after arising, 24-h illumination mesor (cosine-fitted mean), and illumination acrophase (cosine-fitted peak time) were calculated. Sleep was scored each night using validated wrist actigraphic methods. A sleep diary was completed each morning. During two 24-h periods, urine was collected approximately every 2 h during wakefulness and following any voidings during the sleep period. Cosine-fitting established the acrophase of urinary 6-sulfatoxymelatonin (aMT6s) excretion. Morning illumination and 24-h illumination were modestly associated with better mood and sleep. Associations of light with mood and sleep were consistently greater for subjects whose body clocks were delayed relative to the group median. Less morning window covering in the subjects' bedrooms was associated with more morning light and less depressed mood. The results suggest that both morning and 24-h light exposure may be beneficial for older adults.

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PMID: 25374475


The association of quality of life with potentially remediable disruptions of circadian sleep/activity rhythms in patients with advanced lung cancer.
BACKGROUND: Cancer patients routinely develop symptoms consistent with profound circadian disruption, which causes circadian disruption diminished quality of life. This study was initiated to determine the relationship between the severity of potentially remediable cancer-associated circadian disruption and quality of life among patients with advanced lung cancer.

METHODS: We concurrently investigated the relationship between the circadian rhythms of 84 advanced lung cancer patients and their quality of life outcomes as measured by the EORTC QLQ C30 and Ferrans and Powers QLI. The robustness and stability of activity/sleep circadian daily rhythms were measured by actigraphy.

Fifty three of the patients in the study were starting their definitive therapy following diagnosis and thirty one patients were beginning second-line therapy. Among the patients who failed prior therapy, the median time between completing definitive therapy and baseline actigraphy was 4.3 months, (interquartile range 2.1 to 9.8 months).

RESULTS: We found that circadian disruption is universal and severe among these patients compared to non-cancer-bearing individuals. We found that each of these patient's EORTC QLQ C30 domain scores revealed a compromised capacity to perform the routine activities of daily life. The severity of several, but not all, EORTC QLQ C30 symptom items correlate strongly with the degree of individual circadian disruption. In addition, the scores of all four Ferrans/Powers QLI domains correlate strongly with the degree of circadian disruption. Although
Ferrans/Powers QLI domain scores show that cancer and its treatment spared these patients' emotional and psychological health, the QLI Health/Function domain score revealed high levels of patients' dissatisfaction with their health which is much worse when circadian disruption is severe. Circadian disruption selectively affects specific Quality of Life domains, such as the Ferrans/Powers Health/Function domain, and not others, such as EORTC QLQ C30 Physical Domain.

CONCLUSIONS: These data suggest the testable possibility that behavioral, hormonal and/or light-based strategies to improve circadian organization may help patients suffering from advanced lung cancer to feel and function better.

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Association of rest-activity and light exposure rhythms with sleep quality in insomnia patients.

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The relevance of altered rest-activity rhythm (RAR) and light exposure rhythm (LER) in insomnia patients under natural conditions remains unclear. The aim of this study was to compare the parametric and nonparametric circadian variables of
RAR and those of LER under natural conditions between insomnia patients and normal controls (NC) in a community-dwelling setting. The relationship of the nonparametric variables with sleep quality was also explored in both groups. Participants above 18 years old were recruited from three Public Health Centers in a rural area of Korea. Actigraphy (Actiwatch 2; Philips Respironics, Murrysville PA, USA) recording was conducted for 7 days. Subjects were eligible for our study if they had an insomnia disorder (ID) for at least 1 month. Actigraphy data of 78 normal control (NC) subjects (Age, 55.95 ± 13.22 years) and 104 patients with insomnia disorder (ID) (Age, 62.14 ± 12.34 years) were included for the analysis. Acrophases and amplitudes of RAR and LER were estimated using cosinor analysis. Interdaily stability (IS), intradaily variability (IV), and relative amplitude (RA) of these rhythms were determined using nonparametric methods. Parametric cosinor and nonparametric variables of RAR and LER were compared between the NC and ID groups. Generalized linear models (GLMs) were applied to evaluate the main effects of group and each nonparametric variable as well as a group by each variable interaction on the sleep onset latency (SOL), sleep efficiency (SE), and wake after sleep onset (WASO) reflecting sleep quality. Among sleep parameters, the ID group showed significantly lower SE and greater WASO than the NC group. There were no significant differences in the acrophase and amplitude of RAR and LER between the two groups. There were no significant differences in IV, IS, and RA of RAR and LER between the two groups either. GLMs for RAR revealed a significant interaction between the group and IS on the SOL (β = -46.39, p < 0.01), indicating a negative relationship of the IS with SOL in ID unlike its positive relationship in NC. There were no significant main effects of IV on the SOL, SE, and WASO, but significant main effects of RA
on the SE and WASO ($\beta = 63.65$ and $\beta = -221.43$, respectively, $p < 0.01$). GLMs for LER revealed no significant main effects of IS, IV or RA on the SOL, SE, and WASO, but significant interactions between group and RA on the SE and WASO ($\beta = 56.17$ and $\beta = -171.93$, respectively, $p < 0.05$), indicating a stronger positive relationship of the RA with SE in ID compared to NC, and a negative relationship of the RA with WASO in ID, unlike its positive relationship in NC. Although our study did not reveal group differences in circadian variables of RAR and LER, it suggested that the regularity of RAR could be positively associated with sleep initiation, while the robustness of LER could be positively associated with sleep maintenance in insomnia patients.

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The association of sleep duration with adolescents' fat and carbohydrate consumption.


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Comment in
Sleep. 2010 Sep;33(9):1135-6.

STUDY OBJECTIVES: To investigate the relation between sleep duration and energy consumption in an adolescent cohort.

DESIGN: Cross-sectional.

SETTING: Free-living environment.

PARTICIPANTS: Two hundred forty adolescents (mean age 17.7 +/- 0.4 years).

MEASUREMENTS AND RESULTS: Daily 24-hour food-recall questionnaires and wrist-actigraphy measurements of sleep duration were employed to test
the hypothesis that shorter weekday sleep duration (< 8 h) is associated with altered nutrient intake. Nutrition parameters included total calories, calories from meals and snacks, and proportions of caloric intake from fat and carbohydrates. Compared with adolescents sleeping 8 or more hours on average on weekdays, those sleeping less than 8 hours consumed a higher proportion of calories from fats (35.9% +/- 6.7% vs 33.2% +/- 6.9%; mean +/- SD; P = 0.004) and a lower proportion of calories from carbohydrates (49.6% +/- 8.2% vs 53.3% +/- 8.3%; P = 0.001). After adjusting for potential confounders, shorter sleep duration was significantly associated with an average daily increase of calories consumed from fat of 2.2 percentage points and an average daily decrease in percentage of calories from carbohydrates of 3.0 percentage points. In unadjusted analyses, shorter sleep duration was also associated with a 2.1-fold increased odds (95% confidence interval: 1.03, 4.44) of daily consuming 475 or more kcal from snacks. CONCLUSION: Quantitative measures of macronutrient intake in adolescents were associated with objectively measured sleep duration. Short sleep duration may increase obesity risk by causing small changes in eating patterns that cumulatively alter energy balance.

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Association of Urinary 6-Sulfatoxymelatonin (aMT6s) Levels and Objective and Subjective Sleep Measures in Older Men: The MrOS Sleep Study.

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BACKGROUND: Sleep and melatonin have been associated with healthy aging. In this study, we examine the association between melatonin levels and sleep among older men.

METHODS: Cross-sectional study of a community-dwelling cohort of 2,821 men aged 65 years or older recruited from six U.S. centers. First morning void urine samples were collected to measure melatonin's major urinary metabolite, 6-sulfatoxymelatonin (aMT6s). We also assessed objective and
subjective sleep parameters. We used logistic regression models to calculate multivariate (MV) odds ratios (ORs), and 95% confidence intervals (CIs) adjusted for important demographic variables and comorbidities.

RESULTS: In the overall sample, the only significant finding in fully adjusted models was that aMT6s levels were inversely associated with subjectively measured daytime sleepiness (sleepiness mean score of 5.79 in the top aMT6s quartile, and 6.26 in the bottom aMT6s quartile, MV OR, 1.32; 95% CI, 0.95–1.84; p trend ≤ .02). When restricting to men without β-blocker use (a known melatonin suppressant), aMT6s levels were significantly associated with shorter sleep time, that is, less than 5 hours (MV OR, = 1.90; 95% CI, 1.21–2.99; p trend = .01), and worse sleep efficiency, that is, less than 70% (MV OR, 1.58; 95% CI, 1.28–2.65; p trend < .001). aMT6s were not associated with subjective sleep quality or respiratory disturbance in any of our analyses.

CONCLUSION: Lower nocturnal melatonin levels were associated with worsened daytime sleepiness, sleep efficiency, and shorter sleep time in older men. The role of circadian interventions, and whether melatonin levels are a modifiable risk factor for poor sleep in older men, warrants further study.

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Association of workload of on-call medical interns with on-call sleep duration, shift duration, and participation in educational activities.

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CONTEXT: Further restrictions in resident duty hours are being considered, and it is important to understand the association between workload, sleep loss, shift duration, and the educational time of on-call medical interns. OBJECTIVE: To assess whether increased on-call intern workload, as measured by the number of new admissions on-call and the number of previously admitted patients remaining on the service, was associated with reductions in on-call sleep, increased total shift duration, and lower likelihood of participation in educational activities. DESIGN, SETTING, AND PARTICIPANTS: Prospective cohort study of medical interns at a single US academic medical center from July 1, 2003, through June 24, 2005. Of the 81 interns, 56 participated (69%), for a total of 165 general medicine inpatient months resulting in 1100 call nights. MAIN OUTCOME MEASURES: On-call sleep duration, estimated by wrist watch actigraphy; total shift duration, measured from paging logs; and participation in educational activities (didactic lectures or bedside teaching), measured by experience sampling method via a personal digital assistant. RESULTS: Mean (SD) sleep duration on-call was 2.8 (1.5) hours and mean (SD) shift duration was 29.9 (1.7) hours. Interns reported spending 11% of their time in educational activities. Early in the academic year (July to October), each new on-call admission was associated with less sleep (-10.5 minutes [95% confidence interval {CI}, -16.8 to -4.2 minutes]; P < .001) and a longer shift duration (13.2 minutes [95% CI, 3.2–23.3 minutes]; P = .01). A higher number of previously admitted patients remaining on the service was associated with a lower odds of
participation in educational activities (odds ratio, 0.82 [95% CI, 0.70–0.96]; P = .01]. Call nights during the week and early in the academic year were associated with the most sleep loss and longest shift durations. CONCLUSION: In this study population, increased on-call workload was associated with more sleep loss, longer shift duration, and a lower likelihood of participation in educational activities.

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Associations among late chronotype, body mass index and dietary behaviors in young adolescents.

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BACKGROUND/OBJECTIVES: Levels of pediatric obesity continue to rise. Previous evidence has linked short sleep duration and/or poor sleep quality to obesity development, although objective data are limited. As adolescents transition through puberty, circadian shifts occur, resulting in sleep loss. However, little is known whether chronotype is associated with body mass index (BMI) or dietary behaviors in adolescents. We hypothesized late chronotype would be positively associated with BMI and poorer dietary behaviors.

SUBJECTS/METHODS: A total of 511 UK young adolescents (11–13 years) from eight secondary schools across the Midlands region (UK) participated in the Midlands Adolescent Schools Sleep Education Study (MASSES), a cross-sectional study to assess potential relationships between chronotype and BMI z-score as well as
dietary habits. Height (cm) and weight (kg) were objectively measured for BMI calculation and participants completed a questionnaire to assess dietary habits. A subsample of 236 adolescents wore wrist actigraphy for 7 days to estimate average sleep duration (weekday, weekend and combined) and sleep efficiency.

RESULTS: Definitely evening chronotype was positively associated with BMI z-score compared to definitely morning chronotypes $\beta = 0.51$, $P < 0.01$, after adjustment. Higher frequency of consuming unhealthy snacks, night-time caffeine consumption and inadequate daily intake of fruit/vegetables were also associated with later chronotype (all $P \leq 0.01$). Actigraphy estimated sleep duration was an independent predictor of BMI z-score $\beta = -0.36$, $P < 0.001$. Sleep efficiency did not predict BMI z-score after adjustment, $\beta = -0.03$, $P = 0.07$.

CONCLUSIONS: Later chronotype young adolescents are at risk of increased BMI and poorer dietary behaviors. Although short sleep duration, but not sleep efficiency, was also an independent risk factor for increased BMI, different mechanisms may be driving the late chronotype and shorter sleep duration associations with BMI in this age group. Sleep hygiene education may help adolescents to better understand the impact of sleeping habits on physical health.

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Associations between children's intelligence and academic achievement: the role of sleep.

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Sleep problems (long wake episodes, low sleep efficiency) were examined as moderators of the relation between children's intelligence and academic achievement. The sample was comprised of 280 children (55% boys; 63% European Americans, 37% African Americans; mean age = 10.40 years, SD = 0.65). Sleep was assessed during seven consecutive nights of actigraphy. Children's performance on standardized tests of intelligence (Brief Intellectual Ability index of the Woodcock-Johnson III) and academic achievement (Alabama Reading and Math Test) were obtained. Age, sex, ethnicity, income-to-needs ratio, single parent status, standardized body mass index, chronic illness and pubertal development were controlled in analyses. Higher intelligence was strongly associated with higher academic achievement across a wide range of sleep quality. However, the association between intelligence and academic achievement was slightly attenuated among children with more long wake episodes or lower sleep efficiency compared with children with higher-quality sleep.

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Associations between circadian activity rhythms and functional brain abnormalities among euthymic bipolar patients: a preliminary study.
BACKGROUND: Working memory and underlying functional brain deficits have been observed in euthymic bipolar disorder (BD) patients, though there is heterogeneity in the degree of deficits. Sleep/circadian rhythm abnormalities are thought to be a core component of BD and may explain some of the heterogeneity in functional abnormalities. This preliminary study examined associations between sleep/circadian rhythm abnormalities and functional magnetic resonance imaging (fMRI) brain response on a working memory task among BD patients.

METHODS: Fourteen euthymic medicated BD patients wore an actigraph for 7 days before undergoing fMRI with a working memory task. Two matched healthy comparison (HC) groups were used (14 in each sample). One group completed the actigraphy portion and the other completed the fMRI portion of the study. Circadian activity rhythm and sleep variables were calculated and compared between BD and HC participants. Variables that significantly differed were used to examine the association between activity rhythms/sleep abnormalities and fMRI working memory brain response in anatomically defined regions.
RESULTS: Sleep efficiency and the rhythm robustness, mesor, and amplitude-to-width ratio were significantly abnormal in BD patients. Individual variability in all the sleep/circadian variables was significantly associated with the degree of abnormality of brain response in the dorsolateral prefrontal cortex and supramarginal gyri.

LIMITATIONS: Small sample size and multiple comparison groups limit the interpretability of these findings.

CONCLUSIONS: BD patients have abnormal activity rhythms and sleep efficiency, which are associated with abnormal working memory brain response. These preliminary findings support the notion that the sleep/circadian system is important in the functional brain deficits among BD patients.

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Associations between firefighters' physical activity across multiple shifts of wildfire suppression.


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The aim of this study was to examine the associations between firefighters' physical activity levels across consecutive wildfire suppression shifts and to determine whether sleep duration moderated these associations. Forty
volunteer firefighters (31 males, 9 females) wore an activity monitor to concurrently measure physical activity and sleep duration. Sedentary time and time spent in light- (LPA), moderate- (MPA), and vigorous-intensity physical activity (VPA) during each shift were determined using monitor-specific cut points. During any given shift, every additional 60 min spent in LPA was associated with 7.2 min more LPA and 27.6 min MPA the following shift. There were no other significant positive or negative associations. No significant moderating effect of total sleep time was observed. Firefighters are able to maintain and/or increase their physical activity intensity between consecutive shifts. Further research is needed to understand firefighters pacing and energy conservation strategies during emergency wildfire deployments. Practitioner Summary: To examine associations between firefighters' physical activity levels across consecutive shifts during a multi-day emergency wildfire and determine whether sleep duration moderated these associations. Firefighters are able to maintain and/or increase their physical activity intensity between consecutive shifts. No significant moderating effect of total sleep time was observed.

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Associations between Neighborhood Context, Physical Activity, and Sleep in Adolescents.

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OBJECTIVE: This study examined how neighborhood access to recreation facilities and physical activity are linked to multiple indices of adolescent sleep. Physical activity was also assessed as a mediator of the association between access to recreation facilities and sleep.

DESIGN: The study used a cross-sectional design and path modeling analysis techniques.

SETTING: Participants were recruited from small towns and semi-rural communities in Alabama.

PARTICIPANTS: Participants were 231 adolescents (55% female) with an average age of 16.75 years (SD = .81). Sixty-seven percent of the youth were European American and 33% were African American. The sample was socioeconomically diverse with more than a third of participants living at or below the poverty line and less than half from middle class families.

MEASUREMENTS: Adolescent neighborhood access to recreation facilities and physical activity were assessed via self-report. Sleep minutes, efficiency, and schedule were measured using actigraphy.

RESULTS: Access to recreation facilities was associated with more sleep minutes and later morning wake time, as well as a trend towards increased sleep efficiency. Access to recreation facilities was also linked to more physical activity, and physical activity was related to more sleep minutes, later wake time, and less wake time variability. Physical activity was a mediating and intervening link between access to recreation facilities and these sleep parameters.

CONCLUSIONS: Findings implicate physical activity as one mechanism linking neighborhood context to adolescent sleep. The results suggest that establishing more neighborhood opportunities for physical activity may have cascading effects on multiple aspects of adolescent physical health.

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Associations between nocturnal urinary 6-sulfatoxymelatonin, obstructive sleep apnea severity and glycemic control in type 2 diabetes.


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Reduced nocturnal secretion of melatonin, a pineal hormone under circadian control, and obstructive sleep apnea have been both identified as risk factors for the development of type 2 diabetes mellitus. Whether they interact to impact glycemic control in patients with existing type 2 diabetes is not known. Therefore, this study explores the relationships between obstructive sleep apnea, melatonin and glycemic control in type 2 diabetes. As diabetic retinopathy may affect melatonin secretion, we also explore the relationship between retinopathy, melatonin and glycemic control. Fifty-six non-shift workers with type 2 diabetes, who were not using beta-blockers, participated. Most recent hemoglobin A1c
(HbA1c) levels and the results of ophthalmologic examinations were obtained from medical records. Obstructive sleep apnea was diagnosed using an ambulatory device. Sleep duration and fragmentation were recorded by 7-day wrist actigraphy. The urinary 6-sulfatoxymelatonin/creatinine ratio, an indicator of nocturnal melatonin secretion, was measured in an overnight urine sample. Mediation analyses were applied to explore whether low nocturnal urinary 6-sulfatoxymelatonin/creatinine ratio could be a causal link between increasing obstructive sleep apnea severity [as measured by an Apnea Hypopnea Index (AHI)] and poorer glycemic control, and between the presence of retinopathy and glycemic control. AHI and HbA1c were log-scale (ln) transformed. Obstructive sleep apnea was found in 76.8%, and 25.5% had diabetic retinopathy. The median (interquartile range) of urinary 6-sulfatoxymelatonin/creatinine ratio was 12.3 (6.0, 20.1) ng/mg. Higher lnHbA1c significantly correlated with lower 6-sulfatoxymelatonin/creatinine ratio (p = 0.04) but was not directly associated with OSA severity. More severe obstructive sleep apnea (lnAHI, p = 0.01), longer diabetes duration (p = 0.02), retinopathy (p = 0.01) and insulin use (p = 0.03) correlated with lower urinary 6-sulfatoxymelatonin/creatinine ratio, while habitual sleep duration and fragmentation did not. A mediation analysis revealed that lnAHI negatively correlated with urinary 6-sulfatoxymelatonin/creatinine ratio (coefficient = -2.413, p = 0.03), and urinary 6-sulfatoxymelatonin/creatinine negatively associated with lnHbA1c (coefficient = -0.005, p = 0.02), after adjusting for covariates. Mediation analysis indicated that the effect of lnAHI on lnHbA1c was indirectly mediated by urinary 6-sulfatoxymelatonin/creatinine ratio (B = 0.013, 95% CI: 0.0006, 0.0505). In addition, having retinopathy was significantly associated with reduced nocturnal urinary 6-sulfatoxymelatonin/creatinine ratio, and an increase in HbA1c by 1.013% of its original value (B = -0.013, 95% CI: -0.038, -0.005). In conclusion, the
presence and severity of obstructive sleep apnea as well as the presence of diabetic retinopathy were associated with lower nocturnal melatonin secretion, with an indirect adverse effect on glycemic control. Intervention studies are needed to determine whether melatonin supplementation may be beneficial in type 2 diabetes patients with obstructive sleep apnea.

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Associations between number of consecutive night shifts and impairment of neurobehavioral performance during a subsequent simulated night shift.

Magee M, Sletten TL, Ferguson SA, Grunstein RR, Anderson C, Kennaway DJ, Lockley SW, Rajaratnam SM.

OBJECTIVE: This study aimed to investigate sleep and circadian phase in the relationships between neurobehavioral performance and the number of consecutive shifts worked.

METHODS: Thirty-four shift workers [20 men, mean age 31.8 (SD 10.9) years] worked 2-7 consecutive night shifts immediately prior to a laboratory-based, simulated night shift. For 7 days prior, participants worked their usual shift sequence, and sleep was assessed with logs and actigraphy. Participants completed a 10-minute auditory psychomotor vigilance task (PVT) at the start (~21:00 hours) and end (~07:00 hours) of the simulated night shift. Mean reaction times (RT), number of lapses and RT distribution was compared between those who worked 2-3 consecutive night shifts versus those who worked 4-7 shifts.

RESULTS: Following 4-7 shifts, night shift workers had significantly longer mean RT at the start and end of shift, compared to those who worked 2-3 shifts. The
slowest and fastest 10% RT were significantly slower at the start, but not end, 
of shift among participants who worked 4-7 nights. Those working 4-7 nights also 
demonstrated a broader RT distribution at the start and end of shift and had 
significantly slower RT based on cumulative distribution analysis (5 
th), 25 
(th), 50 (th), 75 (th)percentiles at the start of shift; 75th 
percentile at the 
end of shift. No group differences in sleep parameters were found for 
7 days and 
24 hours prior to the simulated night shift. 
CONCLUSION: A greater number of consecutive night shifts has a 
negative impact on 
neurobehavioral performance, likely due to cognitive slowing. 

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ahead of print]

Associations between Self-Reported Daily Affect Ratings and Sleep 
Duration during 
the First Two Weeks of Antidepressant Therapy.

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Background: In the context of a randomized controlled trial evaluating 
the 
efficacy of augmenting fluoxetine treatment in young adults with major 
depressive 
disorder (MDD) using a modified repeated partial sleep deprivation 
protocol 
contrasting 2 weeks of restricted time in bed (i.e., 6 h TIB) to no 
time in bed 
restriction (i.e., 8 h TIB) the study examines whether sleep duration and the
timing of repeated partial sleep deprivation predicts patient-reported affect ratings. Participants: Participants included 58 young adults with DSM-IV-diagnosed MDD. Methods: Daily ratings of affect and sleep were collected during the first 2 weeks of initiating fluoxetine treatment, yielding 630 person-days. Actigraphy monitoring was employed to assess compliance with time in bed condition. Results: Negative affect ratings and positivity ratios in the morning were more improved among participants assigned to the 6 h TIB condition compared to the 8 h TIB group. Participants whose bedtime was delayed by 2-h nightly demonstrated the most significant improvement in negative affect and positivity ratio during the first 2 weeks of fluoxetine therapy. Moreover, the trajectory of morning negative affect ratings in the first 2 weeks was predictive of remission after 4 weeks of fluoxetine therapy. Conclusions: These findings suggest that monitoring changes in daily affect may be a valuable marker of early treatment response in young adults with MDD.

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Associations between sleep disturbance, cognitive functioning and work disability in Bipolar Disorder.

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Bipolar Disorder (BD) is associated with impairment in a number of areas including poor work functioning, often despite the remission of mood symptoms. The present study aimed to examine the role of sleep disturbance and cognitive functioning in occupational impairment in BD. Twenty-four euthymic BD participants and 24 healthy control participants completed a week of prospective assessment of sleep disruption via self-report and actigraphy, a battery of neuropsychological tests of executive functioning, working memory, and verbal learning, and assessments of work functioning. BD participants experienced significantly poorer cognitive functioning as well as greater months of unemployment and greater incidence of being fired than controls. Moderation analyses revealed that both poor sleep and cognitive functioning were associated with poor work performance in BD participants, but not control participants. Sleep and cognitive functioning may be impaired in euthymic BD and are associated with poor work functioning in this population. More research should be conducted to better understand how sleep and cognitive functioning may interact in BD.

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Associations of executive function with sleepiness and sleep duration in adolescents.
BACKGROUND: Sleep deprivation and sleepiness are associated with poorer school performance, impaired neurobehavioral functioning, and behavioral problems. OBJECTIVE: To determine if adolescents with high levels of sleepiness or short sleep duration have impaired executive functioning. METHODS: Ours was a cross-sectional analysis of data from 236 healthy adolescents in a community-based cohort study. Sleepiness was measured by using a modified version of the Epworth Sleepiness Scale. Participants underwent 5- to 7-day wrist actigraphy at home before overnight polysomnography. Exposure variables were excessive sleepiness (Epworth Sleepiness Scale ≥ 11) and weekday mean sleep duration. The main outcome measures were the global executive composite scale from the Behavior Rating Inventory of Executive Function and the tower test-total achievement score from the Delis-Kaplan Executive Functioning System. RESULTS: Participants (N = 236) were 13.7 +/- 0.8 years of age, and 52.1% were boys. Mean weekday sleep duration was 7.70 +/- 1.03 hours; 11% slept <6.5 hours on average on weekdays, and 26% reported excessive sleepiness. In unadjusted analyses, sleepy adolescents had poorer executive functioning on the Behavior Rating Inventory of Executive Function global executive composite scale and the Delis-Kaplan Executive Functioning System tower test-total achievement. Analyses adjusted for potential confounders resulted in a modest attenuation of the association with the Behavior Rating Inventory of Executive Function and a larger attenuation for the Delis-Kaplan Executive Functioning System. Caregiver education modified the association between sleepiness and the Behavior Rating Inventory of Executive Function outcomes. Among sleepy adolescents,
those with less-educated caregivers had greater impairment on the Behavior Rating Inventory of Executive Function global executive composite scale. Sleep duration was not significantly associated with executive functioning outcomes. CONCLUSIONS: Decrements in selected executive function scales are associated with subjective sleepiness, but not sleep duration, in adolescents. The association between sleepiness and executive functioning is strongest among adolescents with primary caregivers who have lower levels of education, suggesting an increased susceptibility.Pediatricians and public health officials should consider sleepiness as a potentially important contributor to adolescent functioning.

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Associations of objective and subjective sleep disturbance with cognitive function in older men with comorbid depression and insomnia.

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OBJECTIVES: To examine whether poor objective and subjective sleep quality are differentially associated with cognitive function.

DESIGN: Cross-sectional.

SETTING: Participants were recruited from primary and secondary care, and directly from the community, in Sydney, Australia.

PARTICIPANTS: The sample consisted of 74 men 50 years and older (mean [SD], 58.4 [6.2] years), with comorbid depression and above-threshold insomnia symptoms, participating in a trial of online cognitive behavioral therapy for insomnia.

MEASUREMENTS: Insomnia severity and depression severity were assessed via self-report. Objective sleep efficiency and duration were measured using actigraphy. Objective cognitive function was measured using 3 subtests of a computerized neuropsychological battery.

RESULTS: Poor objective sleep efficiency was associated with slower reaction time ($r=-0.249$, $P=.033$) and poorer executive functioning (odds ratio, 4.14; 95% confidence interval, 1.35–12.69), but not memory. These associations remained after adjusting for age, education, depression severity, cardiovascular risk, and medication. Subjective sleep quality was not related to cognitive function.

CONCLUSIONS: Among older men with depression and insomnia, objectively measured poor sleep efficiency may be associated with worse cognitive function, independent of depression severity. Objective poor sleep may be underpinned by neurobiological correlates distinct from those underlying subjective poor sleep and depression, and represent a potentially effective modifiable mechanism in interventions to improve cognitive functioning in this population. This supports the use of objective measures of sleep in diagnostic assessments and care.

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Associations of objectively measured and self-reported sleep duration with carotid artery intima media thickness among police officers.

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BACKGROUND: We aimed to examine the association of objectively measured and self-reported sleep duration with carotid artery intima media thickness (IMT) among 257 police officers, a group at high risk for cardiovascular disease (CVD).

METHODS: Sleep duration was estimated using actigraphic data and through self-reports. The mean maximum IMT was the average of the largest 12 values scanned bilaterally from three angles of the near and far wall of the common carotid, bulb, and internal carotid artery. Linear and quadratic regression models were used to assess the association of sleep duration with IMT.

RESULTS: Officers who had fewer than 5 or 8 hr or more of objectively measured sleep duration had significantly higher maximum IMT values, independent of age. Self-reported sleep duration was not associated with either IMT measure.

CONCLUSION: Attainment of sufficient sleep duration may be considered as a possible strategy for atherosclerosis prevention among police
Associations of self-reported and objectively measured sleep disturbances with depression among primary caregivers of children with disabilities.

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OBJECTIVE: The objective of this study was to determine the association between sleep and depression using both self-reported (subjective) and actigraphic (objective) sleep traits.

METHODS: A cross-sectional study was conducted among 175 female primary caregivers of children with disabilities receiving care at a rehabilitation center in Punta Arenas, Chile. The eight-item Patient Health Questionnaire was used to ascertain participants' depression status. The Pittsburgh Sleep Quality Index was used to define subjective, or perceived, sleep quality. Wrist-worn actigraph monitors, worn for seven consecutive nights, were used to characterize objective sleep quality and disturbances. Interviewer-administered questionnaires were used to collect information on sociodemographic and lifestyle factors. Linear regression models were fit using continuous sleep parameters as the dependent variables and depression status as the independent variable.
Multivariable models were adjusted for body mass index, marital status, smoking status, education level, and children's disabilities.

RESULTS: Using an eight-item Patient Health Questionnaire score ≥10, 26.3% of participants presented with depression. Depressed women were more likely to self-report overall poorer (subjective) sleep compared to non-depressed women; however, differences in sleep were not consistently noted using actigraphic (objective) sleep traits. Among the depressed, both sleep duration and total time in bed were significantly underestimated. In multivariable models, depression was negatively associated with sleep duration using both subjective (β=-0.71, standard error [SE] =0.25; P=0.006) and objective sleep (β=-0.42, SE =0.19; P=0.026).

CONCLUSION: The association between sleep and depression differed comparing subjective and objective methods of assessment. Research strategies allowing for the integration of both perceived and objective measures of sleep traits are encouraged.

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Associations of the 24-h activity rhythm and sleep with cognition: a population-based study of middle-aged and elderly persons.


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BACKGROUND: Cognitive functioning changes with age, sleep, and the circadian rhythm. We investigated whether these factors are independently associated with different cognitive domains assessed in middle-aged and elderly persons.

METHODS: In 1723 middle-aged and elderly persons (age 62 ± 9.4 years, mean ± standard deviation, SD) of the Rotterdam Study, we collected actigraphy recordings of on average 138 h. Actigraphy was used to quantify 24-h rhythms by calculating the stability of the rhythm over days and the fragmentation of the rhythm. Sleep parameters including total sleep time, sleep-onset latency, and wake after sleep onset were also estimated from actigraphy. Cognitive functioning was assessed with the word learning test (WLT), word fluency test (WFT), letter digit substitution task (LDST), and Stroop color word test (Stroop).

RESULTS: Persons with less stable 24-h rhythms performed worse on the LDST \( (B = -0.42 \text{ per SD increase, } p = 0.004) \) and the Stroop interference trial \( (B = -1.04 \text{ per SD increase, } p = 0.003) \) after full adjustment. Similarly, persons
with more fragmented rhythms performed worse on the LDST (B = -0.47 per SD increase, p = 0.002) and the Stroop (B = 1.47 per SD increase, p <0.001). By contrast, longer observed sleep-onset latencies were related to worse performance on the WLT delayed recall (B = -0.19 per SD increase, p = 0.027) and the WFT (B = -0.45 per SD increase, p = 0.007).

CONCLUSIONS: Disturbances of sleep and the 24-h activity rhythm were independently related to cognition; while persons with longer sleep-onset latencies had worse performance on memory and verbal tasks, persons with 24-h rhythm disturbances performed less on executive functioning and perceptual speed tasks.

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At-sea trial of 24-h-based submarine watchstanding schedules with high and low correlated color temperature light sources.

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United States Navy submariners have historically lived with circadian disruption while at sea due to 18-h-based watcheschedules. Previous research demonstrated that circadian entrainment improved with 24-h-based watcheschedules. Twenty-nine
male crew members participated in the study, which took place on an actual submarine patrol. The crew were exposed, first, to experimental high correlated color temperature (CCT = 13,500 K) fluorescent light sources and then to standard-issue fluorescent light sources (CCT = 4100 K). A variety of outcome measures were employed to determine if higher levels of circadian-effective light during on-watch times would further promote behavioral alignment to 24-h-based watchschedules. The high CCT light source produced significantly higher circadian light exposures than the low CCT light source, which was associated with significantly greater 24-h behavioral alignment with work schedules using phasor analysis, greater levels of sleep efficiency measured with wrist actigraphy, lower levels of subjective sleepiness measured with the Karolinska Sleepiness Scale, and higher nighttime melatonin concentrations measured by morning urinary 6-sulfatoxymelatonin/creatinine ratios. Unlike these diverse outcome measures, performance scores were significantly worse under the high CCT light source than under the low CCT light source, due to practice effects. As hypothesized, with the exception of the performance scores, all of the data converge to suggest that high CCT light sources, combined with 24-h watchschedules, promote better behavioral alignment with work schedules and greater sleep quality on submarines. Since the order and the type of light sources were confounded in this field study, the results should only be considered as consistent with our theoretical understanding of how regular, 24-h light-dark exposures combined with high circadian light exposures can promote greater behavioral alignment with work schedules and with sleep.

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Athletes' rest-activity circadian rhythm differs in accordance with the sport discipline.

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The correct expression of circadian rhythmicity is crucial for the body homeostasis. The rest-activity circadian rhythms (RARs) are involved in the control of the sleep-wake cycle and altered RARs could lead to a compromised health status. Many studies focused on examining sleep behavior and circadian rhythms in physically active subjects or athletes but, unexpectedly, no data on RARs are available. Therefore, we studied the existence of the RAR in athletes and the possible difference in RAR's characteristics among sport disciplines. The study had a prospective observational design and RARs were recorded for five consecutive training days through actigraphy (Actiwatch 2 actigraph; Philips Respironics, OR, USA) in 43 athletes (mean age: 25.6 ± 3.2 years). Athletes competed in three different disciplines and had different training schedules and competition levels: professional triathletes (N = 10; 6 females and 4 males) had 2 morning (08:30-12:00) and 1 afternoon (15:00-17:00) training sessions, professional volleyball players (N = 19; 12 females and 7 males) used to train once in the morning (09:00-11:30) and once in the afternoon (15:00-18:00), and non-professional soccer players (N = 14; all males) trained always
late in the evening (20:30-22:30). To determine the existence of RARs, the activity counts (A.C.) data were analyzed using the single and the population mean cosinor method; a one-way analysis of variance (ANOVA) followed by the Tukey-Kramer post-hoc test was used for the comparison of RAR characteristics among soccer, volleyball and triathlon athletes. Partial eta squared ($\eta^2$) was used to determine the magnitude of the effect for significant outcomes ($\alpha = 0.05$) in ANOVA. The presence of a significant RAR both for each of the 43 athletes ($p < 0.001$) and for the three categories of athletes ($p < 0.001$) was observed. RARs differed among sport disciplines: the Midline Estimating Statistic of Rhythm (MESOR) was significantly higher in triathletes (mean: 347 A.C. with 95% Confidence Interval [CI]: 314-379) compared to both volleyball (mean: 188 A.C. with 95% CI: 173-203; $p < 0.001$) and soccer players (mean: 289 A.C. with 95% CI: 267-312; $p < 0.01$) with $\eta^2 = 0.72$. Amplitude (A) values showed the same significant trend of MESOR data (ANOVA: $p < 0.001$; $\eta^2 = 0.65$) while the acrophase ($\Phi$) occurred at 18:28 for soccer players, significantly later than triathlon (15:20 h; $p < 0.001$) and volleyball players (16:24 h; $p < 0.001$) (ANOVA: $p < 0.001$; $\eta^2 = 0.84$). The higher training duration and intensity reached by triathlon athletes in the morning sessions caused a phase advance of their RAR's acrophase $\Phi$ and higher MESOR and A amplitude compared to volleyball players and triathletes. Therefore, different sport disciplines require different training schedules, training loads and intensities that translate into different RARs. Strength coaches and medical staff of professional teams should strongly consider actigraphy as a practical and powerful tool to monitor RARs, sleep behavior, and the activity levels of their athletes; highlighting potential circadian disruptions through actigraphy could be helpful to prevent
Attention bias for sleep-related stimuli in primary insomnia and delayed sleep phase syndrome using the dot-probe task.

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STUDY OBJECTIVES: Cognitive models of primary insomnia (PI) suggest attention bias as a maintaining process. This study used a hallmark measure of attention bias, the dot-probe task, to determine whether attention bias to sleep-related stimuli is present in individuals with PI. Control groups of good sleepers (GS) and individuals with delayed sleep phase syndrome (DSPS), a sleep disorder with no presumed cognitive pathway and, hence, no predicted association with attention bias, were included.

DESIGN: A between-groups (PI, DSPS, GS) design was employed. Participants completed a dot-probe task with stimuli comprising sleep-related and neutral words, balanced for length and frequency of usage. It was predicted a priori that PI would show greater attention bias to sleep stimuli compared with GS and DSPS groups. No difference between GS and DSPS was predicted.

PARTICIPANTS: Sixty-three individuals completed the study (PI = 21; DSPS = 22; GS = 20), with those in PI and DSPS classified by International Classification of Sleep Disorders criteria according to self-report sleep diaries and actigraphy. GS scored < 5 on the Pittsburgh Sleep Quality Index, reported being sleep-related stimuli.
good sleepers, and met no criteria for a current or previous sleep disorder.

INTERVENTIONS: N/A.

MEASUREMENTS AND RESULTS: As predicted, PI showed increased vigilance for sleep-related stimuli relative to GS and DSPS. No differences between GS and those with DSPS were found. The PI group showed shorter response latencies relative to the GS and DSPS groups.

CONCLUSIONS: Results support an association between attention bias and PI. Further work must determine whether or not attention bias is a causal factor. Speeded responses in the PI group suggest heightened arousal, indicating that physiologic factors may play a related role.

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Attenuation of short wavelengths alters sleep and the ipRGC pupil response.

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PURPOSE: Exposure to increasing amounts of artificial light during the night may contribute to the high prevalence of reported sleep dysfunction. Release of the sleep hormone melatonin is mediated by the intrinsically photosensitive retinal ganglion cells (ipRGCs). This study sought to investigate whether melatonin level and sleep quality can be modulated by decreasing night-time input to the ipRGCs.

METHODS: Subjects (ages 17–42, n = 21) wore short wavelength-blocking glasses prior to bedtime for 2 weeks. The ipRGC-mediated post illumination pupil response was measured before and after the experimental period. Stimulation was presented
with a ganzfeld stimulator, including one-second and five-seconds of long and short wavelength light, and the pupil was imaged with an infrared camera. Pupil diameter was measured before, during and for 60 s following stimulation, and the six-second and 30 s post illumination pupil response and area under the curve following light offset were determined. Subjects wore an actigraph device for objective measurements of activity, light exposure, and sleep. Saliva samples were collected to assess melatonin content. The Pittsburgh Sleep Quality Index (PSQI) was administered to assess subjective sleep quality.

RESULTS: Subjects wore the blue-blocking glasses 3:57 ± 1:03 h each night. After the experimental period, the pupil showed a slower redilation phase, resulting in a significantly increased 30 s post illumination pupil response to one-second short wavelength light, and decreased area under the curve for one and five-second short wavelength light, when measured at the same time of day as baseline. Night time melatonin increased from 16.1 ± 7.5 pg mL⁻¹ to 25.5 ± 10.7 pg mL⁻¹ (P < 0.01). Objectively measured sleep duration increased 24 min, from 408.7 ± 44.9 to 431.5 ± 42.9 min (P < 0.001). Mean PSQI score improved from 5.6 ± 2.9 to 3.0 ± 2.2.

CONCLUSIONS: The use of short wavelength-blocking glasses at night increased subjectively measured sleep quality and objectively measured melatonin levels and sleep duration, presumably as a result of decreased night-time stimulation of ipRGCs. Alterations in the ipRGC-driven pupil response suggest a shift in circadian phase. Results suggest that minimising short wavelength light following sunset may help in regulating sleep patterns.

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Atypical sexual behavior during sleep.

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OBJECTIVE: This article reports a case series of atypical sexual behavior during sleep, which is often harmful to patients or bed partners.

METHODS: Eleven subjects underwent clinical evaluation of complaints of sleep-related atypical sexual behavior. Complaints included violent masturbation, sexual assaults, and continuous (and loud) sexual vocalizations during sleep. One case was a medical-legal case. Sleep logs, clinical evaluations, sleep questionnaires, structured psychiatric interviews, polysomnography, actigraphy, home electroencephalographic monitoring during sleep, and clinical electroencephalographic monitoring while awake and asleep were used to determine clinical diagnoses.

RESULTS: Atypical sexual behaviors during sleep were associated with feelings of guilt, shame, and depression. Because of these feelings, patients and bed partners often tolerated the abnormal behavior for long periods of time without seeking medical attention. The following pathologic sleep disorders were demonstrated on polysomnography: partial complex seizures, sleep-disordered breathing, stage 3 to 4 non-rapid eye movement (REM) sleep parasomnias, and REM sleep behavior disorder. These findings were concurrent with morning amnesia.

CONCLUSIONS: The atypical behaviors were related to different syndromes despite the similarity of complaints from bed partners. In most cases the disturbing and often harmful symptoms were controlled when counseling was instituted and sleep disorders were treated. In some cases treatment of seizures or psychiatric disorders was also needed. Clonazepam with simultaneous psychotherapy
was the
most common successful treatment combination. The addition of
antidepressant or
antiepileptic medications was required in specific cases.

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Automatic annotation of actigraphy data for sleep disorders diagnosis
purposes.

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The diagnosis of Sleep disorders, highly prevalent in the western
countries,
typically involves sophisticated procedures and equipments that are
intrusive to
the patient. Wrist actigraphy, on the contrary, is a non-invasive and
low cost
solution to gather data which can provide valuable information in the
diagnosis
of these disorders. The acquired data may be used to infer the Sleep/
Wakefulness
(SW) state of the patient during the circadian cycle and detect
abnormal
behavioral patterns associated with these disorders. In this paper a
classifier
based on Autoregressive (AR) model coefficients, among other features,
is
proposed to estimate the SW state. The real data, acquired from 23
healthy
subjects during fourteen days each, was segmented by expert medical
personal with
the help of complementary information such as light intensity and
Sleep e-Diary
information. Monte Carlo tests with a Leave-One-Out Cross Validation
(LOOCV)
strategy were used to assess the performance of the classifier which
achieves an
accuracy of 96%.
Automatic sleep staging using heart rate variability, body movements, and recurrent neural networks in a sleep disordered population.


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STUDY OBJECTIVES: To validate a previously developed sleep staging algorithm using heart rate variability (HRV) and body movements in an independent broad cohort of unselected sleep disordered patients.

METHODS: We applied a previously designed algorithm for automatic sleep staging using long short-term memory recurrent neural networks to model sleep architecture. The classifier uses 132 HRV features computed from electrocardiography and activity counts from accelerometry. We retrained our algorithm using two public datasets containing both healthy sleepers and sleep disordered patients. We then tested the performance of the algorithm on an independent hold-out validation set of sleep recordings from a wide range of sleep disorders collected in a tertiary sleep medicine center.

RESULTS: The classifier achieved substantial agreement on four-class sleep staging (wake/N1–N2/N3/rapid eye movement [REM]), with an average $\kappa$ of 0.60 and accuracy of 75.9%. The performance of the sleep staging algorithm was significantly higher in insomnia patients ($\kappa = 0.62$, accuracy =
77.3%). Only in REM parasomnias, the performance was significantly lower (κ = 0.47, accuracy = 70.5%). For two-class wake/sleep classification, the classifier achieved a κ of 0.65, with a sensitivity (to wake) of 72.9% and specificity of 94.0%.

CONCLUSIONS: This study shows that the combination of HRV, body movements, and a state-of-the-art deep neural network can reach substantial agreement in automatic sleep staging compared with polysomnography, even in patients suffering from a multitude of sleep disorders. The physiological signals required can be obtained in various ways, including non-obtrusive wrist-worn sensors, opening up new avenues for clinical diagnostics.

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Autonomic activation during sleep in posttraumatic stress disorder and panic: a mattress actigraphic study.


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BACKGROUND: While it has been reported that persons with posttraumatic stress disorder (PTSD) manifest tonic autonomic activation, the literature contains numerous counterexamples. In revisiting the question, this study
employed a novel method of mattress actigraphy to unobtrusively estimate heart rate and respiratory sinus arrhythmia over multiple nights of sleep in the home.

METHODS: Sleep cardiac autonomic status was estimated in four diagnostic groups, posttraumatic stress disorder, panic disorder, persons comorbid for both conditions, and control subjects. All 59 participants were community-residing nonveterans screened for sleep apnea and periodic leg movement disorder with polysomnography. Heart rate and respiratory sinus arrhythmia were calculated from the kinetocardiogram signal measured via accelerometers embedded in a mattress topper. Times in bed and asleep were also estimated. Per participant data were obtained from a median of 12 nights.

RESULTS: Both posttraumatic stress disorder and posttraumatic stress disorder/panic disorder comorbid groups exhibited significantly higher heart rates and lower respiratory sinus arrhythmia magnitudes than panic disorder participants and control subjects. Panic disorder participants were indistinguishable from control subjects. The PTSD-only group exhibited longer times in bed and longer times presumably asleep than the other three groups.

CONCLUSIONS: In this study, posttraumatic stress disorder, but not panic disorder, was associated with altered cardiac autonomic status during sleep. Among participants meeting criteria for PTSD alone, autonomic activation co-occurred with prolongation of actigraphic sleep.

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Bedtime and evening light exposure influence circadian timing in preschool-age children: A field study.

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Light exposure and sleep timing are two factors that influence inter-individual variability in the timing of the human circadian clock. The aim of this study was to quantify the degree to which evening light exposure predicts variance in circadian timing over and above bedtime alone in preschool children. Participants were 21 children ages 4.5-5.0 years (4.7 ± 0.2 years; 9 females). Children followed their typical sleep schedules for 4 days during which time they wore a wrist actigraph to assess sleep timing and a pendant light meter to measure minute-by-minute illuminance levels in lux. On the 5th day, children participated in an in-home dim-light melatonin onset (DLMO) assessment. Light exposure in the 2 h before bedtime was averaged and aggregated across the 4 nights preceding the DLMO assessment. Mean DLMO and bedtime were 19:22 ± 01:04 and 20:07 ± 00:46, respectively. Average evening light exposure was 710.1 ± 1418.2 lux. Children with later bedtimes (lights-off time) had more delayed melatonin onset times ($r=0.61$, $p=0.002$). Evening light exposure was not independently associated with DLMO ($r=0.32$, $p=0.08$); however, a partial correlation between evening light exposure and DLMO when controlling for bedtime yielded a positive correlation ($r=0.46$, $p=0.02$). Bedtime explained 37.3% of the variance in the timing of DLMO, and evening light exposure accounted for an additional 13.3% of the variance. These findings represent an important step in understanding factors that influence circadian phase in preschool-age children and have implications for understanding a modifiable pathway that may underlie late sleep timing.
and the development of evening settling problems in early childhood.

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A behavioral-educational intervention to promote maternal and infant sleep: a pilot randomized, controlled trial.

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STUDY OBJECTIVES: Maternal and infant sleep are significant health concerns for postpartum families. The results of previously published studies have indicated that behavioral-educational strategies promote infant sleep, but these reports relied on parental report and did not include maternal sleep. This pilot study of a maternal-infant sleep intervention evaluated feasibility, acceptability, and effects on sleep and other outcomes in the early postpartum period. DESIGN: Randomized controlled trial with concealed-group allocation. SETTING: Hospital postpartum unit with home follow-up. PARTICIPANTS: First-time mothers and their infants randomly assigned to sleep intervention (n = 15) or control group (n = 15). INTERVENTIONS: The sleep intervention included a 45-minute meeting with a nurse to discuss sleep information and strategies, an 11-page booklet, and
weekly phone contact to reinforce information and problem solve. The control group received a 10-minute meeting during which only maternal sleep hygiene and basic information about infant sleep were discussed, a 1-page pamphlet, and calls at weeks 3 and 5 to maintain contact without provision of advice.

MEASUREMENT AND RESULTS: Questionnaires were completed at baseline and 6 weeks; sleep diaries and mother and infant actigraphy were completed at 6 weeks. The mothers in the sleep intervention group averaged 57 minutes more nighttime sleep, and fewer rated their sleep as a problem, as compared with the mothers in the control group. Infants in the sleep intervention group had fewer nighttime awakenings and had maximum lengths of nighttime sleep that were, on average, 46 minutes longer than those in the control group.

CONCLUSIONS: A behavioral-educational intervention with first-time mothers in the early postpartum period promotes maternal and infant sleep. Further evaluation of the intervention in a larger, more diverse sample is needed.

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A Behavioral-Educational Intervention to Promote Pediatric Sleep During Hospitalization: A Pilot Randomized Controlled Trial.

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OBJECTIVE/BACKGROUND: Hospitalization can contribute to common sleep difficulties in children. Interventions aimed at hospitalized children need to be developed and piloted with rigorous evaluative methods. The primary purpose of this study was to examine the feasibility and acceptability of a behavioral-educational intervention aimed at increasing nighttime sleep for hospitalized children.

PARTICIPANTS: Hospitalized children aged 4–10 years and their caregivers.

METHODS: A pilot randomized, controlled trial with concealed-group allocation was conducted. Forty-eight hospitalized children (ages 4–10) and their caregivers were randomized to either the Relax to Sleep (RTS) intervention group (n = 24) or the Usual Care (UC) comparison group (n = 24). The RTS intervention was comprised of a one-on-one educational session for the parent that was guided by a standardized booklet containing information on sleep and instructions for training the child in the use of a diaphragmatic breathing exercise. UC participants received no information about sleep or relaxation. Children wore actigraphs for 3 days and nights and completed sleep diaries. Outcome measures included feasibility, acceptability, and sleep outcomes.

RESULTS: Parental reports indicated they enjoyed the discussion on sleep, found the information helpful, and their child found diaphragmatic breathing easy to use, and would use it again in the future. Children in the RTS group averaged 50 minutes more nighttime sleep, and had less wake after sleep onset time compared to children in the UC group.

CONCLUSION: Sleep is critically important to children's health and well-being and should be given important consideration during hospitalization. Although the results of this pilot trial seem promising, more interventional studies are needed.
Behavioral-educational sleep interventions for pediatric epilepsy: a randomized controlled trial.

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STUDY OBJECTIVES: To evaluate the effect of a clinic-based, behavioral-educational sleep intervention on sleep of children with epilepsy, maternal knowledge about childhood sleep, and maternal sleep quality. METHODS: A total of 100 toddlers and preschool-age children with epilepsy (1.5–6 years, 55% boys) and their parents were randomized to receive sleep intervention (n = 50) or usual care with attention (n = 50). Outcomes were assessed at baseline, 3, 6, and 12 months after intervention with the use of objective actigraphy, Children's Sleep Habits Questionnaire, Parents' Sleep Knowledge Inventory, and Pittsburgh Sleep Quality Index. Intervention effects were examined using general linear models for repeated measurements to compare the mean change in outcomes from baseline to 12 months post-intervention between the two groups. RESULTS: Sleep intervention resulted in children having greater sleep efficiency by 2.03% compared with the usual care group (95% CI = 0.20% to 3.86%;
Children in the intervention group also had significantly longer total nighttime sleep as objectively assessed by actigraphy than did those in the usual care group, with an adjusted mean difference of 16.13 minutes (95% CI = 0.24% to 32.03%; \( p = .04 \)). No intervention effects were observed for maternal knowledge about childhood sleep, and maternal sleep quality.

**CONCLUSION:** Sleep intervention provided during routine neurologic visits results in significant, measurable, and sustained benefits in sleep quality and quantity in children with epilepsy. Future trials are warranted to evaluate whether improvements in sleep could impact health-related quality of life or other aspects of functioning in children with epilepsy.

**CLINICAL TRIAL:** This trial has been registered at [www.clinicaltrials.gov](http://www.clinicaltrials.gov) (trial name: Sleep Intervention for Pediatric Epilepsy; registration number: NCT02514291).

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Behavioral Interventions for Infant Sleep Problems: A Randomized Controlled Trial.


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OBJECTIVES: To evaluate the effects of behavioral interventions on the sleep/wakefulness of infants, parent and infant stress, and later child emotional/behavioral problems, and parent-child attachment.

METHODS: A total of 43 infants (6-16 months, 63% girls) were randomized to receive either graduated extinction (n = 14), bedtime fading (n = 15), or sleep education control (n = 14). Sleep measures included parent-reported sleep diaries and infant actigraphy. Infant stress was measured via morning and afternoon salivary cortisol sampling, and mothers' self-reported mood and stress. Twelve months after intervention, mothers completed assessments of children's emotional and behavioral problems, and mother-child dyads underwent the strange situation procedure to evaluate parent-child attachment.

RESULTS: Significant interactions were found for sleep latency (P < .05), number of awakenings (P < .0001), and wake after sleep onset (P = .01), with large decreases in sleep latency for graduated extinction and bedtime fading groups, and large decreases in number of awakenings and wake after sleep onset for the graduated extinction group. Salivary cortisol showed small-to-moderate declines in graduated extinction and bedtime fading groups compared with controls. Mothers' stress showed small-to-moderate decreases for the graduated extinction and bedtime fading conditions over the first month, yet no differences in mood were detected. At the 12-month follow-up, no significant differences were found in emotional and behavioral problems, and no significant differences in secure-insecure attachment styles between groups.
CONCLUSIONS: Both graduated extinction and bedtime fading provide significant sleep benefits above control, yet convey no adverse stress responses or long-term effects on parent-child attachment or child emotions and behavior.

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Behavioral Interventions for Sleep Disturbances in Children with Neurological and Neurodevelopmental Disorders: A Systematic Review and Meta-analysis of Randomized Controlled Trials.


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STUDY OBJECTIVES: Sleep disturbances are common and associated with negative functional and health consequences in children with neurological and neurodevelopmental disorders (NNDDs), and represent an important potential target for behavioral interventions. This systematic review examined the efficacy of
behavioral sleep interventions (BSIs) for children with NNDDs and comorbid sleep disturbances.

METHODS: A systematic search of MEDLINE, EMBASE, PsychINFO, and CENTRAL was conducted in April 2019. Randomized controlled trials (RCTs) of BSI for children with NNDDS were included. Meta-analysis and GRADE quality ratings were performed on sleep and secondary functional outcomes (cognition, academics, behavior).

RESULTS: Nine RCTs were identified (n=690; Mage=8.39±2.64 years; 71.11% male). Largely moderate level evidence for post-treatment improvements in sleep were found on (i) subjectively reported sleep disturbances (total sleep disturbance [SMD=0.89], night wakings [SMD=0.52], bedtime resistance [SMD=0.53], parasomnias [SMD=0.34], sleep anxiety [SMD=0.50]), subjectively reported sleep patterns (sleep duration [SMD=0.30], sleep onset duration [SMD=0.75]) and (ii) objectively measured actigraphic sleep patterns (total sleep time [MD=18.09 mins; SMD=0.32], sleep onset latency [MD=11.96 mins; SMD=0.41]). Improvements in sleep (subjective, not actigraphy) were maintained at follow-up, but few studies conducted follow-up assessments resulting in low quality evidence. Reduction in total behavioral problems (SMD=0.48) post-treatment, and attention/hyperactivity (SMD=0.28) at follow-up were found. Changes in cognition and academic skills were not examined in any studies.

CONCLUSIONS: BSIs improve sleep, at least in the short-term, in children with NNDDs. Benefits may extend to functional improvements in behavior. More rigorous RCTs involving placebo-controls, blinded outcome assessment, longer follow-up durations, and assessment of functional outcomes are required.

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Behavioral parent training to address sleep disturbances in young children with autism spectrum disorder: a pilot trial.


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OBJECTIVES: A large percentage of children with autism spectrum disorders (ASD) have bedtime and sleep disturbances. However, the treatment of these disturbances has been understudied. The purpose of our study was to develop a manualized behavioral parent training (BPT) program for parents of young children with ASD and sleep disturbances and to test the feasibility, fidelity, and initial efficacy of the treatment in a small randomized controlled trial (RCT).

PARTICIPANTS AND METHODS: Parents of a sample of 40 young children diagnosed with ASD with an average age of 3.5 years were enrolled in our study. Participants were randomized to either the BPT program group or a comparison group who were given nonsleep-related parent education. Each participant was individually administered a 5-session program delivered over the 8-week study. Outcome measures of feasibility, fidelity, and efficacy were collected at weeks 4 and 8 after the baseline time point. Children's sleep was assessed by parent report and objectively by actigraphy.

RESULTS: Of the 20 participants in each group, data were available for 15 participants randomized to BPT and 18 participants randomized to the comparison group.
condition. Results supported the feasibility of the manualized parent training program and the comparison program. Treatment fidelity was high for both groups. The BPT program group significantly improved more than the comparison group based on the primary sleep outcome of parent report. There were no objective changes in sleep detected by actigraphy.

CONCLUSIONS: Our study is one of few RCTs of a BPT program to specifically target sleep disturbances in a well-characterized sample of young children with ASD and to demonstrate the feasibility of the approach. Initial efficacy favored the BPT program over the comparison group and suggested that this manualized parent training approach is worthy of further examination of the efficacy within a larger RCT.

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Behavioral reactivity to acute stress among Black and White women with type 2 diabetes: The roles of income and racial discrimination.


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This study investigated relationships of income and self-reported racial discrimination to diabetes health behaviors following an acute stressor. A total of 77 diabetic women (51% Black, 49% White) completed a laboratory
public speaking stressor. That evening, participants reported same-day eating, alcohol consumption, and medication adherence; physical activity was measured with actigraphy, and the next morning participants reported sleep quality. Measures were repeated on a counterbalanced control day. There was no mean level difference in health behaviors between stressor and control days. On stressor day, lower income predicted lower physical activity, sleep quality, and medication adherence, and higher racial discrimination predicted more eating and alcohol consumed, even after accounting confounders including race and control day behaviors.

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Better quality sleep promotes daytime physical activity in patients with chronic pain? A multilevel analysis of the within-person relationship.

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BACKGROUND: Promoting physical activity is key to the management of chronic pain, but little is understood about the factors facilitating an individual's engagement in physical activity on a day-to-day basis. This study examined the within-person effect of sleep on next day physical activity in patients with chronic pain and insomnia.

METHODS: 119 chronic pain patients monitored their sleep and physical activity
for a week in their usual sleeping and living environment. Physical activity was measured using actigraphy to provide a mean activity score each hour. Sleep was estimated with actigraphy and an electronic diary, providing an objective and subjective index of sleep efficiency (A-SE, SE) and a sleep quality rating (SQ).

The individual and relative roles of these sleep parameters, as well as morning ratings of pain and mood, in predicting subsequent physical activity were examined in multilevel models that took into account variations in relationships at the 'Day' and 'Participant' levels.

RESULTS: Of the 5 plausible predictors SQ was the only significant within-person predictor of subsequent physical activity, such that nights of higher sleep quality were followed by days of more physical activity, from noon to 11 pm. The temporal association was not explained by potential confounders such as morning pain, mood or effects of the circadian rhythm.

CONCLUSIONS: In the absence of interventions, chronic pain patients spontaneously engaged in more physical activity following a better night of sleep. Improving nighttime sleep may well be a novel avenue for promoting daytime physical activity in patients with chronic pain.

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Birth weight and childhood obesity: a 12-country study.

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OBJECTIVES: Few studies have investigated the association between the full range of birth weight and the risk of childhood obesity in high-, middle- and low-income countries. The aim of the present study is to assess the association between different levels of birth weight and the risk of obesity among children aged 9–11 years in 12 countries.

METHODS: A multinational, cross-sectional study of 5141 children aged 9–11 years
was conducted in 12 countries. Height and weight were obtained using standardized methods. Time spent in moderate-to-vigorous physical activity (MVPA), sedentary and sleeping were objectively measured using 24-h, waist-worn accelerometer (Actigraph GT3X+) monitored for 7 days. Birth weight and other factors (regions, parental education, maternal history of gestational diabetes, children age, gender, breast feeding, gestational age, unhealthy diet scores and healthy diet scores) were collected by parental and children's questionnaires. Multilevel modeling was used to account for the nested nature of the data. RESULTS: The overall prevalence of obesity (BMI z-score>+2 s.d.) was 15.4% for boys and 10.0% for girls. There was a positive association between birth weight and BMI z-scores. The multivariable-adjusted odds ratios (ORs) of childhood obesity were significantly higher among children whose birth weights were 3500–3999 g (OR 1.45; 95% confidence interval (CI): 1.10-1.92), and >4000 g (OR 2.08; 95% CI: 1.47-2.93), compared with the reference group (2500-2999 g). The positive association between birth weight and the odds of childhood obesity was seen in girls, whereas a U-shaped association appeared in boys. CONCLUSIONS: High levels of birth weight, defined as birth weight ≥3500 g, were associated with increased odds of obesity among 9-11-year-old children in 12 countries. However, sex differences in the association between birth weight and the risk of obesity need to be considered when planning interventions to reduce childhood obesity.

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Blocking blue light during mania – markedly increased regularity of sleep and
rapid improvement of symptoms: a case report.

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OBJECTIVE: Available pharmacological treatment of mania is insufficient. Virtual darkness therapy (blue light-blocking treatment by means of orange-tinted glasses) is a promising new treatment option for mania. The basis for this might be the recently identified blue light-sensitive retinal photoreceptor, which is solely responsible for light stimulus to the circadian master clock. This is the first case report describing the clinical course of a closely monitored, hospitalized patient in a manic episode first receiving clear-lensed, and then blue light-blocking glasses.

METHODS: A 58-year-old Caucasian man, with bipolar I disorder and three previous manic episodes, was hospitalized during a manic episode. In addition to pharmacological treatment, he was treated with clear-lensed glasses for seven days, then one day without glasses, followed by six days of blue light-blocking glasses. During the entire observational period, he wore an actigraph with internal light sensors.

RESULTS: Manic symptoms were unaltered during the first seven days. The transition to the blue-blocking regime was followed by a rapid and sustained decline in manic symptoms accompanied by a reduction in total sleep, a reduction in motor activity during sleep intervals, and markedly increased regularity of sleep intervals. The patient's total length of hospital stay was 20
days shorter than the average time during his previous manic episodes. CONCLUSIONS: The unusually rapid decline in symptoms, accompanied by uniform sleep parameter changes toward markedly increased regularity, suggest that blue-blockers might be targeting a central mechanism in the pathophysiology of mania that needs to be explored both in clinical research and in basic science.

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Blood pressure circadian pattern and physical exercise assessment by accelerometer and 7-day physical activity recall scale.


BACKGROUND: The relationship between regular physical activity, measured objectively and by self-report, and the circadian pattern of 24-hour ambulatory arterial blood pressure (BP) has not been clarified.

METHODS: We performed a cross-sectional study in a cohort of healthy patients. We included 1,345 patients from the EVIDENT study (mean age 55 ± 14 years; 59.3% women). Physical activity was assessed using the 7-day physical activity recall (PAR) questionnaire (metabolic equivalents (MET)/hour/week) and the Actigraph GT3X accelerometer (counts/minute) for 7 days; ambulatory arterial BP was measured with a radial tonometer (B-pro device).

RESULTS: The dipper-pattern patients showed a higher level of activity than nondipper patients, as assessed by accelerometer and 7-day PAR. Physical activity measures correlated positively with the percent drop in systolic BP (SBP; ρ = 0.19 to 0.11; P < 0.01) and negatively with the systolic and diastolic sleep to wake ratios (ρ = −0.10 to −0.18; P < 0.01) and heart rate (ρ = −0.13; P < 0.01). In logistic regression, considering the circadian pattern (1, dipper; 0, nondipper) as the dependent variable, the odds ratio of the third tertile of counts/minute was 1.79 (95% confidence interval [CI], 1.35–2.38; P < 0.01) and of MET/hour/week was 1.33 (95% CI, 1.01–1.75; P = 0.04) after adjustment for confounding variables.

CONCLUSIONS: Physical activity, as evaluated by both the accelerometer and the 7-day PAR, was associated with a more marked nocturnal BP dip and,
accordingly, a lower SBP and diastolic BP sleep to wake ratio.

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Blood withdrawal affects iron store dynamics in primates with consequences on monoaminergic system function.

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Iron homeostasis is essential for the integrity of brain monoaminergic functions and its deregulation might be involved in neurological movement disorders such as the restless legs syndrome (RLS). Although iron metabolism breakdown concomitantly appears with monoaminergic system dysfunction in iron-deficient rodents and in RLS patients, the direct consequences of peripheral iron deficiency in the central nervous system (CNS) of non-human primates have received little attention. Here, we evaluated the peripheral iron-depletion impact on brain monoamine levels in macaque monkeys. After documenting circadian variations of iron and iron-related proteins (hemoglobin, ferritin and transferrin) in both serum and cerebrospinal fluid (CSF) of normal macaques, repeated blood withdrawals (RBW) were used to reduce peripheral iron-related parameter levels. Decreased serum iron levels were paradoxically associated with increased CSF iron concentrations. Despite limited consequences on tissue monoamine contents (dopamine – DA, 3, 4-dihydroxyphenylacetic acid – DOPAC, homovanillic acid, L-3, 4-dihydroxyphenylalanine – L-DOPA, 5-8 hydroxytryptamine – 5-HT, 5-hydroxyindoleacetic acid – 5-HIAA and noradrenaline) measured with post-mortem chromatography, we found distinct and region-dependent relationships of these tissue concentrations with CSF iron and/or serum iron and/or blood hemoglobin. Additionally, striatal extracellular DA, DOPAC and 5-HIAA levels
evaluated by in vivo microdialysis showed a substantial increase, suggesting an overall increase in both DA and 5-HT tones. Finally, a trending increase in general locomotor activity, measured by actimetry, was observed in the most serum iron-depleted macaques. Taken together, our data are compatible with an increase in nigrostriatal DAergic function in the event of iron deficiency and point to a specific alteration of the 5-HT/DA interaction in the CNS that is possibly involved in the etiology of RLS.

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Blue-blocking glasses as additive treatment for mania: a randomized placebo-controlled trial.


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OBJECTIVES: The discovery of the blue lightsensitive retinal photoreceptor responsible for signaling daytime to the brain suggested that light to the circadian system could be inhibited by using blue-blocking orange tinted glasses. Blue-blocking (BB) glasses are a potential treatment option for bipolar mania. We examined the effectiveness of BB glasses in hospitalized patients with bipolar disorder in a manic state.

METHODS: In a single-blinded, randomized, placebo-controlled trial (RCT), eligible patients (with bipolar mania; age 18–70 years) were recruited from five clinics in Norway. Patients were assigned to BB glasses or placebo (clear glasses) from 6 p.m. to 8 a.m. for 7 days, in addition to treatment as usual. Symptoms were assessed daily by use of the Young Mania Rating Scale (YMRS). Motor activity was assessed by actigraphy, and compared to data from a healthy control group. Wearing glasses for one evening/night qualified for inclusion in the intention-to-treat analysis.
RESULTS: From February 2012 to February 2015, 32 patients were enrolled. Eight patients dropped out and one was excluded, resulting in 12 patients in the BB group and 11 patients in the placebo group. The mean decline in YMRS score was 14.1 [95% confidence interval (CI): 9.7–18.5] in the BB group, and 1.7 (95% CI: -4.0 to 7.4) in the placebo group, yielding an effect size of 1.86 (Cohen's d).

In the BB group, one patient reported headache and two patients experienced easily reversible depressive symptoms.

CONCLUSIONS: This RCT shows that BB glasses are effective and feasible as add-on treatment for bipolar mania.

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Blue-Enriched Lighting for Older People Living in Care Homes: Effect on Activity, Actigraphic Sleep, Mood and Alertness.

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OBJECTIVE: Environmental (little outdoor light; low indoor lighting) and
age-related physiological factors (reduced light transmission through the ocular lens, reduced mobility) contribute to a light-deprived environment for older people living in care homes.

METHODS: This study investigates the effect of increasing indoor light levels with blue-enriched white lighting on objective (rest-activity rhythms, performance) and self-reported (mood, sleep, alertness) measures in older people.

Eighty residents (69 female), aged 86 ± 8 yrs (mean ± SD), participated (MMSE 19 ± 6). Overhead fluorescent lighting was installed in communal rooms (n=20) of seven care homes. Four weeks of blue-enriched white lighting (17000 K ≅ 900 lux) were compared with four weeks of control white lighting (4000 K ≅ 200 lux), separated by three weeks wash-out. Participants completed validated mood and sleep questionnaires, psychomotor vigilance task (PVT) and wore activity and light monitors (AWL). Rest-activity rhythms were assessed by cosinor, non-parametric circadian rhythm (NPCRA) and actigraphic sleep analysis.

Blue-enriched (17000 K) light increased wake time and activity during sleep decreasing actual sleep time, sleep percentage and sleep efficiency (p < 0.05) (actigraphic sleep). Compared to 4000 K lighting, blue-enriched 17000 K lighting significantly (p < 0.05) advanced the timing of participants' rest-activity rhythm (cosinor), increased daytime and night-time activity (NPCRA), reduced subjective anxiety (HADA) and sleep quality (PSQI). There was no difference between the two light conditions in daytime alertness and performance (PVT).

CONCLUSION: Blue-enriched lighting produced some positive (increased daytime activity, reduced anxiety) and negative (increased night-time activity, reduced sleep efficiency and quality) effects in older people.

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Blue-enriched office light competes with natural light as a zeitgeber.

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OBJECTIVES: Circadian regulation of human physiology and behavior (eg, body temperature or sleep-timing), depends on the "zeitgeber" light that synchronizes them to the 24-hour day. This study investigated the effect of changing light temperature at the workplace from 4000 Kelvin (K) to 8000 K on sleep-wake and activity-rest behavior.

METHODS: An experimental group (N=27) that experienced the light change was compared with a non-intervention group (N=27) that remained in the 4000 K environment throughout the 5-week study period (14 January to 17 February). Sleep logs and actimetry continuously assessed sleep-wake behavior and activity patterns.

RESULTS: Over the study period, the timing of sleep and activity on free days steadily advanced parallel to the seasonal progression of sunrise in the non-intervention group. In contrast, the temporal pattern of sleep and activity in the experimental group remained associated with the constant onset of work.

CONCLUSION: The results suggest that artificial blue-enriched light competes with natural light as a zeitgeber. While subjects working under the warmer light (4000 K) appear to entrain (or synchronize) to natural dawn, the subjects who were exposed to blue-enriched (8000 K) light appear to entrain to office hours. The results confirm that light is the dominant zeitgeber for the human
clock and that
its efficacy depends on spectral composition. The results also
indicate that
blue-enriched artificial light is a potent zeitgeber that has to be
used with
diligence.

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2019.

Blunted Nocturnal Salivary Melatonin Secretion Profiles in Military-
Related
Posttraumatic Stress Disorder.

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Background: Sleep disturbances are a hallmark of posttraumatic stress
disorder
(PTSD), yet few studies have evaluated the role of dysregulated
endogenous
melatonin secretion in this condition. Methods: This study compared
the sleep
quality and nocturnal salivary melatonin profiles of Canadian Armed Forces (CAF) personnel diagnosed with PTSD, using the Clinician Administered PTSD Scale (CAPS score ≥50), with two healthy CAF control groups; comprising, a "light control" (LC) group with standardized evening light exposure and "normal control" (NC) group without light restriction. Participants were monitored for 1-week using wrist actigraphy to assess sleep quality, and 24-h salivary melatonin levels were measured (every 2h) by immunoassay on the penultimate day in a dim-light (< 5 lux) laboratory environment. Results: A repeated measures design showed that mean nocturnal melatonin concentrations for LC were higher than both NC (p = .03) and PTSD (p = .003) with no difference between PTSD and NC. Relative to PTSD, NC had significantly higher melatonin levels over a 4-h period (01 to 05 h), whereas the LC group had higher melatonin levels over an 8-h period (23 to 07 h). Actigraphic sleep quality parameters were not different between healthy controls and PTSD patients, likely due to the use of prescription sleep medications in the PTSD group. Conclusions: These results indicate that PTSD is associated with blunted nocturnal melatonin secretion, which is consistent with previous findings showing lower melatonin after exposure to trauma and suggestive of severe chronodisruption. Future studies targeting the melatonergic system for therapeutic intervention may be beneficial for treatment-resistant PTSD.

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Body weight gain in rats by a high-fat diet produces chronodisruption in
activity/inactivity circadian rhythm.

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In the last few decades, obesity has become one of the most important public health problems. Adipose tissue is an active endocrine tissue which follows a rhythmic pattern in its functions and may produce alterations in certain circadian rhythms. Our aim was to evaluate whether the locomotor activity circadian rhythm could be modified by a hypercaloric diet in rodents. Two groups were considered in the experiment: 16 rats were used as a control group and were fed standard chow; the other group comprised 16 rats fed a high-fat diet (35.8% fat, 35% glucides). The trial lasted 16 weeks. Body weight was measured every week, and a blood sample was extracted every two weeks to quantify triglyceride levels. The activity/inactivity circadian rhythm was logged through actimetry throughout the trial, and analysed using the DAS 24© software package. At the end of the experiment, the high-fat fed rats had obese-like body weights and high plasma triglyceride levels, and, compared with the control group, increased diurnal activity, decreased nocturnal activity, reductions in amplitude, midline estimating statistic of rhythm, acrophase and interdaily stability, and increases in intradaily variability of their activity rhythms. The results thus show how obesity can lead to symptoms of chronodisruption in the body similar to those of ageing.

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Breast cancer patients have progressively impaired sleep-wake activity rhythms during chemotherapy.

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PURPOSE: Prior cross-sectional studies have shown that cancer patients have sleep-wake activity cycles that show little distinction between daytime and nighttime, a pattern indicative of circadian disruption. This pattern is seen both before and during cancer treatment. Long-term data are needed, however, to assess to what extent circadian rhythm impairments evolve over the course of chemotherapy. The goal of this study was to assess the longitudinal course of sleep-wake activity rhythms before and during chemotherapy for breast cancer.

PATIENTS AND METHODS: Ninety-five women scheduled to receive neoadjuvant or adjuvant anthracycline based chemotherapy for a stage I-III breast cancer participated. The participants wore a wrist actigraph for 72 consecutive hours at baseline (pre-chemotherapy), as well as during the weeks 1, 2 and 3 (W1, W2, W3) of cycle 1 and cycle 4 of chemotherapy. Sleep-wake circadian activity variables were computed based on actigraphic data.

RESULTS: Compared to baseline, with the exception of acrophase, all circadian rhythm variables examined, including amplitude, mesor, up-mesor, down-mesor, and rhythmicity were significantly impaired during the first week of both chemotherapy cycles. Although the circadian variables approached baseline values during W2 and W3 of cycle 1, most remained significantly more impaired during W2 and W3 of cycle 4.

CONCLUSION: These data suggest that the first administration of chemotherapy is associated with transient disruption of sleep-wake rhythm, while
repeated administration of chemotherapy results in progressively worse and more enduring impairments in sleep–wake activity rhythms.

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Bright light therapy protects women from circadian rhythm desynchronization during chemotherapy for breast cancer.

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Circadian rhythms (CRs) are commonly disrupted in women undergoing chemotherapy for breast cancer (BC). Bright light improves and strengthens CRs in other populations. This randomized controlled study examined the effect of morning administration of bright light therapy on CRs in women undergoing chemotherapy for BC. It was hypothesized that women receiving bright light therapy would exhibit more robust rhythms than women exposed to dim light. Thirty-nine women newly diagnosed with BC and scheduled for chemotherapy were randomized into 2 groups: bright white light (BWL) or dim red light (DRL). Women were instructed to use the light box every morning for 30 min during their first 4 cycles of chemotherapy. Wrist actigraphy was recorded at 5 time points: prior to chemotherapy (baseline), Cycle-1 treatment week (C1TW), Cycle-1 recovery week (C1RW), Cycle-4 treatment week (C4TW), and Cycle-4 recovery week (C4RW). There was a Group × Time interaction at C4TW compared to baseline such that
the DRL group showed significant deterioration in the mean of the activity rhythm (mesor) and amplitude, whereas the BWL group exhibited a significant increase in both mesor and amplitude. The DRL group also exhibited significant deterioration in overall rhythm robustness at C1TW, C4TW, and C4RW. Women in the BWL group also showed significant decreases in overall rhythm robustness at C1TW and C4TW, but returned to baseline levels at both recovery weeks. The results suggest that morning administration of bright light may protect women from experiencing CR deterioration during chemotherapy.

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Bright light therapy to promote sleep in mothers of low-birth-weight infants: a pilot study.

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Having a low-birth-weight (LBW) infant in a neonatal intensive care unit (NICU) can intensify a mother's sleep disturbances due to both stress and the dim lighting in the ICU setting, which desynchronizes circadian rhythms. The purpose of this pilot study was to examine the effectiveness of a 3-week bright light therapy intervention on sleep and health outcomes of mothers with LBW infants in the NICU. Controlled stratified randomization was used to assign 30 mothers to a treatment or control group. Data were collected at pretreatment (second week
postpartum) and after the 3-week intervention. Sleep data were assessed by wrist actigraph (total sleep time [TST], circadian activity rhythms [CARs]) and the General Sleep Disturbance scale. Other outcome variables were measured by the Lee's Fatigue scale, Edinburgh Postpartum Depression scale, and the Medical Outcomes Short Form 36, version 2. Mothers averaged 26.6 (SD = 6.3) years of age, and the majority were Black (73%). The mean gestational age for the infants was 27.7 (SD = 2.0) weeks. Small to large effect sizes were found when comparing the pre- to posttreatment differences between groups. Although none of the differences were statistically significant in this small sample, for mothers in the treatment group nocturnal TST (d = .33), CAR (d = 1.06), morning fatigue (d = .22), depressive symptoms (d = .40), physical health-related quality of life (d = .33), and mental health-related quality of life (d = .60) all improved compared to the control group. Bright light therapy is feasible for mothers with infants in an NICU. Clinically significant improvements have been evidenced; a larger-scale trial of effectiveness is needed.

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Bright light treatment has limited effect in subjects over 55 years with mild early morning awakening.

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31 subjects, age 55 yr. or older, suffering from mild early morning awakening were randomized to either a bright light (10,000 lux) or to a red dim light placebo condition (200 lux). Light exposure took place in the evening
in the patients' homes, 60 to 30 min. before bedtime and lasted for 3 wk. The subjects kept a sleep diary for 2 wk. and wore an actigraph for 1 wk. both before treatment and at post-treatment. Of the eight sleep diary outcome variables, significant effects that could be attributed to the light treatment were only detected for time spent in bed after final morning awakening. None of the six actigraph outcome variables yielded any significant effect of the light therapy. Explanations for the limited therapeutic effects of bright light treatment obtained in the present study are discussed, such as the criteria defining early morning awakening, the selection procedure, problems with compliance, age of the sample, and the dose of light. The lack of an objective circadian marker in this study could represent a problem concerning the timing of the light exposure. Despite the limited success of bright light therapy in this study, bright light therapy should still be considered as a treatment option for early morning awakening.

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Bright light treatment of depression for older adults [ISRCTN55452501].

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BACKGROUND: The incidence of insomnia and depression in the elder population is significant. It is hoped that use of light treatment for this group could provide safe, economic, and effective rapid recovery.

METHODS: In this home-based trial we treated depressed elderly
subjects with bright white (8,500 Lux) and dim red (<10 Lux) light for one hour a day at three different times (morning, mid-wake and evening). A placebo response washout was used for the first week. Wake treatment was conducted prior to the initiation of treatment, to explore antidepressant response and the interaction with light treatment. Urine and saliva samples were collected during a 24-hour period both before and after treatment and assayed for aMT6s and melatonin respectively to observe any change in circadian timing. Subjects wore a wrist monitor to record light exposure and wrist activity. Daily log sheets and weekly mood (GDS) and physical symptom (SAFTEE) scales were administered. Each subject was given a SCID interview and each completed a mood questionnaire (SIGH–SAD–SR) before and after treatment. Also, Hamilton Depression Rating (SIGH–SAD version) interviews were conducted by a researcher who was blind to the treatment condition. A control group of healthy, age-matched, volunteers was studied for one day to obtain baseline data for comparison of actigraphy and hormone levels.

RESULTS: Eighty-one volunteers, between 60 and 79 years old, completed the study. Both treatment and placebo groups experienced mood improvement. Average GDS scores improved 5 points, the Hamilton Depression Rating Scale (HDRS) 17 scores (extracted from the self-rated SIGH–SAD–SR) improved 6 points. There were no significant treatment effects or time-by-treatment interactions. No significant adverse reactions were observed in either treatment group. The assays of urine and saliva showed no significant differences between the treatment and placebo groups. The healthy control group was active earlier and slept earlier but received less light than the depressed group at baseline.

CONCLUSION: Antidepressant response to bright light treatment in this age group was not statistically superior to placebo. Both treatment and placebo groups experienced a clinically significant overall improvement of 16%.
African Americans and socioeconomically disadvantaged individuals have higher rates of a variety of sleep disturbances, including short sleep duration, poor sleep quality, and fragmented sleep. Such sleep disturbances may contribute to pervasive and widening racial and socioeconomic (SES) disparities in health. A
growing body of literature demonstrates that over and above individual-level SES, indicators of neighborhood disadvantage are associated with poor sleep. However, there has been scant investigation of the association between sleep and the most proximal environments, the home and residential block. This is the first study to examine the association between objective and self-reported measures of housing and block conditions and sleep. The sample included 634 adults (mean age = 58.7 years; 95% African American) from two low-income urban neighborhoods. Study participants reported whether they experienced problems with any of seven different housing problems (e.g., broken windows) and rated the overall condition of their home. Trained data collectors rated residential block quality. Seven days of wrist actigraphy were used to measure average sleep duration, efficiency, and wakefulness after sleep onset (WASO), and a sleep diary assessed sleep quality. Multivariate regression analyses were conducted for each sleep outcome with housing or block conditions as predictors in separate models. Participants reporting "fair" or "poor" housing conditions had an adjusted average sleep duration that was 15.4 min shorter than that of participants reporting "good" or "excellent" conditions. Those reporting any home distress had 15.9 min shorter sleep and .19 units lower mean sleep quality as compared with participants who did not report home distress. Poor objectively measured block quality was associated with 14.0 min shorter sleep duration, 1.95% lower sleep efficiency, and 10.7 additional minutes of WASO. Adverse housing and proximal neighborhood conditions are independently associated with poor sleep health. Findings highlight the importance of considering strategies that target upstream determinants of sleep health disparities.

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Call Schedule and Sleep Patterns of Urology Residents Following the 2011 ACGME Reforms.

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INTRODUCTION: In response to the 2011 Accreditation Council for Graduate Medical Education duty hour restrictions, many residency programs adopted a night float system. Due to concerns regarding the effects of night float on sleep and subsequently on patient care, we examined sleep patterns of residents on different call schedules.

METHODS: Urology residents assigned to day shift (Monday-Friday, 6am-6pm), night float (Sunday-Friday, 6pm-6am) or 24-hour home call and attending physicians were monitored for two-week periods using actigraphy bands. Total sleep time, light versus deep sleep time, sleep latency and number of sleep disruptions were measured. Comparative statistics and logistic regression were used to compare call systems and to determine predictors of sleep metrics.

RESULTS: When comparing day shift, night float, and 24-hour home call, the only significant difference was in sleep latency. All sleep variables except sleep latency were significantly different among residents of various levels (junior, senior, research year). Compared to residents, attendings had shorter sleep latency and were woken less frequently. Being a research year resident was the only significant univariate predictor of total sleep. Age and being a research year resident were significant univariate predictors of sleep latency.

CONCLUSIONS: This pilot study demonstrates the feasibility of actigraphy in
measuring sleep patterns of urology house officers. It also suggests that night float does not significantly impact total sleep or quality of sleep. Further research is needed to confirm these findings and to determine the effects of night float rotations on resident quality of life and patient safety.

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PMID: 27840844

Can a school-based sleep education programme improve sleep knowledge, hygiene and behaviours using a randomised controlled trial.

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OBJECTIVES: The present study investigated the effectiveness of a school-based sleep education programme in improving key sleep behaviours, sleep knowledge, and sleep hygiene.

DESIGN AND METHODS: A cross-sectional cluster-randomised controlled
trial with two groups (Intervention and Control) and three assessment time points [baseline, immediately post intervention (6 weeks post baseline) and follow-up (18 weeks post baseline)] was employed. A total of 296 students (mean age = 12.2 ± 0.6 years; 59% female) from 12 schools in Adelaide, South Australia, were recruited, with 149 participants in the Intervention group and 147 in the Control group. The intervention consisted of four classroom lessons delivered at weekly intervals, followed by a group project on sleep topics, which students presented at a parental information evening. Sleep patterns were assessed objectively (actigraphy, n = 175) and subjectively (time-use recall, n = 251) at three time points. Sleep knowledge and sleep hygiene (n = 296) were also measured.

RESULTS: Generalised estimating equations were used to compare changes in the Intervention and Control groups. The programme increased time in bed by 10 min (p = 0.03) for the Intervention group relative to the Control group, due to a 10-min delay in wake time (p = 0.00). These changes were not sustained at follow-up. There was no impact on sleep knowledge or sleep hygiene.

CONCLUSION: Investment in the sleep health of youth through sleep education is important but changes to sleep patterns are difficult to achieve. More intensive programmes, programmes with a different focus or programmes targeting different age groups may be more effective.

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Can Circadian Dysregulation Exacerbate Migraines?

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OBJECTIVE: This observational pilot study examined objective circadian phase and sleep timing in chronic migraine (CM) and healthy controls (HC) and the impact of circadian factors on migraine frequency and severity.

BACKGROUND: Sleep disturbance has been identified as a risk factor in the development and maintenance of CM but the biological mechanisms linking sleep and migraine remain largely theoretical.

METHODS: Twenty women with CM and 20 age-matched HC completed a protocol that included a 7 day sleep assessment at home using wrist actigraphy followed by a circadian phase assessment using salivary melatonin. We compared CM vs HC on sleep parameters and circadian factors. Subsequently, we examined associations between dim-light melatonin onset (DLMO), the midpoint of the sleep episode, and the phase angle (time from DLMO to sleep midpoint) with the number of migraine days per month and the migraine disability assessment scale (MIDAS).

RESULTS: CM and HC did not differ on measures of sleep or circadian phase. Within the CM group, more frequent migraine days per month was significantly
correlated with DLMO (r = .49, P = .039) and later sleep episode (r = .47, P = .037). In addition, a greater phase angle (ie, circadian misalignment) was significantly correlated with more severe migraine-related disability (r = .48, P = .042).

These relationships remained significant after adjusting for total sleep time.

CONCLUSIONS: This pilot study revealed that circadian misalignment and delayed sleep timing are associated with higher migraine frequency and severity, which was not better accounted for by the amount of sleep. These findings support the plausibility and need for further investigation of a circadian pathway in the development and maintenance of chronic headaches. Specifically, circadian misalignment and delayed sleep timing could serve as an exacerbating factor in chronic migraines when combined with biological predispositions or environmental factors.

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Can modifications to the bedroom environment improve the sleep of new parents? Two randomized controlled trials.

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Postpartum sleep disruption is common among new parents. In this randomized controlled trial we evaluated a modified sleep hygiene intervention for new parents.
parents (infant proximity, noise masking, and dim lighting) in anticipation of night-time infant care. Two samples of new mothers (n = 118 and 122) were randomized to the experimental intervention or attention control, and sleep was assessed in late pregnancy and first 3 months postpartum using actigraphy and the General Sleep Disturbance Scale. The sleep hygiene strategies evaluated did not benefit the more socioeconomically advantaged women or their partners in Sample 1, but did improve postpartum sleep among the less advantaged women of Sample 2. Simple changes to the bedroom environment can improve sleep for new mothers with few resources.

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Cancer symptom complexes related to alterations in molecular circadian axis signaling.

Rich TA.

One of the most common symptoms in cancer patients is fatigue that is often associated with appetite loss and sleep disruption. Quality of life indices and objective measures of these symptoms are now possible and continue to improve our understanding of how these symptoms are caused. Disruption of 24 hour rest/activity patterns measured by actigraphy is one example where there is overlap of the objective measurement of symptoms and the circadian axis. This paper reviews new data relevant to understanding mechanisms involving inhibition of the circadian system and the production of symptom complexes in cancer patients through hypothalamic signaling by tumor produced members of the...
A case-control study of sleep disturbances in pediatric obsessive-compulsive disorder.

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BACKGROUND: Sleep disturbances, including delayed sleep phase disorder (DSPD) and disorders of sleep initiation and maintenance (DIMS), have repeatedly been identified in adult obsessive-compulsive disorder (OCD). These disturbances have not been well-characterized objectively in pediatric OCD.

METHODS: Thirty OCD-affected youth (8-18 yrs, 40% male) and 30 age and gender-matched healthy controls (HCs) completed the Sleep Disturbances Scale for Children (SDSC), and one week of continuous actigraphy with concurrent sleep diary documentation. A subsample completed the Children's Sleep Hygiene Scale (CSHS) and Sleep Attitudes and Beliefs Scale (SABS).

RESULTS: Seventy-two percent of OCD participants reported sleep disturbances
versus 15% of HC participants ($p < 0.001$). Convergent actigraphy results suggested DIMS but not DSPD were common.

**DISCUSSION:** The parents of OCD-affected children seem to be successfully controlling bedtimes, preventing circadian rhythm system disruptions. OCD status does adversely impact, however, the perisleep arousal system. These results have important clinical implications, suggesting sleep problems may be best managed through direct treatment of OCD symptoms. It is recommended that all pediatric OCD patients be screened for sleep disturbances to inform treatment plan development.

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A case of extremely long sleep and waking episodes.

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This report analyzes the sleep/wake patterns of a 32-year-old severely mentally retarded person with extreme periods of sleep and waking. The sleep and waking patterns were obtained from behavioral observations for 1 year. The validity of these observations was assessed by parallel actigraph recordings and behavioral observations for 1 month. The mean sleep episode was 30.5 hours in length and the mean waking episode was 30.9 hours in length. The longest sleep episode was 131 hours and the longest wake episode was 154 hours. There was little evidence of systematic homeostatic or circadian patterning.

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PMID: 7846464 [Indexed for MEDLINE]
A Case of Non-24-Hour Sleep-Wake Rhythm Disorder Treated With a Low Dose of Ramelteon and Behavioral Education.

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ABSTRACT: Non-24-hour sleep-wake rhythm disorder (N24SWD) occurs when the intrinsic circadian pacemaker does not entrain (synchronize) to the 24-hour light/dark cycle. There is currently no established treatment for sighted patients with N24SWD. To the best of our knowledge, there have been very few reports on the efficacy of ramelteon administered to sighted patients with N24SWD. We report the case of a sighted patient with N24SWD whose free-running sleep-wake pattern recorded by actigraphy was stopped after the administration of a low dose of ramelteon combined with behavioral education.

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PMID: 29991416 [Indexed for MEDLINE]
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Objectives. To assess the development of the rest–activity rhythm and quality of sleep during course of treatment of patients with major depressive episode receiving antidepressant treatment plus quetiapine. Methods. Ten patients with major depressive episode were followed over 4 weeks. Motor activity was measured with actigraphy, sleep with the Pittsburgh Sleep Quality Index (PSQI), and depression was followed with HAM-D-21 and BDI. Correlations and associations were calculated with non-parametric statistical tests. Results. Circadian motor activity improved during the 4 weeks treatment period only for daytime-related motor activity (M10), but not for night-time-related motor activity (L5). Patients with statistically significant higher sleep efficiency scores and sleep fraction on the actigraph after week 1 showed clinical improvement on the HAM-D score after week 4. Patients with good sleep efficiency at week 1 (assessed by PSQI) showed statistically significant clinical improvement of depression after week 4. Conclusions. Various sleep parameters at week 1 of treatment seem to be predictive for treatment outcome of depression after week 4. Actigraphy and subjective sleep assessment with PSQI are useful tools to predict treatment outcome of depression. The positive effects of quetiapine on motor activity and sleep show the clinical significance of our findings.

DOI: 10.1080/13651500600736726
PMID: 24941146


Case study: A case–series evaluation of a behavioral sleep intervention for three children with autism and primary insomnia.
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OBJECTIVE: To assess the effectiveness of a manualized multi-component behavioral sleep intervention for children with autism spectrum disorder (ASD) and primary insomnia. 

METHODS: Three children (2 males and 1 female, aged 8–9 years) participated. The intervention consisted of a treatment handbook for parents; a distance treatment approach was used in which parents had weekly telephone contact with a therapist. The main behavioral strategies employed were Faded Bedtime with Response Cost and positive reinforcement. Within a case-series design, both subjective (parent-report questionnaires and sleep diaries) and objective (actigraphy) measures were used to record changes in children's sleep and daytime behavior. 

RESULTS: For all 3 children, mean sleep onset latency was reduced following the intervention. These improvements were generally maintained at follow-up 12 weeks later. 

CONCLUSIONS: The current study provides preliminary evidence for the effectiveness of a manualized behavioral sleep intervention program for improving insomnia in children with ASD. 

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CC130 pilot fatigue during re-supply missions to former Yugoslavia.

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PURPOSE: Deployment of troops in foreign theaters requires a massive airlift capability. The fatigue encountered in such operations can be severe enough to pose a flight safety hazard. The current study documents sleep and the effect of fatigue on aircrew performance during re-supply missions in support of Canadian troops in Bosnia in 1996.

METHODS: Ten routine re-supply missions from Trenton, Canada, to Zagreb, Croatia, were studied and involved 9 pilots and 9 co-pilots. To document their sleep hygiene, all pilots wore wrist actigraphs from approximately 5 d prior to the mission, until the mission was completed. Psychomotor performance was tested during the actual flights. Three psychomotor trials during the outbound transatlantic leg (Trenton to Lyneham, UK) were employed, one trial on the Lyneham-Zagreb-Lyneham leg, and three trials on the return transatlantic leg from Lyneham to Trenton.

RESULTS: The amount of daily sleep during the 3-d period prior to the mission steadily decreased from an average of 8 h 40 min per day to 6 h 30 min ($p < 0.001$). During the missions, the worst night of sleep occurred during the second night overseas. During both transatlantic legs, there were significant decrements in the subjective ratings of alertness ($p < 0.001$), and increases in physical ($p < 0.001$) and mental fatigue ($p < 0.001$). Performance on the logical reasoning task as well as the multitask showed probable fatigue effects during the outbound leg of the missions.

CONCLUSIONS: Our transport pilots showed a pattern of progressively decreasing sleep. Self-rated scores for alertness, mental and physical fatigue, indicate a deterioration of alertness, and an increase in fatigue throughout the long transatlantic flights.

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Cerebral small vessel disease is related to disturbed 24-h activity rhythms: a population-based study.


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BACKGROUND AND PURPOSE: Cerebral small vessel disease is common in elderly persons. Patients with dementia or stroke frequently have cerebral small vessel disease and often experience disturbances in the sleep-wake rhythm. It is unknown whether cerebral small vessel disease is related to disturbances in sleep and 24-h activity rhythms.

METHODS: This study was conducted in the Rotterdam Study. A total of 970 community-dwelling persons (mean age 59.2 years) underwent brain magnetic resonance imaging and actigraphy. Cerebral small vessel disease was defined as white matter lesions (total volume in millilitres) and the presence of cerebral microbleeds and lacunar infarcts. Twenty-four hour activity rhythms and sleep were measured with actigraphy by estimating the instability and fragmentation of the activity rhythm and total sleep time. Sleep quality was assessed.
with the Pittsburgh Sleep Quality Index. White matter lesions, instability, fragmentation and sleep quality were standardized for analyses.

RESULTS: Higher white matter lesion volume (β = 0.09 per SD, 95% confidence interval 0.02; 0.15) and cerebral microbleeds (β = 0.19 per SD, 95% confidence interval 0.02; 0.37) were significantly related to more fragmented 24-h activity rhythms. None of the small vessel disease markers was related to total sleep time or sleep quality.

CONCLUSIONS: White matter lesion volume and the presence of cerebral microbleeds are related to disturbed activity rhythms. This suggests that subclinical brain damage affects the 24-h activity rhythm.

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Challenges in diagnosing narcolepsy without cataplexy: a consensus statement.

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BACKGROUND: Diagnosing narcolepsy without cataplexy is often a challenge as the symptoms are nonspecific, current diagnostic tests are limited, and there are no useful biomarkers. In this report, we review the clinical and physiological aspects of narcolepsy without cataplexy, the limitations of available diagnostic procedures, and the differential diagnoses, and we propose an approach for more accurate diagnosis of narcolepsy without cataplexy.

METHODS: A group of clinician-scientists experienced in narcolepsy reviewed the literature and convened to discuss current diagnostic tools, and to map out directions for research that should lead to a better understanding and more accurate diagnosis of narcolepsy without cataplexy.

RECOMMENDATIONS: To aid in the identification of narcolepsy without cataplexy, we review key indicators of narcolepsy and present a diagnostic algorithm. A detailed clinical history is mainly helpful to rule out other possible causes of chronic sleepiness. The multiple sleep latency test remains the most important measure, and prior sleep deprivation, shift work, or circadian disorders should be excluded by actigraphy or sleep logs. A short REM sleep latency (≤ 15 minutes) on polysomnography can aid in the diagnosis of narcolepsy without cataplexy,
although sensitivity is low. Finally, measurement of hypocretin levels can help, as levels are low to intermediate in 10% to 30% of narcolepsy without cataplexy patients.

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[Changes in circadian sleep-wake and rest-activity rhythms during different phases of menstrual cycle].

[Article in Chinese]

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The results of previous studies on the menstrual-related sleep changes were inconsistent. The menstrual-related circadian sleep-wake and rest-activity rhythms changes are still uncertain. Using actigraphic monitoring of wrist activity, we investigated the sleep-wake and rest-activity patterns of 12 normally cyclic healthy women during reproductive life. Multivariate analyses were performed during the four phases of the menstrual cycle: menstrual phase (1st to 5th day of menstrual cycle), late follicular/peri-ovulation phase (11th to 15th day), early to mid luteal phase (18th to 23rd day) and late luteal phase (25th to 28th day), respectively. The variables of circadian sleep-wake pattern were similar in the four phases, except an increased tendency of the sleep latency in peri-ovulation phase compared with the early to mid-luteal phase (19+/−18 vs 9+/−6), but unfortunately no statistical significance were found
Concerning the circadian patterning of rest and activity, the interdaily stability (IS) in menstrual phase was significantly higher than the early to mid luteal phase (P<0.05). In early to mid luteal phase, the M10 onset time was significantly earlier compared with that of the late follicular/peri-ovulation phase (P<0.05), and the cosinor peak time was significantly earlier compared with that of the late luteal phase (P<0.05). The circadian periodogram calculated the period length of the rhythm of average woman. The average length was (24.01±0.29) h, and there was no significant difference among the four menstrual phases. The results suggest that the phase of circadian rest-activity rhythm may be modulated by the menstrual cycle, but the quantity and quality of the rest-activity rhythm have no essential different, and that menstrual cycle may have no effects on the circadian sleep-wake rhythm in normally cyclic healthy women.

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Changes in quality of life and sleep across the perinatal period in women with mood disorders.

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INTRODUCTION: The perinatal period represents a time of significant
Life changes associated with increases in sleep difficulties, depression, and potentially impaired quality of life (QoL). Associations between QoL and sleep among women with perinatal depression are poorly understood, and changes in QoL across the perinatal period have received little attention.

**METHODS:** Participants were the treatment-as-usual group (n = 23) from a clinical trial testing an intervention for perinatal mood disorders. They completed the WHOQOL-Bref, had depression assessed with the HAM-D-17, and wore wrist actigraphs to estimate sleep for 1 week during third trimester and at 6 weeks postpartum.

**RESULTS:** Higher education level was associated with better environmental QoL during pregnancy (p = .044) and presence of older children was associated with worse social QoL postpartum (p = .045). Psychological health QoL worsened (p = .014) across the perinatal period. Total sleep time (p = .001) and sleep efficiency (p = .008) decreased from third trimester to postpartum week 6, but sleep measures were not associated with QoL at either time point. Depressive symptoms decreased from pregnancy to postpartum week 6 and were inversely associated with postpartum physical and social QoL (p = .031 and .048).

**DISCUSSION:** Factors contributing to self-rated QoL are variable across multiple domains during the perinatal period. QoL among our participants was lower than population norms. In our sample of women with depression and/or anxiety, QoL was related to postpartum depressive symptoms, but not to objectively measured sleep quality, quantity, or timing. Links between QoL and sleep may be inherently complex in perinatal women.

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PMID: 32016680

The characteristics of sleep in patients with manifest bipolar disorder, subjects at high risk of developing the disease and healthy controls.

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Sleep is highly altered during affective episodes in patients with bipolar disorder. There is accumulating evidence that sleep is also altered in euthymic states. A deficit in sleep regulation may be a vulnerability factor with aetiological relevance in the development of the disease. This study aims to explore the objective, subjective and lifetime sleep characteristics of patients with manifest bipolar disorder and persons with an elevated risk of developing the disease. Twenty-two patients with bipolar I and II disorder, nine persons with an elevated risk of developing the disorder and 28 healthy controls were evaluated with a structured interview to characterize subjective and lifetime sleeping habits. In addition, participants wore an actimeter for six nights. Patients with bipolar disorder had longer sleep latency and duration compared with healthy controls as determined by actigraphy. The subjective and lifetime sleep characteristics of bipolar patients differed significantly from healthy controls. The results of participants with an elevated risk of developing the disorder had subjective and lifetime characteristics that were largely analogous to those of patients with manifest bipolar disorder. In particular, both groups described recurring insomnia and hypersomnia, sensitivity to shifts in circadian rhythm, difficulties awakening and prolonged sleep latency. This study provides
further evidence that sleep and circadian timing are profoundly altered in patients with bipolar disorder. It may also tentatively suggest that sleep may be altered prior to the first manic episode in subjects at high risk.

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PMID: 22903311 [Indexed for MEDLINE]


Lamprecht ML, Terrill PI, Parsley CL, Bradley AP.

Actigraphy is effective at monitoring circadian rhythms, but often misidentifies periods of restless sleep (defined here as sleep periods with movement) as wake, and periods of quiet wake as sleep. This limitation restricts the effectiveness of actigraphy for investigating sleep disorders. Our objective in this study was to investigate a time-frequency representation of movement during sleep and wake which could ultimately aid in improving classification performance by reducing false wake detections. As a pilot study, we investigate the characteristics of manually labelled movements from six patients (aged 6-12 years, 3 male) during sleep and wake using the over complete discrete wavelet decomposition. The difference between the median wavelet coefficients were analyzed for 30 movement segments from six movement categories during sleep and wake. We found that, in general, the temporal location of high energy coefficients and the energy of the high frequency bands differed between movements during sleep and wake. This indicates that we are able to differentiate movement during sleep and wake with a time-frequency representation. This representation may improve the sleep and wake classification performance by identifying movements specific to sleep and wake.
This will likely improve the poor specificity inherent in conventional actigraphy.

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Characterization of the sleep disorder of anti-IgLON5 disease.


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STUDY OBJECTIVE: To characterize the sleep disorder of anti-IgLON5 disease.
METHODS: We reviewed 27 video-polysomnographies (V-PSG), 6 multiple sleep latency tests (MSLT), 2 videomnoscopies with dexmedetomidine, and 10 actigraphies recorded during the disease course of five patients. Due to severe sleep architecture abnormalities, we used a novel modified sleep scoring system combining conventional stages with a descriptive approach in which two additional stages were identified: undifferentiated-NREM (UN-NREM) and poorly structured N2
(P-SN2) sleep that were characterized by abnormal motor activation and absence or sparse elements of conventional NREM sleep.

RESULTS: Sleep-related vocalizations, movements, behaviors, and respiratory abnormalities were reported by bed-partners. In all patients, NREM sleep onset and sleep reentering after an awakening occurred as UN-NREM (median: 29.8% of total sleep time [TST]) and P-SN2 sleep (14.5% TST) associated with vocalizations and simple and quasi-purposeful movements. Sleep initiation was normalized in one patient with a high dose of steroids, but NREM sleep abnormalities reappeared in subsequent V-PSG. In all patients, if sleep continued uninterrupted, there was a progressive normalization with normal N2 (11.7% TST) and N3 (22.3% TST) sleep but stridor and obstructive apnea emerged. REM sleep behavior disorder (RBD) occurred in four patients. Sleep initiation was also altered in MSLT and dexmedetomidine-induced sleep. Actigraphy showed a 10-fold increase of nocturnal activity compared with controls. Sleep abnormalities remained stable during the disease.

CONCLUSIONS: The sleep disorder of anti-IgLON5 disease presents as a complex sleep pattern characterized by abnormal sleep initiation with undifferentiated NREM sleep, RBD, periods of normal NREM sleep, stridor, and obstructive apnea.

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Child emotional insecurity and academic achievement: the role of sleep disruptions.

El-Sheikh M(1), Buckhalt JA, Keller PS, Cummings EM, Acebo C.
The authors examined children's sleep as an intervening variable in the connection between emotional insecurity in the family and academic achievement. The role of ethnicity (African American and European American) and socioeconomic status (SES) in moderating the examined relations was assessed. One hundred sixty-six children (8- and 9-year-olds) reported their emotional insecurity, and the quantity and quality of children's sleep were examined through actigraphy and self-report. Decreased amount and quality of sleep were intervening variables in the relations between insecurity in the marital relationship and children's achievement. The effects of disrupted sleep on achievement were more pronounced for both African American children and children of lower SES. Results highlight the importance of the contemporaneous examinations of family and sleep functioning in the prediction of child outcomes.

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problems and
cognitive abilities in childhood, little is known about this
association in
toddlerhood, a period of rapid cognitive development. The present
study examined
the association between various sleep problems, using actigraphy, and
performance
on a standardized test of cognitive abilities, longitudinally across
three ages
(30, 36, and 42 months) in a large sample of toddlers (N = 493).
Results revealed
a between-subject effect in which the children who had more delayed
sleep
schedules on average also showed poorer cognitive abilities on average
but did
not support a within-subjects effect. Results also showed that delayed
sleep
explains part of the association between family socioeconomic context
and child
cognitive abilities.

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Development, Inc.

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10.

The Children's Report of Sleep Patterns--Sleepiness Scale: a self-
report measure
for school-aged children.

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OBJECTIVE: To establish the psychometric properties of a self-report
measure of
daytime sleepiness for school-aged children.
METHODS: Three hundred eighty-eight children aged 8-12 years
(inclusive) from
paediatrician's offices, sleep clinic/labs, children's hospitals,
schools, and
the general population were recruited. A multi-method approach was
used to
validate the Children's Report of Sleep Patterns--Sleepiness Scale
(CRSP-S),
including self-report measures (questions about typical sleep),
parent-report
measures (Children's Sleep Habits Questionnaire [CSHQ], proxy version
of CRSP-S,
Children's Sleep Hygiene Scale [CSHS], morningness-eveningness) and
objective
measures (actigraphy and polysomnography [PSG]).
RESULTS: The CRSP-S was shown to be internally consistent (Cronbach's
alpha =
0.77) and the scale's unidimensionality was supported by a one-factor
confirmatory factor analysis. A Rasch-Masters Partial Credit model
demonstrated
that items cover a broad range of sleepiness experiences with minimal
redundancy,
gaps in coverage, or bias against age, gender, or clinical groups.
Test-retest
reliability was 0.82. Construct and convergent validity were
demonstrated with
actigraphy, parental reports of children's sleepiness, sleep
disturbances, sleep
hygiene, circadian preference, and comparison of groups of children
(e.g., sleep
clinic/lab vs. school children).
CONCLUSIONS: The CRSP-S is a reliable and valid self-report measure of
sleepiness
for school-aged children. As an adjunct to parental report measures
and objective
measures of sleep, the CRSP-S provides a brief and psychometrically
robust
measure of children's sleepiness. Children who endorse sleepiness
should have a
more detailed screening for underlying sleep disruptors or causes of
insufficient
sleep.

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j.1467-8624.2010.01439.x.
Children's sleep and adjustment over time: the role of socioeconomic context.

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Relations were examined between children's sleep and their externalizing and internalizing symptoms. Longitudinal relations were examined when children were in 3rd (T1) and 5th (T2) grades, and cross-sectional relations were assessed at T2. Participants included 176 children at T1 (M = 8.68 years) and 141 children at T2 (M = 10.70 years). Sleep was examined via subjective reports and actigraphy. Children reported on anxiety, self-esteem, and depression symptoms, and parents reported on children's externalizing and internalizing symptoms. Cross-sectionally and longitudinally, sleep problems were associated with worse adjustment outcomes; African American children or those from lower socioeconomic status homes were at particular risk. Findings highlight the importance of adequate sleep for children's optimal development, especially in the context of ecological risk.

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PMID: 20573110  [Indexed for MEDLINE]


Children's sleep and cognitive functioning: race and socioeconomic status as moderators of effects.

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Race and socioeconomic status (SES) moderated the link between children's sleep and cognitive functioning. One hundred and sixty-six 8- to 9-year-old African and European American children varying in SES participated. Sleep measures were actigraphy, sleep diaries, and self-report; cognitive measures were from the Woodcock-Johnson III and reaction time tasks. Children had similar performance when sleep was more optimal, but after controlling for SES, African American children had lower performance with sleep disruptions. Children from lower and higher SES had similar performance with better sleep quality and less variability in sleep schedules, but when sleep was more disrupted, higher SES children had better performance. Examination of environmental variables associated with race and SES that may underlie these effects may lead to directions for interventions to improve cognitive performance.

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Chronic artificial blue-enriched white light is an effective countermeasure to delayed circadian phase and neurobehavioral decrements.

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Studies in Polar Base stations, where personnel have no access to sunlight during winter, have reported circadian misalignment, free-running of the sleep–wake rhythm, and sleep problems. Here we tested light as a countermeasure to circadian misalignment in personnel of the Concordia Polar Base station during the polar winter. We hypothesized that entrainment of the circadian pacemaker to a 24-h light–dark schedule would not occur in all crew members (n = 10) exposed to 100–300 lux of standard fluorescent white (SW) light during the daytime, and that chronic non-time restricted daytime exposure to melanopsin-optimized blue-enriched white (BE) light would establish an a stable circadian phase, in participants, together with increased cognitive performance and mood levels. The lighting schedule consisted of an alternation between SW lighting (2 weeks), followed by a BE lighting (2 weeks) for a total of 9 weeks. Rest–activity cycles assessed by actigraphy showed a stable rest–activity pattern under both SW and BE light. No difference was found between light conditions on the intra-daily stability, variability and amplitude of activity, as assessed by non-parametric circadian analysis. As hypothesized, a significant delay of about 30 minutes in the onset of melatonin secretion occurred with SW, but not with BE light. BE light significantly enhanced well being and alertness compared to SW light. We propose that the superior efficacy of blue-enriched white light versus standard white light involves melanopsin-based mechanisms in the activation of the non–visual functions studied, and that their responses do not dampen
with time (over 9-weeks). This work could lead to practical applications of light exposure in working environment where background light intensity is chronically low to moderate (polar base stations, power plants, space missions, etc.), and may help design lighting strategies to maintain health, productivity, and personnel safety.

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PMID: 25072880  [Indexed for MEDLINE]


Chronic Low Quality Sleep Impairs Postural Control in Healthy Adults.

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The lack of sleep, both in quality and quantity, is an increasing problem in modern society, often related to workload and stress. A number of studies have addressed the effects of acute (total) sleep deprivation on postural control. However, up to date, the effects of chronic sleep deficits, either in quantity or quality, have not been analyzed. Thirty healthy adults participated in the study that consisted of registering activity with a wrist actigraph for more than a week before performing a series of postural control tests. Sleep and
circadian rhythm variables were correlated and the sum of activity of the least active 5-h period, L5, a rhythm variable, obtained the greater coefficient value with sleep quality variables (wake after sleep onset WASO and efficiency sleep). Cluster analysis was performed to classify subjects into two groups based on L5 (low and high). The balance tests scores used to assess postural control were measured using Biodex Balance System and were compared between the two groups with different sleep quality. The postural tests were divided into dynamic (platform tilt with eyes open, closed and cursor) and static (clinical test of sensory integration). The results showed that during the tests with eyes closed, the group with worse sleep quality had also worse postural control performance. Lack of vision impairs postural balance more deeply in subjects with chronic sleep inefficiency. Chronic poor sleep quality impairs postural control similarly to total sleep deprivation.

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Conflict of interest statement: The authors have declared that no competing interests exist.


Chronobiology, sleep-related risk factors and light therapy in perinatal depression: the "Life-ON" project.

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BACKGROUND: Perinatal depression (PND) has an overall estimated prevalence of roughly 12%. Untreated PND has significant negative consequences not only on the health of the mothers, but also on the physical, emotional and cognitive development of their children. No certain risk factors are known to predict PND and no completely safe drug treatments are available during pregnancy and breastfeeding. Sleep and depression are strongly related to each other because of a solid reciprocal causal relationship. Bright light therapy (BLT) is a well-tested and safe treatment, effective in both depression and circadian/sleep disorders.

METHODS: In a 3-year longitudinal, observational, multicentre study, about 500
women will be recruited and followed-up from early pregnancy (10-15 gestational week) until 12 months after delivery. The primary aim of the present study is to systematically explore and characterize risk factors for PND by prospective sleep assessment (using wrist actigraphy, polysomnography and various sleep questionnaires) and blood-based analysis of potential markers during the perinatal period (Life-ON study). Secondary aims are to explore the relationship between specific genetic polymorphisms and PND (substudy Life-ON1), to investigate the effectiveness of BLT in treating PND (substudy Life-ON2) and to test whether a short term trial of BLT during pregnancy can prevent PND (substudy Life-ON3).

DISCUSSION: The characterization of specific predictive and risk factors for PND may substantially contribute to improve preventive medical and social strategies for the affected women. The study results are expected to promote a better understanding of the relationship between sleep disorders and the development of PND and to confirm, in a large sample of women, the safety and efficacy of BLT both in prevention and treatment of PND.


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PMID: 27814712 [Indexed for MEDLINE]


Chronobiotic effects of the melatonin agonist LY 156735 following a simulated 9h time shift: results of a placebo-controlled trial.

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INTRODUCTION: The melatonin agonist LY 156735 (LY) is a new investigational drug
under development to treat circadian rhythm disorders. The present study assessed the efficacy of LY to alleviate the symptoms of shift lag and to enhance readaptation of desynchronized circadian rhythms to a new time zone. 

SUBJECTS AND METHODS: Eight healthy male volunteers of age 25–35 yr participated in three identical trials of 13d duration in a temporal isolation unit separated by washout intervals. A high dose (HD) of 5 mg and a low dose (LD) of 0.5 mg of LY and placebo (PL) were administered double-blinded in a three-period cross-over design. Each trial consisted of an adaptation period, a pre-shift period for baseline measurements, a simulated 9h phase-advance shift, and a post-shift period for follow-up. The time shift was performed at 23:00h of day 6 by advancing the laboratory time to 08:00h of day 7. Double-blind study medication was administered at 14:30h on day 6, and at 22:30h on days 7–10. Subjective ratings of jet lag, alertness, tenseness, and daytime fatigue were assessed using visual analog scales (VAS) and standardized questionnaires. The objective markers of readaptation included core body temperature, wrist actigraphy, cortisol and electrolyte excretion, and a battery of computerized performance tests. 

RESULTS: HD but not LD enhanced the readaptation speed of all physiological rhythms investigated, as demonstrated by a significantly faster movement of acrophases towards the post-shift target time. HD (p = 0.05) significantly blunted the post-shift deterioration of performance in those tests that were sensitive to shift lag. Parameters of subjective well-being were not significantly affected by either dose. 

CONCLUSION: This pilot study demonstrates the chronobiotic efficacy of LY when taken at a dose of 5 mg/d.

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PMID: 12405554 [Indexed for MEDLINE]
Chronotype influences activity circadian rhythm and sleep: differences in sleep quality between weekdays and weekend.

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Several studies have shown the differences among chronotypes in the circadian rhythm of different physiological variables. Individuals show variation in their preference for the daily timing of activity; additionally, there is an association between chronotype and sleep duration/sleep complaints. Few studies have investigated sleep quality during the week days and weekends in relation to the circadian typology using self-assessment questionnaires or actigraphy. The purpose of this study was to use actigraphy to assess the relationship between the three chronotypes and the circadian rhythm of activity levels and to determine whether sleep parameters respond differently with respect to time (weekdays versus the weekend) in Morning-types (M-types), Neither-types (N-types) and Evening-types (E-types). The morningness–eveningness questionnaire (MEQ) was administered to 502 college students to determine their chronotypes. Fifty subjects (16 M-types, 15 N-types and 19 E-types) were recruited to undergo a 7-days monitoring period with an actigraph (Actiwatch® actometers, CNT, Cambridge, UK) to evaluate their sleep parameters and the circadian rhythm of their activity levels. To compare the amplitude and the acrophase among the three chronotypes, we used a one-way ANOVA followed by the Tukey-Kramer post-hoc test. To compare the Midline Estimating Statistic of Rhythm (MESOR) among the three
chronotypes, we used a Kruskal-Wallis non-parametric test followed by pairwise comparisons that were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. The analysis of each sleep parameter was conducted using the mixed ANOVA procedure. The results showed that the chronotype was influenced by sex (χ(2) with p = 0.011) and the photoperiod at birth (χ(2) with p < 0.05). Though the MESOR and amplitude of the activity levels were not different among the three chronotypes, the acrophases compared by the ANOVA post-hoc test were significantly different (p < 0.001). The ANOVA post-hoc test revealed the presence of a significant difference (p < 0.001) between the M-types (14:32 h) and E-types (16:53 h). There was also a significant interaction between the chronotype and four sleep parameters: Sleep end, Assumed Sleep, Immobility Time and Sleep Efficiency. Sleep Efficiency showed the same patterns as did Assumed Sleep and Immobility Time: the Sleep Efficiency of the E-types was poorer than that of the M- and N-types during weekdays (77.9% ± 7.0 versus 84.1% ± 4.9 and 84.1% ± 5.2) but was similar to that measured in the M- and N-types during the weekend. Sleep Latency and Movement and Fragmentation Index were not different among the three chronotypes and did not change on the weekend compared with weekdays. This study highlights two key findings: first, we observed that the circadian rhythm of activity levels was influenced by the chronotype; second, the chronotype had a significant effect on sleep parameters: the E-types had a reduced sleep quality and quantity compared with the M- and N-types during weekdays, whereas the E-types reached the same levels as the other chronotypes during the weekends. These findings suggest that E-types accumulate a sleep deficit during weekdays due to social and academic commitments and that they recover from this deficit during "free days" on the weekend.
Chronotype is associated with the timing of the circadian clock and sleep in toddlers.

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Chronotype is a construct reflecting individual differences in diurnal preference. Although chronotype has been studied extensively in school-age children, adolescents and adults, data on young children are scarce. This study describes chronotype and its relationship to the timing of the circadian clock and sleep in 48 healthy children aged 30–36 months (33.4 ± 2.1 months; 24 males). Parents completed the Children's Chronotype Questionnaire (CCTQ) ~2 weeks before the start of the study. The CCTQ provides three measures of chronotype: midsleep time on free days, a multi-item morningness/eveningness score and a single item chronotype score. After 5 days of sleeping on their habitual schedule (assessed with actigraphy and sleep diaries), children participated in an in-home salivary dim light melatonin onset assessment. Average midsleep time on free days was 1:47 ± 0:35, and the average morningness/eveningness score was 26.8 ± 4.3. Most toddlers (58.4%) were rated as 'definitely a morning type' or 'rather morning than evening type', while none (0%) were rated as 'definitely evening type'. More morning types (midsleep time on free days and morningness/eveningness score, respectively) had earlier melatonin onset times \( r = 0.45, r = 0.26 \),
earlier habitual bedtimes \( (r = 0.78, r = 0.54) \), sleep onset times \( (r = 0.80, r = 0.52) \),
sleep midpoint times \( (r = 0.90, r = 0.53) \) and wake times \( (r = 0.74, r = 0.34) \).
Parent ratings using the single-item chronotype score were associated with melatonin onset \( (r = 0.32) \) and habitual bedtimes \( (r = 0.27) \), sleep onset times \( (r = 0.33) \) and sleep midpoint times \( (r = 0.27) \). Morningness may best characterize circadian preference in early childhood. Associations between chronotype and circadian physiology and sleep timing suggest adequate validity for the CCTQ in this age group. These findings have important implications for understanding the marked variability in sleep timing during the early years of life.

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Adolescent maturation is associated with delays of the endogenous circadian phase. Consequently, early school schedules may lead to a mismatch between internal and external time, which can be detrimental to adolescent sleep and health. In parallel, chronotype is known to play a role in adolescent health; evening chronotype adolescents are at higher risk for sleep problems and lower academic achievement. In the summer of 2008, Kénogami High School (Saguenay, Canada) was destroyed by fire. Kénogami students were subsequently relocated to Arvida High School (situated 5.3 km away) for the 2008-2009 academic year. A dual school schedule was implemented, with Arvida students attending a morning schedule (0740-1305 h) and Kénogami students an afternoon schedule (1325-1845 h).

This study aimed to investigate the effects of such school schedules and chronotype on sleep, light exposure, and daytime functioning. Twenty-four morning and 33 afternoon schedule students wore an actigraph during 7 days to measure sleep and light exposure. Academic achievement was obtained from school. Subjects completed validated questionnaires on daytime sleepiness, psychological distress, social rhythms, school satisfaction, alcohol, and chronotype. Overall, afternoon schedule students had longer sleep duration, lower sleepiness, and lower light exposure than morning schedule students. Evening chronotypes (E-types) reported higher levels of sleepiness than morning chronotypes (M-types) in both morning and afternoon schedules. Furthermore, M-types attending the morning schedule reported higher sleepiness than M-types attending the afternoon schedule. No difference was found between morning and afternoon schedule students with regard to academic achievement, psychological distress, social rhythms, school
satisfaction, and alcohol consumption. However, in both schedules, M-type had more regular social rhythms and lower alcohol consumption. In summary, this study emphasizes that an early school schedule is associated with detrimental effects in terms of sleep deprivation and daytime sleepiness, even for M-types. Furthermore, irrespective of school schedule, E-type adolescents face an increased risk for poor daytime functioning.

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Chronotype predicts positive affect rhythms measured by ecological momentary assessment.

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Evening chronotype, a correlate of delayed circadian rhythms, is associated with depression. Altered positive affect (PA) rhythms may mediate the association between evening chronotype and depression severity. Consequently, a better understanding of the relationship between chronotype and PA may aid in understanding the etiology of depression. Recent studies have found that individuals with evening chronotype show delayed and blunted PA rhythms, although these studies are relatively limited in sample size, representativeness and number of daily affect measures. Further, published studies have not included how sleep timing changes on workday and non-workdays, or social jet lag (SJL) may
contribute to the chronotype-PA rhythm link. Healthy non-depressed adults (n = 408) completed self-report affect and chronotype questionnaires. Subsequently, positive and negative affects were measured hourly while awake for at least two workdays and one non-workday by ecological momentary assessment (EMA). Sleep variables were collected via actigraphy and compared across chronotype groups. A cosinor variant of multilevel modeling was used to model individual and chronotype group rhythms and to calculate two variables: (1) amplitude of PA, or the absolute amount of daily variation from peak to trough during one period of the rhythm and (2) acrophase, or the time at which the peak amplitude of affect rhythms occurred. On workdays, individuals with evening chronotype had significantly lower PA amplitudes and later workday acrophase times than their morning type counterparts. In contrast to predictions, SJL was not found to be a mediator in the relationship between chronotype and PA rhythms. The association of chronotype and PA rhythms in healthy adults may suggest the importance of daily measurement of PA in depressed individuals and would be consistent with the hypothesis that evening chronotype may create vulnerability to depression via delayed and blunted PA rhythms.

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Chronotype, Social Jet Lag, and Cardiometabolic Risk Factors in Early Adolescence.


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Importance: Inadequate sleep duration and quality increase the risk of obesity. Sleep timing, while less studied, is important in adolescents because increasing evening preferences (chronotypes), early school start times, and irregular sleep schedules may cause circadian misalignment. Objective: To investigate associations of chronotype and social jet lag with adiposity and cardiometabolic risk in young adolescents. Design, Setting, and Participants: Starting in 1999, Project Viva recruited pregnant women from eastern Massachusetts. Mother–child in-person visits occurred throughout childhood. From January 23, 2012, to October 16, 2016, 804 adolescents aged 12 to 17 years completed 5 days or more of wrist actigraphy, questionnaires, and anthropometric measurements. A cross-sectional analysis using these data was conducted from April 31, 2018, to May 1, 2019. Exposures: Chronotype, measured via a continuous scale with higher scores indicating greater evening preferences, and social jet lag, measured as the continuous difference in actigraphy sleep midpoint in hours from
midnight on weekends vs weekdays, with higher values representing more delayed sleep timing on weekends.

Main Outcomes and Measures: Adiposity, measured via anthropometry and dual-energy x-ray absorptiometry. For a subset of 479 adolescents with blood samples, cardiometabolic risk scores were computed as the mean of 5 sex- and cohort-specific z scores for waist circumference, systolic blood pressure, inversely scaled high-density lipoprotein cholesterol, and log-transformed triglycerides and homeostatic model of insulin resistance.

Results: Among the 804 adolescents in the study, 418 were girls and 386 were boys, with a mean (SD) age of 13.2 (0.9) years. In multivariable models adjusted for age, puberty, season, and sociodemographics, associations of chronotype and social jet lag with adiposity varied by sex. For girls, greater evening preference was associated with a 0.58-cm (95% CI, 0.12-1.03 cm; P = .04 for interaction) higher waist circumference and 0.16 kg/m² (95% CI, 0.01-0.31 kg/m²; P = .03 for interaction) higher fat mass index as measured by dual-energy x-ray absorptiometry; each hour of social jet lag was associated with a 1.19-cm (95% CI, 0.04-2.35 cm; P = .21 for interaction) higher waist circumference and 0.45 kg/m² (95% CI, 0.09-0.82 kg/m²; P = .01 for interaction) higher fat mass index as measured by dual-energy x-ray absorptiometry. Associations of social jet lag and evening chronotypes persisted for many measures of adiposity after adjustment for sleep duration and other lifestyle behaviors. By contrast, no associations were observed in boys. There were no associations with the cardiometabolic risk score for either sex, although statistical power was low for this outcome.

Conclusions and Relevance: Evening chronotypes and social jet lag were associated with greater adiposity in adolescent girls but not adolescent boys. Interventions aimed at improving sleep schedules may be useful for obesity prevention, especially in girls.

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OBJECTIVE: To investigate (1) circadian rest-activity rhythm disturbances among endometrial cancer patients as they recover from surgery in comparison to a historical reference group of women with no cancer history and (2) health- and treatment-related predictors of dysregulated rest-activity rhythms in endometrial cancer patients.

METHODS: 60 endometrial cancer patients participated in a prospective, longitudinal study with actigraphic assessment at 1 week, 1 month, and 4 months post-surgery. 60 women without cancer from an epidemiological sample completed one actigraphic assessment, acting as a reference group.

RESULTS: On average, results revealed initial significant rest-activity dysregulation at 1 week and 1 month post-surgery for the endometrial
cancer group and then significant recovery in rest-activity patterns at 4 months post-surgery. Similarly, the cancer group had significantly more impaired rhythms than the reference group at 1 week post-surgery, but demonstrated comparable rhythms by 4 months post-surgery. Among the health- and treatment-related variables examined, obesity and receipt of more invasive surgery were found to predict more impaired rhythms at all time points.

CONCLUSION(S): The current study highlights significant disturbances in rest-activity patterns for endometrial cancer patients initially during surgical recovery followed by improvement in these patterns by 4 months post-surgery; however, obese patients and those having more invasive surgery demonstrated more impaired rest-activity patterns throughout the 4-month recovery period. Further research is warranted to understand how more impaired rest-activity patterns relate to health and quality of life outcomes.

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Circadian activity rhythm abnormalities in ill and recovered bipolar I disorder patients.

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OBJECTIVES: Most physiological indicators of bipolar disorder (BPD) reflect current acute illness, and rarely have proved to be state-independent. Activity rhythms are highly abnormal in acute phases of BPD; we compared circadian activity rhythms in BPD I patients during ill and recovered states to those of normal controls to test the hypothesis that some abnormalities may persist.

METHODS: We compared 36 adult DSM-IV BPD I patients during acute mania or mixed states, and during full and sustained clinical recovery, to 32 healthy controls of similar age and sex distribution, using wrist-worn, piezoelectric actigraphic monitoring for 72 h and computed cosinor analysis of circadian activity rhythms.

RESULTS: We verified expected major differences between manic or mixed-state BPD I patients and matched normal controls, including phase advances averaging 2.1 h in ill BPD I patients and 1.8 h in recovered patients. Moreover, recovered BPD patients differed highly significantly from controls in several measures, including acrophase advance, higher percentage of nocturnal sleep, and lower average daily activity (mesor). Actigraphic measures among recovered BPD patients were independent of ratings of mania (on the Young Mania Rating Scale), depression (on the Hamilton Depression Rating Scale), or rating-scale scored subjective distress, as well as the type and dose of concurrent psychotropic medication.

CONCLUSIONS: These findings suggest that abnormal activity rhythms, including sustained phase advances, may represent enduring (trait) characteristics of BPD patients even during clinical recovery. If verified, such indices may be useful in supporting diagnoses and as an objective phenotype for genetic or other biological studies.

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Circadian activity rhythm in adult attention-deficit hyperactivity disorder.

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The aim of the present study was to analyze the features of circadian motor activity rhythm of adult attention-deficit hyperactivity disorder (ADHD) patients, by means of functional linear modeling, within the theoretical framework of the two-process model of sleep regulation. Thirty-two ADHD patients and 32 healthy controls (HCs) participated the study. Actiwatch AW64 actigraph was used to quantify motor activity data in 1-min epochs. Participants wore the actigraph on the non-dominant wrist for seven consecutive days. Results show that ADHD patients had significantly higher motor activity than HCs from 4:00 to 7:00, with a peak around 5:00, and from 12:00 to 18:00, with another peak around 14:00. According to the two-process model of sleep regulation, the circadian activity rhythm of ADHD patients may indicate a lower homeostatic sleep
pressure, as reflected by the absence of post-lunch dip, which could be considered a potential trait marker of adult ADHD.

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Circadian activity rhythm in demented and non-demented nursing-home residents measured by telemetric actigraphy.

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There is a need to develop unobtrusive methods for long-term monitoring of sleep/wake and circadian activity patterns in the elderly both in nursing homes and at home settings as sleep is important for health and well-being. The IST Vivago WristCare is an active social alarm system, which provides continuous telemetric monitoring of the user's activity. We examined how the activity signal measured by IST Vivago differed between demented and non-demented subjects living in a nursing home, and how it correlated with the subjective assessment of sleep quality and daytime alertness. The activity signal data together with subjective assessments of sleep quality and daytime vigilance were collected from 42 volunteers (aged 56–97 years; 23 demented and 19 non-demented) for at least 10 days. The demented subjects had lower daytime activity and higher nocturnal activity than the non-demented subjects. Correlations between the activity
parameters and self-assessments were weak but statistically significant. We also found correlation between functional ability and diurnal activity. The results are in line with previous studies with demented and non-demented elderly subjects and suggest that the IST Vivago system provides a valid instrument for unobtrusive continuous long-term monitoring of the circadian rhythm and sleep/wake patterns in the elderly.

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Circadian Activity Rhythm in Early Relapsing-Remitting Multiple Sclerosis.

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While relapsing-remitting is the most prevalent course of multiple sclerosis, the prognostic/predictive markers of the worsening of symptomatology are still debated. With reference to other diseases, the study of the circadian activity rhythm, according to the theoretical framework of the two-process model of sleep regulation and applying functional linear modeling, proved to be useful to identify a possible marker. The usefulness of the study of circadian activity rhythm in multiple sclerosis is strengthened by recent findings indicating a potential involvement of circadian factors in the multifactorial
etiology of the disorder. The aim of the present study was to verify whether circadian activity rhythm of early relapsing-remitting multiple sclerosis patients presents specific alterations, through functional linear modeling. Thirty-five relapsing-remitting multiple sclerosis patients (24 females; mean age ± SD = 31.51 ± 7.74) and 35 healthy controls (24 females; mean age ± SD = 31.29 ± 8.02) were enrolled. They wore an actigraph around the non-dominant wrist for one week. Relapsing-remitting multiple sclerosis patients showed a peak in motor activity around 5:00 a.m., higher than that of healthy controls. The timing of the peak in motor activity in the patients could be explained according to the hyperactive hypothalamus-pituitary-adrenal axis and higher cortisol awakening response reported in these patients.

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Circadian Activity Rhythms and Fatigue of Adolescent Cancer Survivors and Healthy Controls: A Pilot Study.


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STUDY OBJECTIVES: The primary objective of this study was to compare circadian activity rhythms (CARs) of adolescents within five years of completing cancer treatment (survivors) and healthy adolescent controls. Secondary objectives were
to explore differences in the relationship of CARs and fatigue between survivors and controls, and between early survivors (<12 months post-treatment) and late survivors (≥12 months post-treatment).

METHODS: Twenty-nine survivors and 30 controls, aged 13–18 years, participated in this prospective, descriptive pilot study. Adolescents and their parent completed a baseline measure of adolescent's fatigue. Adolescents wore a wrist actigraph continuously for seven days and concurrently kept a sleep diary. Activity data recorded by actigraphy were fitted to an extended cosine model to calculate six CAR variables: acrophase, amplitude, MESOR, up-MESOR, down-MESOR and F-statistic. Linear mixed models explored the relationship between CARs and fatigue.

RESULTS: There were no group differences on CAR or fatigue measures. Among survivors, earlier down-MESOR was associated with higher parent-reported fatigue (p=0.020), and earlier acrophase (p=0.023) and up-MESOR (p=0.025) were associated with higher adolescent-reported fatigue. Significant CAR-by-time post-treatment interaction effects were found on fatigue between early and late survivors. Among controls, higher parent-reported fatigue was associated with higher MESOR (p=0.0495).

CONCLUSIONS: Survivors within the first five years post-treatment were similar to controls on CARs and fatigue, suggesting robust recovery of circadian rhythms post-treatment. Different CAR characteristics were associated with fatigue between survivors and controls. Time post-treatment influenced the relationship between CARs and fatigue for survivors, with significant effects only for early survivors.

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Circadian activity rhythms and mortality: the study of osteoporotic fractures.


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OBJECTIVES: To determine whether circadian activity rhythms are associated with mortality in community-dwelling older women.

DESIGN: Prospective study of mortality.

SETTING: A cohort study of health and aging.

PARTICIPANTS: Three thousand twenty-seven community-dwelling women from the Study of Osteoporotic Fractures cohort (mean age 84).

MEASUREMENTS: Activity data were collected using wrist actigraphy for a minimum of three 24-hour periods, and circadian activity rhythms were
Parameters of interest included height of activity peak (amplitude), midline estimating statistic of rhythm (mesor), strength of activity rhythm (robustness), and time of peak activity (acrophase). Vital status, with cause of death adjudicated through death certificates, was prospectively ascertained.

RESULTS: Over an average of 4.1 years of follow-up, there were 444 (14.7%) deaths. There was an inverse association between peak activity height and all-cause mortality rates, with higher mortality rates observed in the lowest activity quartile (hazard ratio (HR)=2.18, 95% confidence interval (CI)=1.63–2.92) than in the highest quartile after adjusting for age, clinic site, race, body mass index, cognitive function, exercise, instrumental activity of daily living impairments, depression, medications, alcohol, smoking, self-reported health status, married status, and comorbidities. A greater risk of mortality from all causes was observed for those in the lowest quartiles of mesor (HR=1.71, 95% CI=1.29–2.27) and rhythm robustness (HR=1.97, 95% CI=1.50–2.60) than for those in the highest quartiles. Greater mortality from cancer (HR=2.09, 95% CI=1.04–4.22) and stroke (HR=2.64, 95% CI=1.11–6.30) was observed for later peak activity (after 4:33 p.m.; >1.5 SD from mean) than for the mean peak range (2:50–4:33 p.m.).

CONCLUSION: Older women with weak circadian activity rhythms have higher mortality risk. If confirmed in other cohorts, studies will be needed to test whether interventions (e.g., physical activity, bright light exposure) that regulate circadian activity rhythms will improve health outcomes in older adults.

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Circadian activity rhythms and risk of incident dementia and mild cognitive impairment in older women.


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Comment in

OBJECTIVE: Previous cross-sectional studies have observed alterations in activity rhythms in dementia patients but the direction of causation is unclear. We determined whether circadian activity rhythms measured in community-dwelling older women are prospectively associated with incident dementia or mild cognitive impairment (MCI).

METHODS: Activity rhythm data were collected from 1,282 healthy community-dwelling women from the Study of Osteoporotic Fractures (SOF) cohort (mean age 83 years) with wrist actigraphy for a minimum of three 24-
hour periods. Each participant completed a neuropsychological test battery and had clinical cognitive status (dementia, MCI, normal) adjudicated by an expert panel approximately 5 years later. All analyses were adjusted for demographics, body mass index (BMI), functional status, depression, medications, alcohol, caffeine, smoking, health status, and comorbidities.

RESULTS: After 4.9 years of follow-up, 195 (15%) women had developed dementia and 302 (24%) had developed MCI. Older women with decreased activity rhythms had a higher likelihood of developing dementia or MCI when comparing those in the lowest quartiles of amplitude (odds ratio [OR] = 1.57; 95% CI, 1.09-2.25) or rhythm robustness (OR = 1.57; 95% CI, 1.10-2.26) to women in the highest quartiles. An increased risk of dementia or MCI (OR = 1.83; 95% CI, 1.29-2.61) was found for women whose timing of peak activity occurred later in the day (after 3:51 PM) when compared to those with average timing (1:34 PM-3:51 PM).

INTERPRETATION: Older, healthy women with decreased circadian activity rhythm amplitude and robustness, and delayed rhythms have increased odds of developing dementia and MCI. If confirmed, future studies should examine whether interventions (physical activity, bright light exposure) that influence activity rhythms will reduce the risk of cognitive deterioration in the elderly.

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Circadian Activity Rhythms and Sleep in Nurses Working Fixed 8-hr Shifts.
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Shift work is associated with adverse health outcomes. The aim of this study was to explore the effects of shift work on circadian activity rhythms (CARs) and objective and subjective sleep quality in nurses. Female day-shift (n = 16), evening-shift (n = 6), and night-shift (n = 13) nurses wore a wrist actigraph to monitor the activity. We used cosinor analysis and time-frequency analysis to study CARs. Night-shift nurses exhibited the lowest values of circadian rhythm amplitude, acrophase, autocorrelation, and mean of the circadian relative power (CRP), whereas evening-shift workers exhibited the greatest standard deviation of the CRP among the three shift groups. That is, night-shift nurses had less robust CARs and evening-shift nurses had greater variations in CARs compared with nurses who worked other shifts. Our results highlight the importance of assessing CARs to prevent the adverse effects of shift work on nurses' health.

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Circadian activity rhythms for mothers with an infant in ICU.

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Circadian rhythms influence sleep and wakefulness. Circadian activity rhythms (CAR) are altered in individuals with dementia or seasonal affective disorder. To date, studies exploring CAR and sleep in postpartum women are rare. The purpose of this report is to describe relationships between CAR, sleep disturbance, and fatigue among 72 first-time mothers during their second week postpartum while their newborn remain hospitalized in intensive care unit. Seventy-two mothers were included in this secondary data analysis sample from three separate studies. Participants completed the general sleep disturbance scale (GSDS), numerical rating scale for fatigue, and a sleep diary. The objective sleep data included total sleep time (TST), wake after sleep onset (WASO), and CAR determined by the circadian quotient (amplitude/mesor) averaged from at least 48-h of wrist actigraphy monitoring. The TST of mothers who self-reported as poor sleepers was 354 min (SEM = 21.9), with a mean WASO of 19.5% (SEM = 2.8). The overall sleep quality measured by the GSDS was clinically, significantly disrupted (M = 5.5, SD = 1.2). The mean score for morning fatigue was 5.8 (SD = 2.0), indicating moderate fatigue severity. The CAR was 0.62 (SEM = 0.04), indicating poor synchronization. The self-reported good sleepers (GSDS < 3) had better CAR (M = 0.71, SEM = 0.02) than poor sleepers (GSDS > 3) (t[70] = 2.0, p < 0.05). A
higher circadian equation was associated with higher TST ($r = 0.83, p < 0.001$), less WASO ($r = -0.50, p < 0.001$), lower self-reported sleep disturbance scores ($r = -0.35, p = 0.01$), and less morning fatigue ($r = -0.26$). Findings indicate that mothers with a hospitalized infant have both nocturnal sleep problems and disturbed circadian activity rhythms. Factors responsible for these sleep and rhythm disturbances, the adverse effects on mother's physical and mental well-being, and mother-infant relationship require further study.

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Circadian adaptation of airline pilots during extended duration operations between the USA and Asia.

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This study tracked circadian adaptation among airline pilots before, during, and after trips where they flew from Seattle (SEA) or Los Angeles (LAX) to Asia (7--9 time zones westward), spent 7--12 d in Asia, and then flew back to the USA. In Asia, pilots' exposures to local time cues and sleep opportunities were constrained by duty (short-haul flights crossing ≤ 1 time zone/24 h). Fourteen captains and 16 first officers participated (median age = 56 versus 48 yrs, $p.U < 0.001$). Their sleep was monitored (actigraphy, duty/sleep diaries) from 3 d pre-trip to 5 d post-trip. For every flight, Karolinska Sleepiness and
Samn-Perelli Fatigue scales and 5-min psychomotor vigilance task (PVT) tests were completed pre-flight and at top of descent (TOD). Participants had ≥ 3 d free of duty prior to outbound flight(s). From 72--24 h prior to departure (baseline sleep), mean total sleep/24 h (TST) = 7.00 h (SD = 1.18 h) and mean sleep efficiency = 87% (SD = 4.9%). Most pilots (23/30) flew direct to and from Asia, but 7 LAX-based pilots flew via a 1-d layover in Honolulu (HNL). On flights with ≥ 2 pilots, mean total in-flight sleep varied from 0.40 to 2.09 h outbound and from 0.74 to 1.88 h inbound. Duty patterns in Asia were variable, with ≤ 2 flights/d (mean flight duration = 3.53 h, SD = 0.53 h). TST on days 17 in Asia did not differ from baseline (p(F) = 0.2031). However, mean sleep efficiency was significantly lower than baseline on days 5--7 (p(F) = 0.0041). More pilots were on duty between 20:00 and 24:00 h on days 57 (mean = 21%) than on days 24 (mean = 14%). Sleep propensity distribution phase markers and chi-square periodogram analyses suggest that adaptation to local time was complete by day 4 in Asia. On pre-flight PVT tests in Asia, the slowest 10% of responses improved for flights departing 14:00--19:59 h (p(F) = 0.0484). At TOD, the slowest 10% of responses improved across days for flights arriving 14:00--19:59 h (p(F) = 0.0349) and 20:00--01:59 h (p(F) = 0.0379). Sleepiness and fatigue ratings pre-flight and at TOD did not change across days in Asia. TST on post-trip day 1 was longer than baseline (estimated mean extension = 1.68 h; adjusted p(t) < 0.0001). On all post-trip days, sleep efficiency was comparable to baseline. Sleep propensity distribution phase markers and chi-square periodogram analyses suggest complete readaptation in 12 d. Two opposing influences appeared to affect sleep and PVT performance across days in Asia: progressive circadian adaptation to local time and increasing duty during local night, which displaced sleep from the optimal...
physiological time. Cumulative sleep restriction across the return flight may explain the large rebound in TST on day 1 post-trip. Thereafter TST, sleep efficiency, and sleep timing suggest that readaptation was complete. Rapid post-trip readaptation may be facilitated by pilots having unconstrained nocturnal sleep opportunities, coupled with stronger patterns of family and social cues than in Asia.

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Circadian analysis of large human populations: inferences from the power grid.

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Few, if any studies have focused on the daily rhythmic nature of modern industrialized populations. The present study utilized real-time load data from the U.S. Pacific Northwest electrical power grid as a reflection of human operative household activity. This approach involved actigraphic analyses of continuously streaming internet data (provided in 5 min bins) from a human subject pool of approximately 43 million primarily residential users. Rhythm analyses reveal striking seasonal and intra-week differences in human activity patterns, largely devoid of manufacturing and automated load interference. Length of the diurnal activity period (alpha) is longer during the spring than the summer (16.64 h versus 15.98 h, respectively; p < 0.01). As expected, significantly more activity occurs in the solar dark phase during the winter than
during the summer (6.29 h versus 2.03 h, respectively; p < 0.01). Interestingly, throughout the year a "weekend effect" is evident, where morning activity onset occurs approximately 1 h later than during the work week (5:54 am versus 6:52 am, respectively; p < 0.01). This indicates a general phase-delayering response to the absence of job-related or other weekday morning arousal cues, substantiating a preference or need to sleep longer on weekends. Finally, a shift in onset time can be seen during the transition to Day Light Saving Time, but not the transition back to Standard Time. The use of grid power load as a means for human actimetry assessment thus offers new insights into the collective diurnal activity patterns of large human populations.

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Circadian and homeostatic changes of sleep-wake and quality of life in stroke: implications for neurorehabilitation.

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The present study aimed to assess changes in the circadian and homeostatic control of the sleep-wake pattern in stroke patients and correlations with quality of life. Participants were 22 patients (55 ± 12 years) and 24 healthy subjects (57 ± 11 years). Instruments used were: the Pittsburgh Sleep Quality Index, SF-36 Questionnaire and Actigraphy. Data were analyzed by Mann-Whitney test and Spearman's correlation. Results identified a significant difference in sleep quality and quality of life between patients and healthy
subjects, with patients on average exhibiting poor sleep quality (patients: 8.4 ± 3.4; healthy subjects: 6.2 ± 2.5; p = 0.0001) and low quality of life scores (p < 0.001). Correlation analysis detected an association between circadian variables (total activity, start and finish times of activity) and quality of life (p < 0.001). Associations between homeostatic variables (sleep duration, latency and efficiency) and quality of life were also significant (p < 0.001). In conclusion, results in this study showed compromised sleep quality and quality of life in the patients evaluated, associated with circadian and homeostatic alterations. This suggests that complaints regarding poor sleep quality be taken into consideration when planning the rehabilitation of stroke patients.

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Circadian blood pressure classification scheme and the health of patients with chronic kidney disease.

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BACKGROUND: In health, a sinusoidal rhythm is observed in systolic blood pressure (BP) that peaks (acrophase) during the waking hours (in-phase), but in those with chronic kidney disease (CKD) the acrophase is often observed during sleeping hours (out-of-phase). Yet in others the amplitude of the variation may be so blunted that acrophase may not be definable (phase-less). Circadian rhythms in
systolic BP are often described by the dichotomous dipper classification but may not be adequate to fully characterize derangements in cyclical variation in BP.

METHODS: To compare classification of circadian BP variation by phase-based classification to dipper-status we examined the cross-sectional relationship of these classification patterns to several markers of health such as health-related quality of life (Kidney Disease Quality of Life Survey, KDQOL) and physical activity (actigraphy over 2 weeks). We also assessed the relationship of circadian BP variation with circadian variation in urine electrolyte and albumin excretion rates.

RESULTS: Among 103 veterans with CKD (97% men, age 69, diabetes mellitus 30%, eGFR 38.8 ml/min/1.73 m(2)) no differences were seen between dippers and non-dippers (n = 77, 75%) in eGFR, urinary Na and Cl excretion rates, or KDQOL. However, non-dippers had lower levels of physical activity and greater albuminuria compared to dippers. The same patients were classified to be in-phase (n = 36, 35%), phase-less (n = 19, 18%) or out-of-phase (n = 48, 47%). Patients in-phase had a higher eGFR and somewhat surprisingly also had the highest Na and Cl excretion rates compared to others. Those with out-of-phase systolic BP had the lowest physical composite score on KDQOL, the lowest level of physical activity, and the greatest amount of albuminuria.

CONCLUSIONS: Among patients with CKD, circadian BP profile described by either dipper-based or phase-based classification is related to the level of physical activity and the severity of kidney damage. The circadian BP profile is related to overall health and nutritional intake only when using the phase-based classification. The value of these classification schemes to profile circadian BP will require longitudinal studies.

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Circadian Characteristics of Older Adults and Aerobic Capacity.

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BACKGROUND: Alteration of circadian rhythmicity with aging might depend on physical aerobic capacity.
METHODS: Three groups of participants were established based on their peak oxygen consumption (Group 1 < 20mL/min/kg; Group 2 > 20mL/min/kg and <30mL/min/kg; Group 3 > 30mL/min/kg). Each participant had an individual evaluation of their circadian rhythmicity characteristics through two well-known circadian rhythms: core temperature and rest/activity cycles. Nocturnal sleep was also recorded using actimetry and diurnal vigilance tested in a car driving simulator.
RESULTS: The amplitude of the oral temperature fluctuations for Group 1 is significantly lower (p < .05) than that of Group 3. Group 2 (p < .01) and Group 3 (p < .05) were significantly more active during the day than Group 1. The index of inactivity during the night for Groups 2 (p < .05) and 3 (p < .01) was higher than Group 1. Results of the car driving simulation showed that for Group 1, the
number of lane crossings was significantly higher than Groups 2 (p < .01) and 3 (p < .01). In addition, diurnal vigilance was lower in Group 1.

CONCLUSIONS: The biological clock seems to be enhanced in older participants with a higher level of physical capacity.

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Circadian clock gene polymorphisms and sleep-wake disturbance in Alzheimer disease.


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OBJECTIVES: One of the hypothesized causes of the breakdown in sleep-wake consolidation often occurring in individuals with Alzheimer disease (AD) is the dysfunction of the circadian clock. The goal of this study is to report indices of sleep-wake function collected from individuals with AD in relation to relevant polymorphisms in circadian clock-related genes.

DESIGN: One week of ad libitum ambulatory sleep data collection.

SETTING: At-home collection of sleep data and in-laboratory questionnaire.

PARTICIPANTS: Two cohorts of AD participants. Cohort 1 (N = 124): individuals
with probable AD recruited from the Stanford/Veterans Affairs, National Institute on Aging Alzheimer's Disease Core Center (N = 81), and the Memory Disorders Clinic at the University of Nice School of Medicine (N = 43). Cohort 2 (N = 176): individuals with probable AD derived from the Alzheimer's Disease Neuroimaging Initiative data set.

MEASUREMENTS: Determination of sleep-wake state was obtained by wrist actigraphy data for 7 days in Cohort 1 and by the Neuropsychiatric Inventory questionnaire for Cohort 2. Both cohorts were genotyped by using an Illumina Beadstation (Illumina, San Diego, CA), and 122 circadian-related single-nucleotide polymorphisms (SNPs) were examined. In Cohort 1, an additional polymorphism (variable-number tandem repeat in per3) was also determined.

RESULTS: Adjusting for multiple tests, none of the candidate gene SNPs were significantly associated with the amount of wake time after sleep onset (WASO), a marker of sleep consolidation. Although the study was powered sufficiently to identify moderate-sized correlations, we found no relationships likely to be of clinical relevance.

CONCLUSIONS: It is unlikely that a relationship with a clinically meaningful correlation exists between the circadian rhythm-associated SNPs and WASO in individuals with AD.

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PMID: 21709609  [Indexed for MEDLINE]


Circadian Contrasts in Heart Rate Variability Associated With Posttraumatic Stress Disorder Symptoms in a Young Adult Cohort.

Prior research has demonstrated that individuals exposed to trauma have shown impaired autonomic function. We sought to determine if heart rate variability (HRV), a marker of impaired autonomic function, differed across periods of wake, rest, and sleep as a function of the level of symptoms of posttraumatic stress disorder (PTSD). A sample of young adults (N = 209), 95 of whom met full criteria for current PTSD based on the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995), were evaluated for ≈ 24 hr using actigraphy and electrocardiogram. Actigraphy data were categorized as active, rest, or sleep. Multilevel modeling analyses showed that individuals with high PTSD symptom severity had lower high-frequency HRV than individuals with low PTSD symptom severity during periods of sleep, $t(1083) = 2.20, p = .028$, Cohen's $d = 0.12$. No differences were found during periods of activity, $t(1083) = 1.34, p = .499$, $d = 0.05$, or rest, $t(1083) = 1.34, p = .180$, $d = 0.09$. Our findings extended the import of prior studies to suggest that those with elevated PTSD symptoms may have decreased parasympathetic
control during sleep. Moreover, relative to periods of wake and rest, sleep may represent a state of increased vulnerability for decreased parasympathetic cardiac control. Individuals with elevated PTSD symptoms may benefit from early screening for detection of cardiovascular disease.

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Circadian disruption and biomarkers of tumor progression in breast cancer patients awaiting surgery.


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Psychological distress, which can begin with cancer diagnosis and continue with treatment, is linked with circadian and endocrine disruption. In turn, circadian/endocrine factors are potent modulators of cancer progression. We hypothesized that circadian rest–activity rhythm disruption, distress, and diurnal cortisol rhythms would be associated with biomarkers of tumor progression in the peripheral blood of women awaiting breast cancer surgery. Breast cancer patients (n=43) provided actigraphic data on rest–activity rhythm, cancer–specific distress (IES, POMS), saliva samples for assessment of diurnal cortisol rhythm, cortisol awakening response (CAR), and diurnal mean. Ten potential markers of tumor progression were quantified in serum samples and grouped by exploratory factor analysis. Analyses yielded three factors, which appear to include biomarkers reflecting different aspects of tumor progression. Elevated factor scores indicate both high levels and strong clustering among serum signals. Factor 1 included VEGF, MMP–9, and TGF–β; suggesting tumor invasion/immunosuppression. Factor 2 included IL–1β, TNF–α, IL–6R, MCP–1; suggesting inflammation/chemotaxis. Factor 3 included IL–6, IL–12, IFN–γ;
suggesting inflammation/TH1-type immunity. Hierarchical regressions adjusting age, stage and socioeconomic status examined associations of circadian, distress, and endocrine variables with these three factor scores. Patients with poor circadian coordination as measured by rest–activity rhythms had higher Factor 1 scores ($R(2)=.160$, $p=.038$). Patients with elevated CAR also had higher Factor 1 scores ($R(2)=.293$, $p=.020$). These relationships appeared to be driven largely by VEGF concentrations. Distress was not related to tumor-relevant biomarkers, and no other significant relationships emerged. Women with strong circadian activity rhythms showed less evidence of tumor promotion and/or progression as indicated by peripheral blood biomarkers. The study was not equipped to discern the cause of these associations. Circadian/endocrine aberrations may be a manifestation of systemic effects of aggressive tumors. Alternatively, these results raise the possibility that, among patients with active breast tumors, disruption of circadian activity rhythms and elevated CAR may facilitate tumor promotion and progression.

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Circadian dysfunction and fluctuations in gait initiation impairment in Parkinson's disease.

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In people with Parkinson's disease (PD), anticipatory postural adjustments may be prolonged, reduced in amplitude, or absent, contributing to impaired gait initiation. In addition to motor symptoms, disturbance of the circadian rhythm (CR) is one of the common non-motor symptoms of PD. The purpose of this study was to investigate whether time of day modulates the magnitude of gait initiation impairment, and furthermore, if there is any relationship between CR dysfunction and impaired postural control in PD. Seven consecutive 24-h periods of wrist actigraphy (as a measure of CR), and then gait initiation studies (at two different times, 9:00 a.m. and 2:30 p.m., of the same day) were conducted in two cohorts of ten subjects each: people with PD, and age-matched control subjects.

We found that in the PD group, the amplitude of medial/lateral center of pressure (CoP) excursions were significantly reduced in the afternoon as compared with the morning session across all trials ($p < 0.05$). Actigraphy results showed that CR amplitude was significantly decreased ($p < 0.05$) in the PD group, which suggests that the PD group suffered from CR disruption. More importantly, changes in medial/lateral CoP displacement were correlated with abnormal CR amplitude in the PD group. These findings provide novel evidence that diurnal fluctuations in treatment-resistant motor symptoms of PD, such as postural and gait initiation deficits, are associated with CR dysfunction. This study supports the idea that
therapeutic correction of circadian misalignment should be considered in combination with pharmaceutical and rehabilitation treatments of motor symptoms in PD.

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Circadian eating and sleeping patterns in the night eating syndrome.
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Comment in

OBJECTIVE: To compare the eating and sleep-wake patterns of persons with the night eating syndrome (NES) with those of matched control subjects.
RESEARCH METHODS AND PROCEDURES: Forty-six overweight/obese NES subjects (mean age 43.3 +/- 9.8 years; 32 women) and 43 similar controls (mean age 39.0 +/- 11.0 years; 28 women) wore wrist actigraphs for 7 days and completed sleep and food diaries at home.
RESULTS: There was no difference between the total energy intake of the NES and the control subjects, but the pattern of energy intake differed greatly. Relative to control subjects, the temporal pattern of food intake of night eaters was delayed. Food intake after the evening meal, as a proportion of the 24-hour intake, was more than 3-fold greater in NES subjects than in controls (34.6 +/- 10.1% vs. 10.0 +/- 6.9%, p = 0.001). NES subjects had sleep onset, offset, and total sleep duration times comparable with those of controls. NES subjects
reported more nocturnal awakenings than did controls (1.5 +/- 1.0 per night vs. 0.5 +/- 0.5; p < 0.001), and their actigraphically monitored arousals occurred earlier during sleep (at 128 minutes after sleep onset vs. 193 minutes, p = 0.01). NES subjects consumed food on 74% of the awakenings vs. 0% for the controls.

DISCUSSION: The pattern of cumulative energy intake of the night eaters suggests a phase delay in energy consumption relative to sleep-wake times. NES may involve a dissociation of the circadian control of eating relative to sleep.

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Circadian function in patients with advanced non-small-cell lung cancer.


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This study aimed to evaluate whether patients with advanced non-small-cell lung cancer experience disrupted rest–activity daily rhythms, poor sleep quality, weakness, and maintain attributes that are linked to circadian function such as fatigue. This report describes the rest–activity patterns of 33 non-small-cell lung cancer patients who participated in a randomised clinical trial evaluating the benefits of melatonin. Data are reported on circadian function, health–related quality of life (QoL), subjective sleep quality, and anxiety/depression levels prior to randomisation and treatment. Actigraphy data, an objective measure of circadian function, demonstrated that
patients' rest-activity circadian function differs significantly from control subjects. Our patients reported poor sleep quality and high levels of fatigue. Ferrans and Powers QoL Index instrument found a high level of dissatisfaction with health-related QoL. Data from the European Organization for Research and Treatment for Cancer reported poor capacity to fulfil the activities of daily living. Patients studied in the hospital during or near chemotherapy had significantly more abnormal circadian function than those studied in the ambulatory setting. Our data indicate that measurement of circadian sleep/activity dynamics should be accomplished in the outpatient/home setting for a minimum of 4–7 circadian cycles to assure that they are most representative of the patients' true condition. We conclude that the daily sleep/activity patterns of patients with advanced lung cancer are disturbed. These are accompanied by marked disruption of QoL and function. These data argue for investigating how much of this poor functioning and QoL are actually caused by this circadian disruption, and, whether behavioural, light-based, and or pharmacologic strategies to correct the circadian/sleep activity patterns can improve function and QoL.

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Circadian misalignment affects sleep and medication use before and during spaceflight.

Sleep deficiency and the use of sleep-promoting medication are prevalent during spaceflight. Operations frequently dictate work during the biological night and sleep during the biological day, which contribute to circadian misalignment. We investigated whether circadian misalignment was associated with adverse sleep outcomes before (preflight) and during spaceflight missions aboard the International Space Station (ISS). Actigraphy and photometry data for 21 astronauts were collected over 3,248 days of long-duration spaceflight on the ISS and 11 days prior to launch (n=231 days). Sleep logs, collected one out of every 3 weeks in flight and daily on Earth, were used to determine medication use and subjective ratings of sleep quality. Actigraphy and photometry data were processed using Circadian Performance Simulation Software to calculate the estimated endogenous circadian temperature minimum. Sleep episodes were classified as aligned or misaligned relative to the estimated endogenous circadian temperature minimum. Mixed-effects regression models accounting for repeated measures were computed by data collection interval (preflight, flight) and circadian alignment status. The estimated endogenous circadian temperature minimum occurred outside sleep episodes on 13% of sleep episodes during preflight and on 19% of sleep episodes during spaceflight. The mean sleep duration in low-Earth orbit on the ISS was 6.4±1.2 h during aligned and 5.4±1.4 h (P<0.01) during misaligned sleep episodes. During aligned sleep episodes,
astronauts rated their sleep quality as significantly better than during misaligned sleep episodes (66.8±17.7 vs. 60.2±21.0, P<0.01). Sleep-promoting medication use was significantly higher during misaligned (24%) compared with aligned (11%) sleep episodes (P<0.01). Use of any medication was significantly higher on days when sleep episodes were misaligned (63%) compared with when sleep episodes were aligned (49%; P<0.01). Circadian misalignment is associated with sleep deficiency and increased medication use during spaceflight. These findings suggest that there is an immediate need to deploy and assess effective countermeasures to minimize circadian misalignment and consequent adverse sleep outcomes both before and during spaceflight.

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Conflict of interest statement: LKB has previously received research support from Cephalon, NFL charities, Sysco and San Francisco Bar Pilots. She has received consulting/lecture fees or served as a board member for Alertness Solution, Ceridian, Davis Joint Unified School Board, San Jose State University Foundation, Pugot Sound Pilots, Sygma and Torvec. EEF-E is an employee of NASA Ames Research Center; AAK has a patent, REM-Sleep Directed Visual Alarm System and Method, issued. CAC has received consulting fees from, or served as a paid member of scientific advisory boards for Amazon.com, Inc., A2Z Development Center, Inc., Bose Corporation, Boston Red Sox, Cleveland Browns, Institute of Digital Media and Child Development, Jazz Pharmaceuticals, Inc., Koninklijke Philips Electronics, Merck Sharpe and Dohme, Novartis, Purdue Pharma, Quest Diagnostics, Samsung Electronics, Teva Pharmaceutical Industries, and Vanda Pharmaceuticals; owns an equity interest in Somnus and Vanda Pharmaceuticals; and receives research/education support from Philips Respironics, Mary Ann and
Stanley Snider
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Hospital and Partners HealthCare in accordance with their conflict of
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Sanofi-Aventis, Tempur-Pedic, Walmart, Proctor and Gamble, Optum,
Bose, Vanda
Pharmaceutical
Industries, Ltd., Wake Up Narcolepsy, and Sepracor. CAC is the
incumbent of an
endowed professorship provided to Harvard University by Cephalon, and
holds
several process patents in the specialty of sleep and circadian
rhythms (e.g.,
photic resetting of the human circadian pacemaker). CAC has served as
an expert
witness on various legal cases related to Celadon, Crete Carrier
Corporation,
Citgo, sleep and circadian rhythms, including matters related to
Celadon, Crete
Carrier Corporation, Citgo, Bombardier, Fedex, HG Energy, Michael
Jackson’s
mother and children, Purdue Pharma, Stric Lan LLC, Valero, and United
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Circadian motor activity affected by stimulant medication in children
with
attention-deficit/hyperactivity disorder.

Ironside S(1), Davidson F, Corkum P.
Attention-deficit/hyperactivity disorder (ADHD) is a highly prevalent disorder occurring in approximately 3-5% of school-aged children. The core symptoms of ADHD are effectively treated with stimulant medications such as methylphenidate; however, there are also negative side effects, including insomnia. It has been suggested that administration of stimulant medication may alter the timing or regularity of circadian motor activity levels. This study aimed to investigate the impact of stimulant medication on the strength and timing of circadian rhythms in 16 stimulant medication-naïve children with ADHD. Participants were monitored for changes in motor activity during a 3-week blinded placebo-controlled medication trial to examine the impact of immediate-release methylphenidate hydrochloride. Motor activity was measured by actigraphy, and 24-h activity profiles were analysed using cosinor analyses to identify measurable changes in circadian rhythms. The children in this sample demonstrated significant increases in motor activity during the sleep-onset latency period. They also showed a significant reduction in relative circadian amplitude and a phase-delay in the timing of the daily rhythm. Clinicians and parents of children being treated with stimulant medication for ADHD should be aware that stimulant medication may cause disruption of sleep/circadian rhythms. Behavioural strategies to improve sleep may be useful for children experiencing these negative effects from medication.

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Circadian motor asymmetries before and after prolonged wakefulness in humans.

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It was hypothesized that the relative superiority of the non-dominant hand movements during late evening could arise from a more pronounced homeostatic deactivation of the left hemisphere. We tested such hypothesis collecting motor activity before and after prolonged wakefulness. Fifty-one right-handed subjects wore actigraphs on both left and right wrist for three consecutive days (baseline-sleep deprivation-sleep recovery). We replicated higher motor activity in left hand respect to the right hand at 22:00 and 23:00 h, but only in baseline condition. The results provide the evidence that circadian motor asymmetries do not seem to express homeostatic processes.

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Circadian motor asymmetries in humans.

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Previous research studies indicate that motor activity during sleep is lateralized to the non-dominant hand. We put forward the hypothesis that the relative superiority of the non-dominant hand movements during night could arise from a different circadian phase relationship between the two
hemispheres, independently of the sleep condition. The present study evaluated whether actigraphic data are consistent with such hypothesis. A total of 58 right-handed university students wore actigraphs (AMI 32K) on both left and right wrist for 3 consecutive days. Mesor and acrophase were computed using cosinor analysis. Moreover, factorial analysis of variances were carried out on side (left versus right) and time of day. The results indicated that the left hand circadian rhythm had a significant phase delay in comparison to the right hand one. The mean activity of the left hand was significantly higher than that of the right hand from 20:00 until 04:00 h. The results are suggestive of a different circadian activation between the two hemispheres and are discussed in relation to models of circadian regulation of sleep/wake cycle.

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Circadian ontogeny through the lens of nonparametric variables of actigraphy.

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Studies focusing on human rhythmicity show that human circadian rhythm suffers constant changes across lifespan. Changes in rest-activity patterns can be studied through nonparametric variables of actigraphy: L5 (an individual's least active 5 h), M10 (an individual's most active 10 h) and RA (relative amplitude of the rest-activity rhythm). The variable RA is the normalized
difference between L5 and M10 - the higher the RA, the greater the difference between these two variables. This study used the data bank of the Human Chronobiology Laboratory of Federal University of Paraná (Brazil). It analyzed actimetric data of 93 children between 4 and 11 years of age in their naturalistic context in order to describe the development of nonparametric variables. Correlation between age and L5 was significantly negative (rho = -0.29, p = 0.004), while correlation between age and RA was significantly positive (rho = 0.31, p = 0.003). The variables M10, sL5 (start of L5) and sM10 (start of M10) did not show significant correlation to age. Furthermore, there were no statistical differences between genders. The population of this study, healthy children, has been poorly assessed by similar literature. Through our results, we have demonstrated that, as children age, L5 significantly decreases, which reflects a smaller fragmentation of circadian rhythm. As an expected consequence, RA significantly increases. In other words, these nonparametric variables of actimetry successfully demonstrate that children tend to reduce nocturnal activity as they age, a phenomenon that reflects the ongoing consolidation of circadian rhythm.

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Circadian pattern of ambulatory blood pressure in untreated hypertensive patients with and without metabolic syndrome.

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There is a strong association between metabolic syndrome (MS) and increased risk of end-organ damage, cardiovascular disease, stroke, and cardiovascular mortality. Moreover, non-dipping (<10% decline in the asleep relative to the awake blood pressure [BP] mean) and elevated ambulatory pulse pressure (PP), among other factors related to the circadian BP pattern, have also been associated with increased cardiovascular morbidity and mortality. This cross-sectional study investigated the circadian BP pattern in 2,045 non-diabetic untreated patients with uncomplicated essential hypertension (941 men/1,099 women), 48.7 +/- 11.9 yrs of age, classified by the presence or absence of MS. BP was measured by ambulatory monitoring for 48 consecutive hours to substantiate reproducibility of the dipping pattern. Physical activity was simultaneously monitored every min by wrist actigraphy to accurately calculate mean BP when awake and asleep for each subject. MS was present in 40.7% of the patients. Patients with MS were characterized by a significantly higher 24 h mean of systolic BP and a lower diastolic BP compared to patients without MS. Accordingly, ambulatory PP was significantly elevated the entire 24 h in MS patients. The prevalence of an altered non-dipper BP profile was significantly higher in MS patients (48.4 vs. 36.1% in patients without MS, p < 0.001). MS patients were characterized, among other risk factors, by significantly higher uric acid, fibrinogen, leukocyte count, hemoglobin and globular sedimentation velocity, plus lower estimated glomerular filtration rate. Apart from corroborating the significant increased prevalence of a blunted nocturnal BP decline in MS, this study documents ambulatory PP is higher in MS, without differences between groups in mean arterial pressure. This elevated PP might reflect increased arterial stiffness in MS. MS patients were also characterized by elevated values of relevant markers of cardiovascular risk, including
fibrinogen and globular sedimentation velocity. These collective findings indicate that MS should be included among the clinical situations in which ambulatory BP monitoring is recommended.

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Circadian pattern of blood pressure, heart rate, and double product in liver glycogen storage disease.

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The objective of this study was to determine systolic, diastolic, and mean arterial blood pressure (SBP, DBP, and MAP), heart rate (HR), double-product (DP: SBP x HR), and activity levels and their 24h pattern in liver glycogen storage disease (LGSD) patients. A case series of 12 (11 pediatric and one adult) diurnally active LGSD (seven type I, three type III, and two type IX) subjects were simultaneously assessed by 24h ambulatory blood pressure monitoring and wrist actigraphy. Nine subjects were judged to be hypertensive based on the criterion of an elevated 24h mean SBP and/or DBP being elevated beyond reference standards or the SBP and/or DBP load (percentage of time BP exceeds normal values) being greater than 25%. Two of the three other subjects, not viewed as hypertensive based on their 24h average SBP or DBP, exhibited daytime or nighttime SBP and/or DBP load hypertension. Each study variables displayed statistically significant (p < 0.001) group circadian rhythmicity. The
SBP, DBP, and MAP displayed comparable 24h patterns of appreciable amplitude (total peak-trough variation equal to 17.7, 23.6, and 19.6%, respectively, of the 24h mean) with highest values (orthophase) occurring approximately 11 h after the commencement of daytime activity. The sleep-time trough (bathyphase) occurred approximately 4.5 h before morning awakening. The statistically significant (p < 0.006) circadian rhythms of HR (amplitude equal to 33.2% of the 24h mean) and DP (amplitude equal to 49.4% of the 24h mean) peaked earlier, approximately 7.4 h into the daytime activity span. The sleep-time trough occurred approximately 3 h before morning awakening. The 24h pattern in the cardiovascular variables was correlated with the 24h pattern of activity, with r ranging from 0.50 for DBP to 0.39 for HR.

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Circadian pattern of motor activity in adults with attention-deficit/hyperactivity disorder.

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This study aims to describe the 24-hour activity rhythm in adults with attention-deficit/hyperactivity disorder (ADHD). A total of 18 ADHD patients and 37 healthy controls (HCs) wore an actigraph for 7 days. ADHD patients showed higher motor activity than HCs at 4:00, 6:00, 15:00 and 16:00 hour. Within the theoretical framework of the two-process model of sleep regulation, the observed
data may be explained by lower homeostatic sleep pressure in ADHD. This could lead to an increase in motor activity in the second half of the night, when sleep need decreases more rapidly, and in the first half of the afternoon, when patients do not experience the typical post-lunch dip.

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Circadian pattern of motor activity in major depressed patients undergoing antidepressant therapy: relationship between actigraphic measures and clinical course.

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The 24-hour motor activity pattern was evaluated in 26 inpatients with major depression at treatment onset and after 4 weeks of antidepressant therapy. Clinical state, depression, and psychomotor retardation, as well as motor activity level and circadian rhythm, were simultaneously assessed. Treatment responders and nonresponders were also considered. Diurnal hypoactivity and reduced 24-hour rhythm amplitude were found at treatment onset. Activity level increased significantly on discharge. The rest–activity cycle for each depressed patient fit a cosine function of 24-hour periodicity. Data tended to show no phase shift but a large intragroup phase variability. Preliminary findings of a negative correlation between basic activity level and clinical improvement, and a trend toward responders having a lower activity level than nonresponders, suggest
that activity could be used to predict therapeutic response.

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Circadian Phase Advances in Response to Weekend Morning Light in Adolescents With Short Sleep and Late Bedtimes on School Nights.

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Many adolescents fall asleep too late to get enough sleep (8-10 h) on school nights. Morning bright light advances circadian rhythms and could help adolescents fall asleep earlier. Morning bright light treatment before school, however, is difficult to fit into their morning schedule; weekends are more feasible. We examined phase advances in response to morning light treatment delivered over one weekend. Thirty-seven adolescents (16 males; 14.7–18.0 years) who reported short school-night sleep (≤7 h) and late bedtimes (school-nights ≥23:00; weekend/non-school nights ≥24:00) slept as usual at home for ~2 weeks ("baseline") and then kept a fixed sleep schedule (baseline school-night bed and wake-up times ±30 min) for ~1 week before living in the lab for one weekend. Sleep behavior was measured with wrist actigraphy and sleep diary. On Saturday morning, we woke each participant 1 h after his/her midpoint of baseline weekend/non-school night sleep and 1 h earlier on Sunday. They remained in dim room light (~20 lux) or received 1.5 or 2.5 h of intermittent morning bright light (~6000 lux) on both mornings. The dim light melatonin onset
(DLMO), a phase marker of the circadian timing system, was measured on Friday and Sunday evenings to compute the weekend circadian phase shift. The dim room light and 1.5-h bright light groups advanced the same amount (0.6 ± 0.4 and 0.6 ± 0.5 h). The 2.5-h bright light group advanced 1.0 ± 0.4 h, which was significantly more than the other groups. These data suggest that it is possible to phase advance the circadian clock of adolescents who have late bedtimes and short school-night sleep in one weekend using light that begins shortly after their sleep midpoint.

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Circadian phase and its relationship to nighttime sleep in toddlers.

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Circadian phase and its relation to sleep are increasingly recognized as fundamental factors influencing human physiology and behavior. Dim light melatonin onset (DLMO) is a reliable marker of the timing of the circadian clock, which has been used in experimental, clinical, and descriptive studies in the past few decades. Although DLMO and its relationship to sleep have been well documented in school-aged children, adolescents, and adults, very little is known about these processes in early childhood. The purpose of this study
was 1) to describe circadian phase and phase angles of entrainment in toddlers and 2) to examine associations between DLMO and actigraphic measures of children's nighttime sleep. Participants were 45 healthy toddlers aged 30 to 36 months (33.5 ± 2.2 months; 21 females). After sleeping on a parent-selected schedule for 5 days (assessed with actigraphy and diaries), children participated in an in-home DLMO assessment involving the collection of saliva samples every 30 minutes for 6 hours. Average bedtime was 2015 ± 0036 h, average sleep onset time was 2043 ± 0043 h, average midsleep time was 0143 ± 0038 h, and average wake time was 0644 ± 0042 h. Average DLMO was 1929 ± 0051 h, with a 3.5-hour range. DLMO was normally distributed; however, the distribution of the bedtime, sleep onset time, and midsleep phase angles of entrainment were skewed. On average, DLMO occurred 47.8 ± 47.6 minutes (median = 39.4 minutes) before bedtime, 74.6 ± 48.0 minutes (median = 65.4 minutes) before sleep onset time, 6.2 ± 0.7 hours (median = 6.1 hours) before midsleep time, and 11.3 ± 0.7 hours before wake time. Toddlers with later DLMOs had later bedtimes (r = 0.46), sleep onset times (r = 0.51), midsleep times (r = 0.66), and wake times (r = 0.65) (all p < 0.001). Interindividual differences in toddlers' circadian phase are large and associated with their sleep timing. The early DLMOs of toddlers indicate a maturational delay in the circadian timing system between early childhood and adolescence. These findings are a first step in describing the fundamental properties of the circadian system in toddlers and have important implications for understanding the emergence of sleep problems and the consequences of circadian misalignment in early childhood.

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Circadian phase estimation of chronic insomniacs relates to their sleep characteristics.

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The significance of the phase of circadian rhythmicity for the diagnosis of sleep disturbance was investigated in a group of 80 chronic insomniacs (59 females; mean age 34.8, range 18–59 years). In order to stay close to common clinical practice, data were collected by means of two-week sleep diaries in combination with repeated measurements of subjective alertness and oral temperature. Special measures were taken to minimize the impact of masking upon the temperature measurements. In addition, wrist activity was monitored for an overlapping period of 11 days. Measurements of oral temperature and subjective alertness were fitted with 3 (rd) –degree polynomials, for which the peak times (times of maximum) were identified. Principal Components Analysis of these peak times and the times of bed-in and wake-up for all subjects revealed that the phase estimates for the alertness and the sleep-wake rhythms had a strong interrelationship, which was independent from the temperature phase. Using the 25– and the 75–percentiles of the frequency distribution of the temperature peak times as boundaries, the subjects were classified into early (N = 18), middle (N = 37) and late (N = 19) temperature phase subgroups, which had mean peak times of 14:08 h, 17:43 h and 20:09 h, respectively. Comparisons between the early phase and the late phase subgroups showed that a significant overall MANOVA effect was mainly due to
differences in total sleep time (early < late) as calculated from the log, and to differences in the mean nocturnal actigraphic count (early> late). Moreover, the subjective estimates of sleep latency (early < late) and wake after sleep onset (early > late) tended to differ between the two subgroups. The main result of this study, i.e., that insomniacs with a relatively advanced temperature phase had a relatively shorter and more restless sleep, while insomniacs with a relatively delayed temperature phase tended to experience a relatively long sleep latency, supports the conclusion that the addition of oral temperature measurements to a sleep/wake log extends its diagnostic and therapeutic applicability.

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Circadian phase in adults of contrasting ages.

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There is evidence that aging may impair phase-shifting responses to light synchronizers, which could lead to disturbed or malsynchronized circadian rhythms. To explore this hypothesis, 62 elder participants (age, 58 to 84 years) and 25 young adults (age, 19 to 40 years) were studied, first with baseline 1-wk wrist actigraphy at home and then by 72 h in-laboratory study using an ultra-short sleep-wake cycle. Subjects were awake for 60 minutes in 50 lux followed by 30 minutes of darkness for sleep. Saliva samples were collected for melatonin, and urine samples were collected for aMT6s (a urinary
metabolite of melatonin) and free cortisol every 90 minutes. Oral temperatures were also measured every 90 minutes. The timing of the circadian rhythms was not significantly more variable among the elders. The times of lights-out and wake-up at home and urinary free cortisol occurred earlier among elders, but the acrophases (cosinor analysis-derived peak time) of the circadian rhythm of salivary melatonin, urinary aMT6s, and oral temperature were not significantly phase-advanced among elders. The estimated duration of melatonin secretion was 9.9 h among elders and 8.4 h among young adults \((p < 0.025)\), though the estimated half-life of blood melatonin was shorter among elders \((p < 0.025)\), and young adults had higher saliva melatonin and urinary aMT6s levels. In summary, there was no evidence for circadian desynchronization associated with aging, but there was evidence of some rearrangement of the internal phase-angles among the studied circadian rhythms.

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Circadian phase in sleep-disturbed adolescents with a history of substance abuse: a pilot study.

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The relationship between actigraphy- or diary-based sleep parameters and salivary melatonin-based dim light melatonin onsets (DLMOs) was examined in 21 adolescents with a history of substance abuse and current complaints of sleep difficulties. The adolescents displayed relationships between diary-based sleep
times and DLMO that were of comparable strength with those reported for adult insomniacs and healthy adolescents during the school year, but weaker than those observed in healthy adults and healthy adolescents on summer vacation. When the sample was divided into adolescents with late and early DLMOs, the 2 groups had significantly different phase angles between DLMO and sleep variables but no other significant differences in sleep parameters. However, circadian phase and its relationship to sleep may have sleep and behavioral consequences.

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Circadian phase response curves to light in older and young women and men.

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BACKGROUND: The phase of a circadian rhythm reflects where the peak and the trough occur, for example, the peak and trough of performance within the 24 h. Light exposure can shift this phase. More extensive knowledge of the human circadian phase response to light is needed to guide light treatment for shiftworkers, air travelers, and people with circadian rhythm phase disorders. This study tested the hypotheses that older adults have absent or weaker phase-shift responses to light (3000 lux), and that women's responses might differ from those of men.

METHODS: After preliminary health screening and home actigraphic recording baselines, 50 young adults (ages 18-31 years) and 56 older adults (ages 59-75
years) remained in light-controlled laboratory surroundings for 4.7 to 5.6 days, while experiencing a 90-min ultra-short sleep-wake cycle. Following at least 30 h in-lab baseline, over the next 51 h, participants were given 3 treatments with 3000 lux white light, each treatment for 3 h, centered at one of 8 clock times. The circadian rhythms of urinary aMT6s (a melatonin metabolite), free cortisol, oral temperature, and wrist activity were assessed at baseline and after treatment.

RESULTS: Light (3000 lux for 3 h on 3 days) induced maximal phase shifts of about 3 h. Phase shifts did not differ significantly in amplitude among older and young groups or among women and men. At home and at baseline, compared to the young, the older adults were significantly phase-advanced in sleep, cortisol, and aMT6s onset, but not advanced in aMT6s acrophase or the temperature rhythm. The inflection from delays to advances was approximately 1.8 h earlier among older compared to young participants in reference to their aMT6s rhythm peaks, and it was earlier in clock time.

CONCLUSION: In these experimental conditions, 3000 lux light could shift the phase of circadian rhythms to about the same extent among older and young adults, but the optimal light timing for phase shifting differed. For an interval near 4 PM, bright light produced only negligible phase shifts for either age group.

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Circadian phase shifts and mood across the perinatal period in women with a history of major depressive disorder: a preliminary communication.
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BACKGROUND: Perinatal changes in maternal sleep patterns may modify circadian phase. Our objectives were to (a) measure changes in circadian phase and phase angle between salivary dim light melatonin onset (DLMO) and sleep onset across the perinatal period; and (b) prospectively examine associations between circadian measures and depressed mood in women with a history of major depressive disorder (MDD).

METHODS: Twelve women (age±SD=26.9±5 years) who fulfilled DSM-IV criteria for history of MDD (but not in a mood episode at enrollment) were studied from third trimester of pregnancy through postpartum week 6. Participants completed sleep diaries, wore wrist actigraphs and light sensors, and had mood assessed with the Hamilton Depression Rating Scale (HAM-D-17) during 3 separate weeks of the perinatal period; they gave saliva samples at 33 weeks gestation and 6 weeks postpartum to determine DLMO phase.

RESULTS: Nine women had DLMO phase shifts ≥30 min. On average±SD, new mothers phase delayed 42±80 min (range=163 min phase delay to 144 min phase advance). The time interval between average actigraphic sleep onset and DLMO was shorter at 6 weeks postpartum compared to 3rd trimester in 9 of 12 women, indicating that most new mothers were going to bed closer to the onset of endogenous melatonin secretion. Circadian measures were associated with depressed mood at postpartum weeks 2 and 6.

LIMITATIONS: These data are preliminary findings from a small sample and require replication.

CONCLUSIONS: We observed individual differences in magnitude and direction of
circadian phase shifts and their timing relative to sleep across the perinatal period. These measures were correlated with postpartum depressive symptoms. These preliminary data indicate that changes in perinatal circadian rhythms may contribute to the development of postpartum mood disorders.

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Circadian phenotype impacts the brain's resting-state functional connectivity, attentional performance, and sleepiness.


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INTRODUCTION: Functional connectivity (FC) of the human brain's intrinsically connected networks underpins cognitive functioning and disruptions of FC are associated with sleep and neurological disorders. However, there is limited research on the impact of circadian phenotype and time of day on FC.

STUDY OBJECTIVES: The aim of this study was to investigate resting-state FC of the default mode network (DMN) in Early and Late circadian phenotypes over a socially constrained day.

METHODS: Thirty-eight healthy individuals (14 male, 22.7 ± 4.2 years) categorized as Early (n = 16) or Late (n = 22) using the Munich ChronoType
Questionnaire took part. Following a 2-week baseline of actigraphy coupled with saliva samples for melatonin and cortisol rhythms, participants underwent testing at 14:00 hours, 20:00 hours, and 08:00 hours the following morning. Testing consisted of resting-state functional magnetic resonance imaging (fMRI), a structural T1 scan, attentional cognitive performance tasks, and self-reported daytime sleepiness. Seed-based FC analysis from the medial prefrontal and posterior cingulate cortices of the DMN was performed, compared between groups and linked with behavioral data.

RESULTS: Fundamental differences in the DMN were observed between Early and Late circadian phenotypes. Resting-state FC of the DMN predicted individual differences in attention and subjective ratings of sleepiness.

CONCLUSION: Differences in FC of the DMN may underlie the compromised attentional performance and increased sleepiness commonly associated with Late types when they conform to a societally constrained day that does not match their intrinsic circadian phenotype.

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Circadian preference and sleep timing from childhood to adolescence in relation to genetic variants from a genome-wide association study.

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OBJECTIVE: Recent genome-wide association studies (GWASs) have revealed new genetic variants behind self-reported individual circadian preference, a distinct biological trait that is fairly stable during adulthood. In this study we analyze whether these genetic variants associate with objectively measured sleep timing from childhood to adolescence, over a nine-year period, with self-reported circadian preference during late adolescence.

METHODS: The participants (N = 100, 61% girls) came from a community cohort from Finland born in 1998. Sleep midpoint was measured with actigraphy at 8, 12 and 17 years. Circadian preference was self-reported at the age of 17 years. Single nucleotide polymorphisms (SNPs) were extracted at 12 years of age from the Illumina OmniExpress Exome 1.2 bead array data. Weighted polygenic risk scores (PRSs) were calculated based on top SNPs from a recent GWAS for morningness-eveningness in an adult population.

RESULTS: The PRS for circadian preference towards morningness was associated with earlier sleep midpoint from childhood to adolescence. When the time points were analyzed separately, the association between genetic tendency towards morning preference and earlier sleep midpoint was strongest among the 17-year-olds. Furthermore, the shift towards later sleep rhythm from early to late adolescence
was milder for those with a higher PRS for morning preference. PRS for morning preference was also associated with self-reported circadian preference towards morningness in late adolescence.

CONCLUSION: Our results suggest that genetic variants found for circadian preference in adults are already associated with objective sleep timing during childhood and adolescence, and predict individual developmental sleep trajectories from childhood onwards.

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Circadian preferences in young adults: Psychometric properties and factor structure of the Portuguese version of the Preferences Scale (PS-6).

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Morningness is a trait-like variable which has been extensively studied within chronobiology. Despite the number of existing measures to assess morningness, there is a need for brief instruments that are psychometrically sound to be used in applied settings. Accordingly, the modified version of the Preferences Scale (PS-6) comprises six items and was reported to have adequate
reliability and satisfactory validity indicators. In this article, the psychometric properties of the Portuguese version of the PS-6 are reported. A total of 700 students attending medical school were recruited, and this sample was randomly divided into two groups. In the first group (n = 352), we assessed the internal consistency calculations and conducted a principal component analysis of the posited structure. In the second group (n = 348), we conducted a confirmatory factor analysis (CFA) using structural equation modeling. Overall, the results indicated that the PS-6 has adequate reliability ($\alpha = .75$) and is constituted by two components: (I) preferred cognitive activities timings and (II) preferred sleeping-eating timings, respectively. In conclusion, the Portuguese version of the PS seems suitable for use in research and applied settings such as shift work schedules management. However, the applicability of the PS-6 in other samples and further validity indicators should be both investigated. The use of actigraphy and biological measures should also be collected to enhance the robustness of the PS-6.

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Circadian Profile of an Emergency Medicine Department: Scheduling Practices and Their Effects on Sleep and Performance.

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BACKGROUND: Shiftwork causes circadian disruption and is the primary reason for attrition from Emergency Medicine.

OBJECTIVES: We aimed to develop concrete recommendations to mitigate negative effects of shiftwork based on measures of work, sleep, alertness, and performance in emergency physicians.

METHODS: Thirty-one Emergency Medicine residents were surveyed retrospectively about sleep and alertness on different shifts. Additionally, the sleep, performance, and alertness of 22 Emergency Medicine resident and attending physicians was tracked continuously over 4 weeks via sleep logs, actigraphy, real-time reported sleepiness, and performance on a vigilance task. Schedules were analyzed for circadian disruption. Physicians also predicted their sleep schedules, which were compared with actual schedules; participants tracked extensions of shifts, schedule changes, and shifts in other hospitals.

RESULTS: Daily rhythms were apparent in real-time performance and alertness data, with peaks at around 4 pm. Sleep difficulty was highest, sleep shortest, and alertness and performance lowest for night shifts. Emergency Medicine residents tended to cluster multiple night shifts in a row, despite evidence of accumulating sleep debt over consecutive shifts. There were many shifts that caused high circadian disruption, which could be avoided by simple amendments to scheduling practices.

CONCLUSIONS: Circadian principles should be applied as suggested by the American
College of Emergency Physicians. Chronotype should be considered in scheduling. Night shifts, particularly, should not be extended. Clustering all night shifts in a row should probably be discouraged. The additional vulnerabilities for night shift could be mitigated by adopting napping mid- or post night shift and by providing pay differentials.

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Circadian regulation gene polymorphisms are associated with sleep disruption and duration, and circadian phase and rhythm in adults with HIV.


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Genes involved in circadian regulation, such as circadian locomotor output cycles kaput [CLOCK], cryptochrome [CRY1] and period [PER], have been associated with sleep outcomes in prior animal and human research. However, it is unclear whether polymorphisms in these genes are associated with the sleep disturbances commonly
experienced by adults living with human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS). Thus, the purpose of this study was to describe polymorphisms in selected circadian genes that are associated with sleep duration or disruption as well as the sleep-wake rhythm strength and phase timing among adults living with HIV/AIDS. A convenience sample of 289 adults with HIV/AIDS was recruited from HIV clinics and community sites in the San Francisco Bay Area. A wrist actigraph was worn for 72 h on weekdays to estimate sleep duration or total sleep time (TST), sleep disruption or percentage of wake after sleep onset (WASO) and several circadian rhythm parameters: mesor, amplitude, the ratio of mesor to amplitude (circadian quotient), and 24-h autocorrelation. Circadian phase measures included clock time for peak activity (acrophase) from actigraphy movement data, and bed time and final wake time from actigraphy and self-report. Genotyping was conducted for polymorphisms in five candidate genes involved in circadian regulation: CLOCK, CRY1, PER1, PER2 and PER3. Demographic and clinical variables were evaluated as potential covariates. Interactions between genotype and HIV variables (i.e. viral load, years since HIV diagnosis) were also evaluated. Controlling for potentially confounding variables (e.g. race, gender, CD4+ T-cell count, waist circumference, medication use, smoking and depressive symptoms), CLOCK was associated with WASO, 24-h autocorrelation and objectively-measured bed time; CRY1 was associated with circadian quotient; PER1 was associated with mesor and self-reported habitual wake time; PER2 was associated with TST, mesor, circadian quotient, 24-h autocorrelation and bed and wake times; PER3 was associated with amplitude, 24-h autocorrelation, acrophase and bed and wake times. Most of the observed associations involved a significant interaction between genotype and HIV. In this chronic illness population,
polymorphisms in several circadian genes were associated with measures of sleep disruption and timing. These findings extend the evidence for an association between genetic variability in circadian regulation and sleep outcomes to include the sleep-wake patterns experienced by adults living with HIV/AIDS. These results provide direction for future intervention research related to circadian sleep-wake behavior patterns.

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Circadian research in mothers and infants: how many days of actigraphy data are needed to fit cosinor parameters?

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Actigraphy is an easily applied approach for assessing activity and circadian patterns in mother-infant dyads. However, timing and duration of actigraphic measurements can affect assessment accuracy. The purpose of this study was to determine the number of days of actigraphy data required to portray circadian rhythm in mothers and their young infants. Continuous actigraphy monitoring was performed in 20 mother-infant pairs over a 4-day period. Cycle mesor, amplitude, acrophase, and R2 were calculated and compared using from 1 to 4 days of data. Parameters based on 4 days of data were correlated with parameters derived from 1 to 3 days of data. There were no differences among mother or infant cosinor parameters except infant acrophase, which stabilized after > or = 2 days of data. Acceptable reliability (r > .80) was achieved with > or = 2 days of
data. It was concluded that a recording period of 2 days adequately depicted circadian rhythm of actigraphy in mothers and infants.

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Circadian rest-activity disturbances in children with seasonal affective disorder.

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OBJECTIVE: Seasonal affective disorder (SAD) affects from 1.7% to 5.5% of children. Previous studies found that nonseasonally depressed children had a blunted circadian rhythm, while adults with SAD had a delayed and poorly entrained rhythm. The purpose of this study was to determine whether pediatric SAD more closely resembles nonseasonal pediatric depression or adult SAD.

METHOD: Twelve normal, healthy volunteers (11.6 +/- 3.7 years; 6 female, 6 male) and 14 unmedicated children with SAD (11.0 +/- 3.3 years; 9 female, 5 male) meeting Rosenthal/NIMH criteria for SAD and Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic version criteria for major depression had their levels of activity recorded for 72 hours (weekdays) using belt-worn actigraphs.

RESULTS: The SAD group had blunted circadian amplitudes that were 10% lower than normal (p = .004). They were more poorly modeled by the standard cosinor equation (p = .001), and a circadian rhythm accounted for 39% less of the variability in their activity profile (p = .007). The amplitude of the 12-hour harmonic rhythm
was markedly increased. There were no differences between SAD and control children in the timing of the circadian rhythm and degree of entrainment. CONCLUSIONS: Children with SAD displayed dysregulated circadian activity rhythms comparable with those reported in nonseasonally depressed children, yet different from those observed in adults.

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Circadian rest–activity disturbances in seasonal affective disorder.

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BACKGROUND: Previous studies hypothesized that seasonal affective disorder (SAD) was caused by a circadian rhythm abnormality. The purpose of this study was to ascertain whether rest–activity rhythms were phase delayed, diminished in amplitude, or more poorly entrained to the 24-hour day.

METHOD: Twenty healthy adult controls and 25 outpatients meeting Rosenthal–National Institute of Mental Health criteria for SAD and DSM-III-R criteria for major or bipolar depression with seasonal pattern had their levels of activity recorded for 72 hours (weekdays) using wrist-worn actigraphs.

RESULTS: Subjects with SAD had activity levels that were 11% lower than controls (P = .03), and their levels of activity were most attenuated during the first 2 hours after arising (P = .004). The relative amplitude of the circadian rhythm did not differ between groups. Patients with SAD were phase delayed by 50 minutes for the entire period (P = .02). Analysis of each individual day indicated that patients were delayed by up to 70 minutes (P = .007). Interdaily
stability, an index of coupling between the rhythm and its zeitgeber was reduced in SAD (P = .01). Compared with controls, patients with SAD had best-fit circadian periods that were 92% more deviated from 24 hours (P = .007) and daily acrophase (time of the peak of the fit circadian rhythm) times that were 110% more variable between days (P < .001).

CONCLUSIONS: Patients with SAD have circadian rest–activity rhythms that are significantly phase delayed and more poorly entrained to the 24-hour day.

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Circadian Rest–Activity Pattern Changes in Aging and Preclinical Alzheimer Disease.

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Importance: Circadian rhythm disturbances occur in symptomatic Alzheimer disease (AD) and have been hypothesized to contribute to disease pathogenesis. However, it is unknown whether circadian changes occur during the presymptomatic phase of the disease.

Objective: To examine the associations between circadian function, aging, and preclinical AD pathology in cognitively normal adults.

Design, Setting, and Participants: This cross-sectional study was conducted using...
community volunteers from the Knight Alzheimer's Disease Research Center at Washington University in St Louis. Cognitively normal participants (n = 205) underwent 7 to 14 days of actigraphy in their home environment between 2010 and 2012, in addition to clinical assessment, amyloid imaging with Pittsburgh Compound B (PiB), and cerebrospinal fluid biomarker collection. Data collected from 3 years before to 6 months after actigraphy were included. Sixteen participants were excluded owing to incomplete data collection. Main Outcomes and Measures: Circadian rhythm analysis was performed on actigraphy data using 3 methods: cosinor, nonparametric, and empirical mode decomposition. Preclinical AD was assessed by longitudinal clinical assessment, amyloid imaging with PiB, and cerebrospinal fluid biomarker collection. Results: Data from 189 participants were included in the analyses. The mean (SD) age was 66.6 (8.3) years, and 121 participants (64%) were women. Older age (β = .247; P = .003) and male sex (β = .170; P = .04), in the absence of amyloid pathology, were associated with a significant increase in intradaily variability, a nonparametric measure of rest-activity rhythm fragmentation, as well as decreased amplitude by several measures. After correction for age and sex, the presence of preclinical amyloid plaque pathology, assessed by positive PiB imaging (mean [SD], 0.804 [0.187] for PiB negative vs 0.875 [0.178] for PiB positive; P = .05) or increasing cerebrospinal fluid phosphorylated-tau to amyloid β 42 ratio (β = .231; P = .008), was associated with increased intradaily variability, indicating rest-activity rhythm fragmentation. Conclusions and Relevance: Preclinical AD is associated with rest-activity rhythm fragmentation, independent of age or sex. Aging was also associated with circadian dysfunction independently of preclinical AD pathology, particularly in men. The presence of circadian rhythm abnormalities in the preclinical phase of AD suggests that circadian dysfunction could contribute to early
Bipolar disorder (BD) and borderline personality disorder (BPD) are two psychiatric disorders with overlapping features that can be challenging to separate diagnostically. Growing evidence suggests that circadian rhythm disturbances are associated with psychiatric illness, however circadian patterns of behaviour have not been elucidated in BPD or differentiated from BD. This study compared the circadian structure and timing of rest-activity patterns in BPD with BD and healthy volunteers. Participants with BD (N = 31) and BPD (N = 21) and healthy controls (HC, N = 35) wore an actigraph on their non-dominant wrist for 28 day periods as part of the Automated Monitoring of Symptom Severity (AMoSS) study. Non-parametric circadian rhythm analysis of rest-activity patterns and cosinor analysis of distal temperature rhythms were conducted to elucidate circadian function between groups. Covariates
controlled for included employment status, BMI and gender. Compared with HC and BD, individuals with BPD showed significantly delayed phase of night-time rest patterns ("L5 onset") (mean difference = 1:47 h, P < 0.001; mean difference = 1:38 h, P = 0.009, respectively), and relative to HC showed delayed daytime activity onset ("M10 onset") (mean difference = 2:13 h, P = 0.048) and delayed temperature phase (mean difference = 1:22 h, P = 0.034). These findings suggest that delayed circadian function may be a clinically important phenotype in individuals with BPD. Future work should interrogate the causality of this association and examine interventions which target delayed circadian function in the treatment of BPD.

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The circadian rest-activity rhythm, a potential safety pharmacology endpoint of cancer chemotherapy.


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The robustness of the circadian timing system (CTS) was correlated to quality of life and predicted for improved survival in cancer patients. However, chemotherapy disrupted the CTS according to dose and circadian timing in mice. A continuous and repeated measures longitudinal design was implemented
here to characterize CTS dynamics in patients receiving a fixed circadian-based chemotherapy protocol. The rest–activity rhythm of 49 patients with advanced cancer was monitored using a wrist actigraph for 13 days split into four consecutive spans of 3–4 days each, i.e., before, during, right after and late after a fixed chronotherapy course. The relative amount of activity in bed vs. out of bed (I<0, main endpoint), the autocorrelation coefficient r24, the relative 24-hr amplitude (Amp), interdaily stability (IS) and intradaily variability (IV) were compared according to study span. Circadian disruption (I<0 ≤ 97.5%) resulted from the administration of the fixed chronotherapy protocols, with all five rest–activity rhythm parameters being worsened in the whole group of patients (p < 0.05). Mean parameter values subsequently recovered to near baseline values. The occurrence of circadian disruption on chemotherapy was associated with a higher risk of clinically relevant fatigue (p = 0.028) or body weight loss (p = 0.05). Four CTS dynamic patterns characterized treatment response including no change (9.5% of the patients); improvement (14.3%); alteration and complete recovery (31%) or sustained deterioration (45%), possibly due to inadequate chronotherapy dosing and/or timing. Improved clinical tolerability could result from the minimization of circadian disruption through the personalization of chronotherapy delivery.

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Circadian rest–activity rhythm as an objective biomarker of patient-reported
outcomes in patients with advanced cancer.


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BACKGROUND: Psychosocial symptoms often cluster together, are refractory to treatment, and impair health-related quality of life (HR-QoL) in cancer patients. The contribution of circadian rhythm alterations to systemic symptoms has been overlooked in cancer, despite a causal link shown under jet lag and shift work conditions. We investigated whether the circadian rest-activity rhythm provides a reliable and objective estimate of the most frequent patient-reported
outcome measures (PROMs).

METHODS: Two datasets were used, each involving concomitant 3-day time series of wrist actigraphy and HR-QoL questionnaires: EORTC QLQ-C30 was completed once by 237 patients with metastatic colorectal cancer; MD Anderson Symptom Inventory (MDASI) was completed daily by 31 patients with advanced cancer on continuous actigraphy monitoring, providing 1015 paired data points. Circadian function was assessed using the clinically validated dichotomy index I < 0. Nonparametric tests compared PROMs and I < 0. Effect sizes were computed. Sensitivity subgroup and temporal dynamics analyses were also performed.

RESULTS: I < 0 values were significantly lower with increasing symptom severity and worsening HR-QoL domains. Fatigue and anorexia were worse in patients with circadian disruption. The differences were both statistically and clinically significant (P < 0.001; d ≥ 0.33). Physical and social functioning, and global quality/enjoyment of life were significantly better in patients with robust circadian rhythm (P < 0.001; d ≥ 0.26). Sensitivity analyses validated these findings.

CONCLUSION: Objectively determined circadian disruption was consistently and robustly associated with clinically meaningfully severe fatigue, anorexia, and interference with physical and social functioning. This supports an important role of the circadian system in the determination of cancer patients' HR-QoL and symptoms that deserves therapeutic exploitation.

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Circadian rest-activity rhythm for maintenance of body shape.
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A recently developed wearable device has gained attention in the area of self-discipline for the prevention of lifestyle-related diseases. The present study aimed to clarify the relationship between circadian rhythm and body shape change using actigraphy. Using a body shape vector, we classified 24 women in their 40s and 50s into 3 groups with different body shape changes. A circadian rhythm experiment was conducted on weekdays for 1 week with 24 healthy women. Amounts of activity of the non-dominant wrist and trunk, subjective evaluation of sleep quality, and subjective state of activity were surveyed. In order to maintain a constant body shape throughout life, a less sedentary lifestyle with more trunk movement during the day, getting adequate sleep at night, and having a varied sleep-wake cycle may be important factors.

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Circadian rest-activity rhythm in chronic obstructive pulmonary disease.
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To characterize circadian rest-activity rhythm in COPD, 26 cases (66.9 ± 8.5y) and 15 controls (63.0 ± 10.7y) were assessed by actimetry. Rhythm fragmentation was measured by intradaily variability (IV), while synchronization to the 24-h light-dark cycle was measured by interdaily stability (IS). The average activity during the least active 5-h period (L5) and the average activity during the most active 10-h period (M10) were used to calculate the relative amplitude mean [RAm = (M10−L5)/(M10+L5)]. COPD patients presented higher IVm (0.242 ± 0.097 vs 0.182 ± 0.063) and L5 (36.849 ± 18.239 vs 19.888 ± 12.268) and lower RAm (0.696 ± 0.134 vs 0.833 ± 0.093) than controls. Future studies on the effects of chronotherapy measures in COPD are warranted.

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BACKGROUND: At-risk mental states (ARMS) are clinical syndromes that are associated with higher risk, compared with the general population, for developing psychosis and bipolar disorder. Circadian rhythm misalignments have been proposed to be part of this early phase of the clinical course.

OBJECTIVE: To compare circadian rhythm of activity and rest changes between ARMS individuals and a healthy control group.

METHODS: Forty volunteers of both genders, aged between 13 and 27 years old, participated in this study (n=20 ARMS group, and n=20 healthy controls). The ARMS individuals were classified as ultra-high risk for psychosis according to the CAARMS (Comprehensive Assessment of At-risk Mental State) or at high risk for bipolar disorder according to criteria proposed by Bechdolf and colleagues. Participants used an actigraph for fifteen days, kept a sleep diary, and completed the Epworth Sleepiness Scale, the Pittsburgh Sleep Quality Index, and a Morningness–Eveningness Questionnaire.

RESULTS: Compared with healthy volunteers, the ARMS group presented worse sleep quality (P=0.010); longer nap durations (P=0.038), shorter wake times (P=0.001),
higher total sleep times (P=0.011), and shorter activity duration (P=0.021), sleep rhythms were more fragmented, the circadian rest-activity rhythms were less synchronized with the dark-light cycle and had lower amplitudes of motor activity.

CONCLUSION: The results suggest alterations in the circadian rest-activity rhythms (and likely in sleep-wake cycle patterns) in ARMS individuals compared with healthy controls. It is possible that circadian rhythms of activity and rest changes are one of the prodromal clinical and behavioral expressions of the brain changes that underlie ARMS individuals.

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Circadian Rest–Activity Rhythm in Pediatric Type 1 Narcolepsy.
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STUDY OBJECTIVES: Pediatric type 1 narcolepsy is often challenging to diagnose and remains largely undiagnosed. Excessive daytime sleepiness, disrupted nocturnal sleep, and a peculiar phenotype of cataplexy are the prominent features. The knowledge available about the regulation of circadian rhythms in affected children is scarce. This study compared circadian rest–activity rhythm
and actigraphic estimated sleep measures of children with type 1 narcolepsy versus healthy controls.

METHODS: Twenty-two drug-naïve type 1 narcolepsy children and 21 age- and sex-matched controls were monitored for seven days during the school week by actigraphy. Circadian activity rhythms were analyzed through functional linear modeling; nocturnal and diurnal sleep measures were estimated from activity using a validated algorithm.

RESULTS: Children with type 1 narcolepsy presented an altered rest-activity rhythm characterized by enhanced motor activity throughout the night and blunted activity in the first afternoon. No difference was found between children with type 1 narcolepsy and controls in the timing of the circadian phase. Actigraphic sleep measures showed good discriminant capabilities in assessing type 1 narcolepsy nycthemeral disruption.

CONCLUSIONS: Actigraphy reliably renders the nycthemeral disruption typical of narcolepsy type 1 in drug-naïve children with recent disease onset, indicating the sensibility of actigraphic assessment in the diagnostic work-up of childhood narcolepsy type 1.

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Circadian rest-activity rhythm is altered in Parkinson's disease patients with hallucinations.

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The sleep–wake cycle in Parkinson's Disease (PD) is profoundly disrupted, but less is known about circadian rhythm in PD and its relationship to other important clinical features. This study compared rest–activity rhythms in healthy older adults and PD patients with and without hallucinations. Twenty-nine older adults and 50 PD patients (27 with hallucinations, 23 without) were assessed using wrist–worn actigraphy for 5 days. Disease–related and cognitive data were also collected. PD patients demonstrated reduced amplitude of activity (F = 12.719, P < 0.01) and increased intradaily variability (F = 22.005, P < 0.001), compared to healthy older adults, independently of age, and cognitive status. Hallucinators showed lower interdaily stability (F = 7.493, P < 0.01) significantly greater activity during "night-time" (F = 6.080, P < 0.05) and significantly reduced relative amplitude of activity (F = 5.804, P < 0.05) compared to nonhallucinators, independently of clinical factors including motor fluctuations. PD patients with hallucinations display altered rest–activity rhythm characterized by an unpredictable circadian pattern across days, likely arising from damage to brainstem and hypothalamic sleep centers. Treatment of sleep and rest–activity rhythm disturbance is an important target in Parkinson's Disease.

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Circadian rest–activity rhythms during benzodiazepine tapering covered by melatonin versus placebo add–on: data derived from a randomized clinical trial.

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BACKGROUND: Patients with severe mental illness often suffer from disruptions in circadian rest-activity cycles, which might partly be attributed to ongoing psychopharmacological medication. Benzodiazepines are frequently prescribed for prolonged periods despite recommendations of only short-term usage. Melatonin, a naturally occurring nocturnal hormone, has the potential to stabilize disrupted circadian rhythmicity. Our aim was to investigate how prolonged-release melatonin affects rest-activity patterns in medicated patients with severe mental illness and if benzodiazepine dose reduction is associated with changes in circadian rhythm parameters.

METHOD: Data were derived from a randomized, double-blinded clinical trial with 24 weeks follow-up. Participants were randomized to add-on treatment with prolonged-release melatonin (2 mg) or matching placebo, and usual
benzodiazepine dosage was gradually tapered. Here we report the results of 72 h of actigraphic assessment of activity-rest cycles performed pre and post tapering. Changes in rest-activity rhythm parameters between the melatonin and placebo group were analyzed using the univariate general linear model. Change in activity counts per 6 h, from baseline to follow-up, in the whole sample was analyzed using paired samples t-test.

RESULTS: A subsample of 48 patients participated in the actigraphic assessment: 20 in the melatonin group and 28 in the placebo group. Rest-activity cycles varied from regular to highly disrupted. Melatonin significantly increased the interdaily stability and at a trend level decreased the intradaily variability compared with placebo. Benzodiazepine dose reduction was not associated with these circadian rhythm parameters. Activity counts were generally higher after benzodiazepine dose reduction compared with pre tapering, but differences did not reach statistical significance.

CONCLUSION: Our data suggest melatonin as an aid during benzodiazepine withdrawal for patients distressed by disrupted circadian rest-activity cycles. Benzodiazepine tapering might result in diminished sedentary behavior but further research is needed.


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Circadian rest/activity rhythms in knee osteoarthritis with insomnia: a study of osteoarthritis patients and pain-free controls with insomnia or normal sleep.
Aberrant circadian rest/activity rhythms (RARs) may promote poor aging-related health outcomes. Osteoarthritis and chronic insomnia are common age-related conditions, but the circadian RARs of each group have not been well characterized or compared. We evaluated actigraphic RARs in individuals with: (1) knee osteoarthritis (KOA) only; (2) chronic insomnia only; (3) KOA + insomnia; and (4) pain-free good sleepers. Compared to participants with KOA only, those with KOA + insomnia had less robust RARs. There were no differences between other groups. Further research is needed to evaluate whether aberrant RARs contribute to arthritis symptoms and insomnia in KOA, and whether strengthening RARs ameliorates arthritis symptoms.

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PMID: 25290041 [Indexed for MEDLINE]
Background: Cognitive impairment is a common and debilitating symptom of Parkinson's disease (PD), and its etiology is likely multifactorial. One candidate mechanism is circadian disruption. Although there is evidence of circadian abnormalities in PD, no studies have directly assessed their association with cognitive impairment.

Objectives: Investigate whether circadian rest-activity rhythm is associated with cognitive function in PD independently of sleep.

Methods: Thirty-five participants with PD wore wrist actigraph monitors and completed sleep diaries for 7 to 10 days, then underwent neuropsychological testing. Rest-activity rhythm was characterized using nonparametric circadian rhythm analysis of actigraphy data. Objective sleep parameters were also estimated using actigraphy data. Hierarchical regression models assessed the independent contributions of sleep and rest-activity rhythm to cognitive performance.

Results: Less stable day-to-day rest-activity rhythm was associated with poorer executive, visuospatial, and psychomotor functioning, but not with memory. Hierarchical regressions showed that interdaily stability's contribution to cognitive performance was independent of sleep's contributions. Whereas sleep contributed to executive function, but not psychomotor or visuospatial performance, rest-activity rhythm stability significantly contributed to variance in all three of these domains, uniquely accounting for 14.4% to 17.6% of their performance variance.
Conclusions: Our findings indicate that circadian rest-activity rhythm is associated with cognitive impairment independently of sleep. This suggests the possible utility of rest-activity rhythm as a biomarker for circadian function in PD. Future research should explore interventions to stabilize behavioral rhythms in order to strengthen circadian function, which, in turn, may reduce cognitive impairment in PD.

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PMID: 30637282


Circadian rest-activity rhythms predict future increases in depressive symptoms among community-dwelling older men.

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OBJECTIVE: Circadian rest-activity rhythms (CARs) have been cross-sectionally associated with depressive symptoms, although no longitudinal research has examined whether CARs are a risk factor for developing depressive symptoms.

METHODS: We examined associations of CARs (measured with actigraphy over a mean of 4.8 days) with depressive symptoms (measured with the Geriatric Depression Scale) among 2,892 community-dwelling older men (mean age: 76.2 ± 5.5 years) from the MrOS Sleep Study who were without cognitive impairment. Among 2,124 men with minimal (0-2) symptoms at baseline, we assessed associations between CAR parameters and increases to mild (3-5) or clinically significant (≥6) symptoms after an average of 1.2 (±0.32) years.

RESULTS: Cross-sectional associations between rhythm height parameters were independent of chronic diseases, lifestyle, sleep, and self-reported physical activity covariates. For example, men in the lowest mesor quartile had twice the adjusted odds (adjusted odds ratio [AOR]: 2.04, 95% confidence interval [CI]: 1.36-3.04, p = 0.0005) of having prevalent clinically significant symptoms (compared to minimal). Longitudinally, low CAR robustness (being in the lowest quartile of the pseudo-F statistic) was independently associated with increasing odds of developing symptoms (i.e., AOR for having clinically significant depressive symptoms at follow-up = 2.58, 95% CI: 1.11-5.99, p = 0.03).

CONCLUSION: CAR disturbances are indicative of depressive symptomology. Low CAR robustness may independently contribute to the risk of worsening depression symptomology.

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Circadian rhythm abnormalities and autonomic dysfunction in patients with Chronic Fatigue Syndrome/Myalgic Encephalomyelitis.


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Chronic Fatigue Syndrome/Myalgic Encephalomyelitis (CFS/ME) patients frequently show autonomic symptoms which may be associated with a hypothalamic dysfunction. This study aimed to explore circadian rhythm patterns in rest and activity and distal skin temperature (DST) and their association with self-reported outcome measures, in CFS/ME patients and healthy controls at two different times of year. Ten women who met both the 1994 CDC/Fukuda definition and 2003 Canadian criteria for CFS/ME were included in the study, along with ten healthy controls matched for age, sex and body mass index. Self-reported measures were used to assess fatigue, sleep quality, anxiety and depression, autonomic function and health-related quality of life. The ActTrust actigraph was used to record activity, DST and light intensity, with data intervals of one minute over seven consecutive days. Sleep variables were obtained through actigraphic analysis and from subjective sleep diary. The circadian variables and the spectral analysis of the rhythms were calculated. Linear regression analysis was used to
evaluate the relationship between the rhythmic variables and clinical features. Recordings were taken in the same subjects in winter and summer. Results showed no differences in rhythm stability, sleep latency or number of awakenings between groups as measured with the actigraph. However, daily activity, the relative amplitude and the stability of the activity rhythm were lower in CFS/ME patients than in controls. DST was sensitive to environmental temperature and showed lower nocturnal values in CFS/ME patients than controls only in winter. A spectral analysis showed no differences in phase or amplitude of the 24h rhythm, but the power of the second harmonic (12h), revealed differences between groups (controls showed a post-lunch dip in activity and peak in DST, while CFS/ME patients did not) and correlated with clinical features. These findings suggest that circadian regulation and skin vasodilator responses may play a role in CFS/ME.

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Conflict of interest statement: The authors have declared that no competing interests exist.


Circadian rhythm and sleep alterations in older people with lifetime depression: a case–control study.

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BACKGROUND: Depression is common in older people and is associated with underlying brain change increasing the risk of dementia. Sleep disturbance is frequently reported by those with lifetime depression, however whether circadian misalignment also exists is unclear. We aimed to examine circadian rhythms and sleep associations in older patients with and without lifetime depression.

METHODS: Thirty-four older people meeting DSM-IV criteria for lifetime major depression (mean age = 63.9 years), and 30 healthy controls (mean age = 65.7 years) were recruited. Participants underwent 2-weeks of actigraphy followed by a 3-night protocol including dim light melatonin onset (DLMO) assessment and overnight polysomnography (PSG) for sleep architecture. DLMO and phase angle of entrainment were computed.

RESULTS: Compared to controls, participants with depression had a significantly longer phase angle of entrainment (6.82 h ± 1.45 vs. 5.87 h ± 1.60, p = 0.02, Cohens-d = 0.62). A small to moderate yet non-significant difference in DLMO
times, with earlier DLMO (34 ± 27 min) observed in depression (20:36 ± 1:48 vs. 21:10 ± 1:48, p = 0.22, Cohens-d = 0.32). Individuals with depression had longer sleep latency and latency to rapid eye movement sleep than controls (all p < 0.05).

CONCLUSION: Circadian advancement and alterations to the timing of sleep and REM onset are evident in older people with lifetime major depression, despite having only mild residual symptoms. Further research examining the prognostic significance of these changes is warranted as well as chronotherapeutic treatment studies.

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Circadian Rhythm and Sleep During Prolonged Antarctic Residence at Chinese Zhongshan Station.

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OBJECTIVE: Residence at Zhongshan Station (69°22'24"S, 76°22'40"E) for over 1 year exposes winter-over members to marked changes of light-dark cycle, ranging
from the constant daylight of polar days to the constant darkness of polar nights, in addition to geographic and social isolation. This extreme photoperiodic environment may increase the risk of sleep disturbances and circadian desynchrony. The aim of this study was to investigate the circadian rhythm and sleep phase of Chinese winter-over expeditioners at Zhongshan Station.

METHODS: This study was conducted on 17 healthy male participants before departure from Shanghai and during residence at Zhongshan Station for 1 year (before winter, mid-winter, and end of winter). Sequential urine samples over 48 hours were obtained, 6-sulphatoxymelatonin in urine was assessed, and the circadian rhythm was analyzed by a cosine curve-fitting method. Participants' sleep parameters were obtained from wrist actigraphy and sleep logs. Morningness–Eveningness Questionnaire and Seasonal Pattern Assessment Questionnaire were completed.

RESULTS: The acrophase of 6-sulphatoxymelatonin rhythm, sleep onset, sleep offset, and mid-sleep time were delayed significantly (P < .05) in Antarctica relative to departure values. The subjects had greater eveningness preference (P < .05) in mid-winter in Antarctica. The Global Seasonality Score and the prevalence of subsyndromal seasonal affective disorder increased (P < .05) during winter.

CONCLUSIONS: Our results indicate that during polar nights Chinese expeditioners experienced the following problems: delayed circadian rhythm and sleep phase, later chronotype, and incidence of subsyndromal seasonal affective disorder. An appropriate combination of artificial bright light during dark winter months and a strict social schedule are recommended in a winter-over station in Antarctica.

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A circadian rhythm is a cycle of approximately 24 h, responsible for many physiological adjustments, and ageing of the circadian clock contributes to cognitive decline. Rhythmicity is severely impaired in Alzheimer disease (AD) and few therapeutic attempts succeeded in improving sleep disorders in such context. This study evaluated sleep parameters by actigraphy in 30 AD patients before and after trazodone use for 2 weeks, and we show a significant improvement in relative rhythm amplitude (RRA), compatible with a more stable daytime behavioral pattern. So, trazodone appears to produce a stabilization of the circadian rhythms in individuals with AD.

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Circadian rhythm in idiopathic normal pressure hydrocephalus.

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OBJECTIVES: The pathogenesis of idiopathic normal pressure hydrocephalus (iNPH) takes place in structures close to the cerebral ventricular system. Suprachiasmatic nucleus (SCN), situated close to the third ventricle, is involved in circadian rhythm. Diurnal disturbances are well-known in demented patients. The cognitive decline in iNPH is potentially reversible after a shunt operation. Diurnal rhythm has never been studied in iNPH. We hypothesize that there is a disturbance of circadian rhythm in iNPH-patients and the aim was to study any
changes of the diurnal rhythm (mesor and circadian period) as well as any changes
of the diurnal amplitude and acrophase of the activity in iNPH-patients before
and after a shunt operation.
PATIENTS AND METHODS: Twenty consecutive iNPH-patients fulfilling the
criteria of the American iNPH-guidelines, 9 males and 11 females, mean age 73
(49-81) years were included. The patients underwent a pre-operative clinical work-up
including 10m walk time (w10mt) steps (w10ms), TUG-time (TUGt) and steps (TUGs)
and for cognitive function an MMSE score was measured. In order to receive
circadian rhythm data actigraphic recordings were performed using the SenseWear
2 (BodyMedia Inc Pittsburgh, PA, USA) actigraph. Cosinor analyses of
accelerometry data were performed in "R" using non-linear regression with Levenburg-
Marquardt estimation. Pre- and post-operative data regarding mesor, amplitude
and circadian period were compared using Wilcoxon-Mann-Whitney test for paired data.
RESULTS: Twenty patients were evaluated before and three month post-
operatively. Motor function (w10mt, w10ms, TUGt, TUGs) was significantly improved
while MMSE was not significantly changed. Actigraphic measurements (mesor,
amplitude and circadian period) showed no significant changes after shunt operation.
CONCLUSION: This is the first systematic study of circadian rhythm in
iNPH-patients. We found no significant changes in circadian rhythm
after shunt surgery. The conceptual idea of diurnal rhythm changes in
hydrocephalus is still interesting from a theoretical standpoint and warrants further studies
that could include a combination of better designed actigraphic studies in
combination with neuroendocrine markers and imaging methods.

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Circadian rhythm in rest and activity: a biological correlate of quality of life and a predictor of survival in patients with metastatic colorectal cancer.


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The rest-activity circadian rhythm (CircAct) reflects the function of the circadian timing system. In a prior single-institution study, the extent of CircAct perturbation independently predicted for survival and tumor response in 192 patients receiving chemotherapy for metastatic colorectal cancer. Moreover, the main CircAct parameters correlated with several health-related quality of life (HRQoL) scales. In this prospective study, we attempted to extend these results to an independent cohort of chemotherapy-naive metastatic colorectal cancer patients participating in an international randomized phase III trial (European Organisation for Research and Treatment of Cancer 05963). Patients were randomized to receive chronomodulated or conventional infusion of 5-fluorouracil, leucovorin, and oxaliplatin as first-line treatment for metastatic colorectal cancer. Patients from nine institutions completed the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-C30 and wore a wrist accelerometer (actigraph) for 3 days before chemotherapy delivery. Two validated parameters (I<0 and r24) were used to estimate CircAct. Of 130 patients with baseline CircAct assessments, 96 had baseline HRQoL data. I<0 was confirmed to correlate with global quality of life, physical functioning, social
functioning, fatigue, and appetite loss ($r > |0.25|; P < 0.01$). I0 further independently predicted for overall survival with a hazard ratio of 0.94 ($P < 0.0001$). The associations between CircAct parameters, HRQoL, and survival, which were shown in this international study involving previously untreated metastatic colorectal cancer patients, confirm prior single-institution findings in mostly pretreated metastatic colorectal cancer patients. The circadian timing system constitutes a novel therapeutic target. Interventions that normalize circadian timing system dysfunction may affect quality of life and survival in cancer patients.

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PMID: 19470769 [Indexed for MEDLINE]


Circadian rhythm in the assessment of postconcussion insomnia: a cross-sectional observational study.

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BACKGROUND: Insomnia is a major predictor of adverse outcomes in mild traumatic brain injury (mTBI), including concussion; although insomnia symptoms may be due to various sleep disorders, those related to circadian rhythm sleep-wake disorders (CRSWDs) require specific assessment and treatment. The objective of the current study was to determine the prevalence of CRSWD in a sample of treatment-seeking people with chronic insomnia symptoms after an mTBI.

METHODS: Participants aged 17–65 years who had experienced an mTBI and reported chronic insomnia were recruited from diverse community clinics in Ontario 3–24 months after their injury to participate in this cross-sectional observational study. Potential participants were screened by both telephone and intake interview. Exclusion criteria were alcohol or substance use disorders, preexisting brain disorder or previous neurosurgery, recent travel across more than 2 time zones or shift work. Assessments included a clinical interview, questionnaires, 2 weeks of actigraphy and a sleep diary, and a dim-light melatonin onset test. The main outcome measure was the proportion of patients with CRSWDs.

RESULTS: Of the 50 participants (32 [64%] female; median age 39.5 yr), 13 (26% [standard deviation 12%]) had an CRSWD. The most common circadian diagnosis was delayed sleep-wake phase disorder (10 participants [20%]).

INTERPRETATION: The prevalence of CRSWDs may be exceptionally high among people with chronic insomnia symptoms following mTBI. Proper detection and treatment of CRSWDs in this population is essential to facilitate recovery. The findings emphasize the relevance of a diagnostic circadian assessment in patients with mTBI presenting with chronic insomnia symptoms.

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Circadian rhythm mediates the relationship between physical activity and quality of life in younger and older cancer survivors.

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Increasing evidence suggests that physical activity (PA) improves the quality of life (QoL) of cancer survivors. However, the biological mechanisms underlying the relationship between PA and QoL are unclear. The purpose of this study was to determine whether the relationship between PA and QoL differs in younger and older cancer survivors and whether circadian rhythm (CR) mediates this relationship. We also explored the effect of the CR on QoL. The participants were 235 cancer survivors, comprising 143 younger and 92 older patients. Data were collected using the Taiwanese versions of the Physical Activity Scale for the Elderly and Short Form-36. The robustness and stability of the CR were
measured using an actigraph. Mediation was tested using multiple mediation analyses. The CR mediated the relationship between PA and the physical domain of QoL in younger and older cancer survivors (23% and 59% mediating effects, respectively). The CR partially mediated the effect of PA on the mental dimension of QoL in older cancer survivors (36% mediating effect), but not in younger cancer survivors. Cancer survivors with a more robust CR had a significantly higher QoL, particularly in the physical functioning domain ($d = 0.43$, $p < 0.001$). The results provided evidence that the CR mediated the relationship between PA and QoL. Moreover, this mediating effect differed in younger and older cancer survivors. These results can serve as a reference for designing individualized PA programs for cancer survivors.

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Circadian rhythm of hot flashes and activity levels among prostate cancer patients on androgen deprivation therapy.

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OBJECTIVE: Altered circadian rhythms have been identified in untreated prostate cancer patients. Findings of restored rhythmicity following cancer treatment may have relevance for cancer control and symptom management. This study assessed and compared the cyclic patterns of hot flashes and activity levels in treated prostate cancer patients.
METHODS: Data were collected during two 24-h periods among 47 prostate patients undergoing androgen deprivation therapy (ADT). Hot flashes were detected objectively through sternal skin conductance and by patients via electronic event marking. Activity levels were recorded on a wrist actigraphy device. RESULTS: The mean frequency of objectively measured and patient-reported hot flashes was 13.6 (SD = 14.3) and 12.6 (SD = 9.6), respectively. There were significant 24-h circadian rhythms of both hot flashes and activity levels. The peak of the rhythms occurred in early afternoon. There was no significant cross correlation between hot flashes and activity levels. CONCLUSIONS: The acrophases of hot flashes and elevated activity levels in this study may represent a normalisation of circadian rhythms following ADT, pointing to the need for more research, including controlled, prospective chronobiologic studies. Future research may have important implications for the survival of prostate cancer patients and the identification of new and safe hot flash treatments.

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Circadian rhythm of rest activity and autonomic nervous system activity at different stages in Parkinson's disease.

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Patients with Parkinson's disease (PD) often suffer from non-motor symptoms, including sleep and autonomic dysfunctions, controlled by circadian
To evaluate the alteration of circadian rhythm in PD patients, we investigated both rest activities and autonomic functions. Twenty-seven patients with idiopathic PD and 30 age-matched control subjects were recruited. Group comparisons of controls (mean age: 68.93 years), early-PD patients classified as Hoehn-Yahr (HY) stage 1&2 (mean age: 70.78 years), and advanced-PD as HY 3&4 (mean age: 68.61 years) were conducted. Measurement of rest activities was performed using Actigraph for 7 continuous days, and included measuring rhythm patterns (activity patterns recorded in or out of bed) and circadian rhythm amplitudes (power of the cycle being closest to 24h). A power spectral analysis of heart rate variability (HRV) using 24-hour ambulatory ECG was also performed. The actigraphic measurements indicated that statistically PD patients have lower activity levels when out of bed and higher activity levels when in bed, and that, the circadian rest-activity rhythm in PD decreases with disease severity. The HRV analysis showed that the total frequency component and low frequency/high frequency ratio were low in PD patients, suggesting that autonomic activities and the circadian rhythm of the sympathetic nervous system are attenuated in PD. This study elucidated the disorganization in the rest activities and HRV of PD patients as well as the gradual alterations in the circadian rhythm. The circadian rhythm disturbances are important to consider the mechanism of non-motor symptoms that occur from early stage of PD.
Circadian rhythm of wrist temperature in normal-living subjects A candidate of new index of the circadian system.

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Most circadian rhythms are under the control of a major pacemaker located in the hypothalamic suprachiasmatic nucleus. Some of these rhythms, called marker rhythms, serve to characterize the timing of the internal temporal order. A marker rhythm, (e.g., one used in chronotherapy) has to be periodic and easy to measure over long periods using non-invasive methods. The most frequent reference variables for human chronotherapy include salivary melatonin or cortisol, urinary 6-sulfatoximelatonin, actimetry and core body temperature (CBT). Recent evidence suggests that sleepiness may be more closely linked to increased peripheral skin temperature than to a core temperature drop, and that distal skin temperature seems to be correlated and phase-advanced with respect to CBT, suggesting that heat loss from the extremities may drive the circadian CBT rhythm. The aim of the present study was to evaluate whether the wrist skin temperature rhythm could be used as a possible index of the human circadian system. To this end, wrist skin temperature (WT1), as determined by a wireless data logger in healthy normal living subjects, was correlated with sleep-wake diaries and oral temperature (OT) recordings. WT and sleep habits were studied in 99 university students. Each subject wore a wireless iButton sensor attached to the inner side of a sport wristband. Our results show that the WT rhythm exhibits an inverse phase relationship with OT, and it is phase-advanced by 60 min with respect to OT. WT
started to increase in association to bed time and dropped sharply after awakening. A secondary WT increase, independent of feeding, was observed in the early afternoon. In conclusion, WT wireless recording can be considered a reliable procedure to evaluate circadian rhythmicity, and an index to establish and follow the effects of chronotherapy in normal living subjects.

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Circadian rhythm sleep disorders following mild traumatic brain injury.

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OBJECTIVE: To describe the physiologic and behavioral characteristics of circadian rhythm sleep disorders (CRSDs) following minor traumatic brain injury (mTBI) in patients complaining of insomnia.

METHODS: Forty two patients with insomnia complaints following mTBI were screened. Those suspected of having CRSD underwent actigraphy, saliva melatonin and oral temperature measurement, and polysomnography. All patients also filled out a self-reported questionnaire to determine their circadian preference.

RESULTS: Fifteen of the 42 patients (36%) with complaints of insomnia following mTBI were diagnosed with CRSD. Eight patients displayed a delayed sleep phase syndrome (DSPS), whereas seven displayed an irregular sleep-wake pattern (ISWP). Whereas all patients with DSPS exhibited a 24-hour periodicity of oral temperature rhythm, three of seven patients with ISWP lacked such a daily rhythm. In addition, ISWP patients exhibited smaller amplitude of oral
temperature rhythm
vs the DSPS group. Subjective Morningness–Eveningness Questionnaire scores were
in accordance with the clinical diagnosis of DSPS or ISWP based on actigraphy.
CONCLUSIONS: Minor traumatic brain injury might contribute to the emergence of
circadian rhythm sleep disorders. Two types of these disorders were observed:
delayed sleep phase syndrome and irregular sleep–wake pattern. The types differed
in the subjective questionnaire scores and had distinct profiles of melatonin and
temperature circadian rhythms.

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Circadian rhythm studies in neuronal ceroid–lipofuscinosis (NCL).

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Sleep disorders are common in NCL patients. The patients have problems such as
frequent awakenings, difficulties with sleep onset, nightmares, and night terrors. The aim of the study was to examine whether the sleep disturbance in NCL can be explained on the basis of desynchronised circadian rhythms. Therefore we studied diurnal patterns of melatonin, cortisol, body temperature, and motor activity of 14 patients. The group consisted of 8 JNCL patients, 5 INCL children, and one boy with Jansky–Bielschowsky disease of the variant type. There were healthy age– and sex–matched control subjects. The blood samples for serum melatonin and cortisol were collected every 2 hours during 24–hour periods. Body temperature was recorded continuously for a 24–hour period by a polygraph.
Diurnal motor activity was measured by wrist actigraphy for 5 days. In most of our patients sleep was fragmented and the sleep phase was irregular. Disturbances in the daily hormonal rhythms occurred only in the minority of the patients and only at an advanced stage of the disease. Although disturbances in the body temperature rhythm were found in about half of the patients, a general failure in the circadian regulatory system does not explain the frequent disturbances of the sleep-wake cycle of the NCL patients.

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Circadian Rhythmicity as a Predictor of Quality of Life in Allogeneic Hematopoietic Cell Transplant Patients.

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CONTEXT: Quality of life (QoL) is increasingly recognized as an important outcome of cancer treatment. Previous studies have examined clinical predictors of QoL, but with the increasing prevalence of wearable sensors that monitor...
sleep and activity patterns, further investigation into whether these behaviors are predictive of post-treatment QoL is now feasible. Among patients receiving aggressive cancer treatment such as hematopoietic cell transplantation (HCT), analysis of circadian rhythms (24-hour patterns of sleep and activity) via wearable sensors is limited.

OBJECTIVE: To evaluate the relationship between overall QoL and circadian rhythms in patients receiving allogeneic HCT.

METHODS: Patients wore an ActiGraph GT3X (Pensacola, FL) activity monitor for at least 72 hours before the initiation of conditioning chemotherapy and transplantation and completed a QoL (Functional Assessment of Cancer Therapy-General [FACT-G]) assessment. QoL assessments were also completed 1, 3, and 6 months after HCT.

RESULTS: Patients (n = 45, M age = 55) were mostly male (66%) with a total FACT-G score of 80.96 (SD = 16.05) before HCT. Mixed models revealed robust cross-sectional associations between overall QoL and multiple circadian rhythmicity parameters, including durations of high physical activity, overall circadian rhythmicity, and earlier starts of daily activity (P's < .01). Recovery of QoL after transplant was predicted by longer pre-transplant durations of high physical activity (P = .04) and earlier evening retirement (P = .04).

CONCLUSION: Our findings suggest that wearable sensor information is a promising method of predicting recovery of QoL after HCT. Additional studies are needed to confirm these findings in a larger sample.

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Circadian rhythmicity as a predictor of weight-loss effectiveness.

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OBJECTIVES: Some of the major challenges associated with successful dietary weight management include the identification of individuals not responsive to specific interventions. The aim was to investigate the potential relationship between weight loss and circadian rhythmicity, using wrist temperature and actimetry measurements, in women undergoing a weight-loss program, in order to assess whether circadian rhythmicity could be a marker of weight-loss effectiveness.

METHODS: Participants were 85 overweight and obese women (body mass index, BMI: 30.24±4.95 kg m(-2)) subjected to a weight-reduction program. Efficacy of the treatment was defined as total weight loss, percentage of initial weight and weekly weight loss rates. Circadian rhythmicity in wrist temperature motor activity and position were analyzed using different sensors.

RESULTS: Lower weight loss was related with a more flattened pattern measured as amplitude from cosinor (r=0.235, P=0.032), a higher fragmentation of rhythms determined by higher intradaily variability (IV) (r=-0.339, P=0.002), and an impaired wrist temperature circadian rhythm determined by the means of Circadian Function Index (r=0.228, P=0.038). Further analyses showed that low
responders displayed lower amplitude (0.71±0.36 versus 1.24±0.62, P=0.036) and higher fragmentation of the circadian rhythm (0.24±0.11 versus 0.15±0.07, P=0.043) than high responders. Whereas we did not find significant differences in total activity rates between high responders and low responders, we found significant differences for the mean values of body position for high responders (39.12±3.79°) as compared with low responder women (35.31±2.53°, P=0.01).

CONCLUSIONS: Circadian rhythms at the beginning of the treatment are good predictors of future weight loss. Further treatment should consider chronobiological aspects to diagnose obesity and effectiveness of treatments.

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Circadian rhythmicity in emerging mood disorders: state or trait marker?

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BACKGROUND: Circadian rhythm disturbances overlap with the symptoms of mood episodes and may trigger or prolong mood symptoms. There is limited research on the role of circadian disturbances in mood disorders in young people and/or first episode cases of unipolar and bipolar disorders.

METHODS: Actigraphy was undertaken for about 14 days in 63 post-pubertal individuals aged 13–25 years with a recent onset of a mood disorder meeting recognised diagnostic criteria. We examined associations between three easily interpretable markers of circadian rhythm activity (amplitude, acrophase and rhythmicity index) and demography and clinical characteristics. Then, circadian markers were compared between diagnostic groups, controlling for potential confounders.

RESULTS: Longer duration of illness was correlated with reduced circadian rhythmicity and lower levels of activity over 24 h. A delay in the timing of maximum activity was associated with the level of manic but not depressive symptoms. The circadian rhythmicity index differentiated unipolar from bipolar cases, and in bipolar but not unipolar disorder, the rhythmicity was less robust in those with more severe manic or depressive symptoms.

CONCLUSIONS: Less robust circadian rhythmicity, especially associated with increasing symptom severity, may represent a more specific or a trait marker of young people with mood disorders who are at higher risk of a bipolar course of illness.

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PMCID: PMC4712181
PMID: 26763505


Circadian rhythms and psychiatric profiles in young adults with unipolar
Abnormalities in circadian rhythms have been reported in people with mood disorders, but these abnormalities are marked by considerable inter-individual variability. This study aimed to identify pathophysiological subgroups on the basis of circadian markers and evaluate how these subgroups relate to psychiatric profiles. Thirty-five young adults (18–31 years old) receiving clinical care for unipolar depressive disorders and 15 healthy controls took part to this study. The Hamilton Rating Scale for Depression and the Young Mania rating scale were used to evaluate the severity of mood symptoms in participants with depressive disorders. All participant underwent ambulatory sleep monitoring with actigraphy for about 12 days before attending a laboratory-based chronobiological assessment which included repeated salivary samples to determine dim light melatonin onset.
(DLMO) and continuous core body temperature (CBT) monitoring using an ingestible temperature sensor. Cluster analyses were conducted across all participants to identify subgroups with consistent circadian timing profiles based on DLMO and the nocturnal minima of CBT. Two clusters were identified: 'delayed' and 'conventional timing' circadian phase. Descriptive analyses showed that the delayed cluster was characterised by abnormal time relationships between circadian phase markers and the sleep-wake cycle. Importantly, individuals from the delayed cluster had worse depression severity \(t(28) = -2.7, p = 0.011\) and hypompanic symptoms \(Z = -2.2, p = 0.041\) than their peers with conventional circadian timing. These findings suggest that delayed and disorganised circadian rhythms may be linked to worse psychiatric profiles in young people with depressive disorders.

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Circadian rhythms and sleep patterns in urban Greek couples.

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A convenience sample of 14 adults (seven couples) who intentionally nap regularly was recruited to describe circadian rhythms and sleep patterns in a culture in which afternoon naps are routine. Participants wore a wrist actigraph for 48 hr during May to obtain two peaks and troughs of activity data. Peak activity, estimated by cosinor analysis (acrophase), occurred at 1542 hours for men and at
1600 hours for women. Compared to their male partners, women had a later acrophase and a significantly stronger 24-hr rhythm, despite similar nap and nighttime sleep schedules. Men had more awakenings during the night and slightly shorter naps than did women. For the 24-hr period, men averaged 6.8 +/- 1.0 hr of sleep and women averaged 7.4 +/- 1.1 hr. Results indicate that Greek adults delay sleep onset at night and awaken early in the morning. Among this small group, naps are an accepted cultural behavior.

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PMID: 17601856 [Indexed for MEDLINE]

Circadian rhythms in 6-sulphatoxymelatonin and nocturnal sleep in blind children.

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This article describes the relationship between melatonin secretion and sleep quality and subjective complaints about sleep in totally blind children. Eleven boarding-school children (mean age 15.2 years) participated. The major urinary melatonin metabolite 6-sulphatoxymelatonin (aMT6s) was measured five times a day for 48 h. Sleep-wake cycles were recorded by continuous actigraphic recordings during the same time period. Results showed that delayed secretory peaks in aMT6s were significantly associated with disturbed nocturnal sleep and with complaints about morning fatigue.

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PMID: 1794154 [Indexed for MEDLINE]

INTRODUCTION: Research has been limited in circadian activity rhythms and their relationship with health status in early-stage breast cancer survivors. Maintaining strong circadian parameters may reduce symptoms and improve physical functioning and disease-free survival.

METHODS: This is a descriptive, correlational, secondary analysis of data from a randomized controlled trial collected 1 year after the first chemotherapy treatment; \( n = 156 \) cases with 7 days of wrist actigraph data of six circadian activity rhythm parameters; measures of function, fatigue, sleep, and anxiety/depression; and demographic/medical data including body mass index (BMI).

RESULTS: In the total sample and three BMI categories, acrophase was the only circadian parameter that reached means established in healthy adults. In the total sample, phase-delayed acrophase was associated with higher depression \( (r = 0.180, p = 0.025) \) and lower morning energy \( (r = -0.194, p = 0.016) \) and trended for higher fatigue \( (r = 0.153, p = 0.057) \). Lower morning energy was also associated with a lower circadian quotient \( (r = 0.158, p = 0.05) \). As BMI increased, weaker circadian parameters were recorded consistently. When compared with women in normal BMI categories, obese women's amplitude and 24-h autocorrelation coefficient were significantly weaker \( (p = 0.011-0.015) \). In obese women, phase-delayed acrophase was correlated with higher fatigue and anxiety and with lower morning energy and physical functioning.
DISCUSSION/CONCLUSIONS: Amplitude and 24-h autocorrelation parameters were significantly weaker, and phase-delayed acrophase was linked to several more intense symptoms and lower physical functioning in obese women. IMPLICATIONS FOR CANCER SURVIVORS: Clinicians need to target high-risk women with phase-delayed rhythms, higher symptoms, and lower physical functioning for intervention.

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PMID: 22484807 [Indexed for MEDLINE]


Circadian skin temperature rhythms, circadian activity rhythms and sleep in individuals with self-reported depressive symptoms.

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BACKGROUND: Disturbed circadian rhythms have been associated with
depression. New body-worn devices allow the objective recording of circadian parameters such as physical activity, skin temperature and sleep. The objective of this study was to investigate whether circadian skin temperature and circadian activity rhythms are altered in depressed individuals.

METHODS: Data on skin temperature, physical activity and sleep were available for 1610 subjects from a population-based cohort study. In a matching process two groups were formed for analysis: 121 participants with pronounced depression symptoms (CES-D Score > 21) and n = 121 matched non-depressed controls (CES-D Score < 15). Circadian rhythms were investigated by analyzing non-parametric rhythm indicators of 24-h skin temperature and physical activity data. Sleep timing, continuity and quantity were calculated from actigraphy.

RESULTS: No differences between the groups were found when all participants were considered. After excluding antidepressant medicated participants, the depression group was found to have a lower skin temperature amplitude t(208) = 2.45, p = .015 and a less stable skin temperature rhythm t(208) = 2.40, p = .017. The amplitude predicted the group status (beta = -5.529, p = .016). No effects were found for activity or sleep.

CONCLUSION: The results indicate that skin-temperature rhythms are blunted in unmedicated depressed individuals. This could be a promising non-invasive marker for further analysis.

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Circadian sleep, illumination, and activity patterns in women: influences of aging and time reference.
Patterns of sleep, illumination, and activity of women of different ages were continuously monitored in their natural environments with a wrist activity monitor. Partial correlation analyses were performed to determine relationships between age and sleep and several circadian rhythm measures including the amplitudes, mesors, and timings of sleep, of illumination, and of activity. We found no age-related decline in actigraphic sleep duration. Age was not a significant correlate of circadian rhythm parameters of sleep. Moreover, no age effects were found on daily illumination exposure or on the circadian timing of illumination and activity patterns. However, the level and amplitude of the circadian activity rhythm showed a gradual decline with aging, independent of the time reference (i.e., Daylight Saving Time versus Standard Time) when recordings were obtained. As expected, significant associations were observed between local time reference and the level and timing of peak of illumination patterns. However, changes in local time reference were not significantly and consistently associated with actigraphic sleep or activity measures.

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PMID: 10716544 [Indexed for MEDLINE]
OBJECTIVE: Children born preterm are at elevated risk for several developmental and health concerns. Early sleep patterns may be associated with these concerns. The current study assesses the associations between toddler circadian sleep/activity patterns and later developmental, behavioral, attentional, and health concerns in this at-risk population.

METHOD: We examined circadian sleep/activity patterns at 2 years of age in 99 children born preterm. Child cognitive skills were tested at 3 years of age, and behavior, attention, and health concerns were reported at 3 and 6 years of age. First, sleep/activity data collected via actigraphy were assessed using time series analysis (TSA). For this, we assessed how each child's sleep/activity pattern compared to a specified 24-hour circadian cycle (SCC) with an adjustment for daytime napping. Second, in a series of regression models child sleep/activity parameters from the TSA were assessed with child gender, prematurity, and family sociodemographic assets as covariates.

RESULTS: Toddlers with patterns that closely aligned with the SCC had higher Abbreviated Intelligence Quotient scores at 3 years of age. Additionally, at 6 years these children had a lower risk for illness-related medical visits. Higher toddler average activity level was associated with fewer teacher-reported attention-deficit hyperactivity disorder symptoms and a lower risk for illness-related medical visits.
CONCLUSION: The novel approach used in this study to index child circadian patterns provides a pattern-based analysis of sleep/activity, which may prove to be developmentally consequential. With replication, these findings may help practitioners promote optimal cognitive and health development via circadian sleep supports in infants born preterm.

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PMCID: PMC4887334
PMID: 27011003 [Indexed for MEDLINE]

Circadian sleep-wake cycles, well-being, and light therapy in borderline personality disorder.

Individuals with borderline personality disorder (BPD) frequently suffer from sleep disturbances. The authors investigated circadian rhythms, sleep, and well-being in women with BPD in their habitual life conditions during 3 weeks with morning light therapy (LT) and 3 weeks without LT (oLT). Sleep-wake cycles were measured using wrist actimetry, proximal skin temperature as an indirect index of relaxation, as well as weekly salivary melatonin to document the internal circadian rhythm phase. Questionnaires assessed clinical state throughout the 6-week protocol. Ten matched healthy women followed the same 6-week protocol without light treatment. Women with BPD had significantly worse subjective sleep quality and reduced daytime alertness compared to controls. Sleep-wake cycles in BPD ranged from highly disturbed to extremely regular patterns. Melatonin and proximal skin temperature profiles revealed appropriate synchronization of the circadian system with the sleep-wake cycle in
most BPD women and in all controls. Morning LT significantly phase-advanced activity in BPD compared to oLT, shortened sleep duration, decreased movement time, and increased skin temperature during sleep (a marker of relaxation). Although general depression scores and borderline symptoms did not change, daytime alertness improved with morning LT, and atypical depression scores were attenuated. Morning LT is a potential adjunct treatment for BPD.

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Circadian sleep/wake rhythm abnormalities as a risk factor of a poststroke apathy.

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BACKGROUND: Poststroke apathy affects 19-55% of patients following stroke and has a negative impact on functional recovery, general health, and quality of life, as well as being a source of significant burden for caregivers.

AIMS: A major clinical issue is the delayed diagnosis of poststroke apathy, and so the aim of our study is to evaluate the relationship between early poststroke alterations of circadian rhythms of sleep/wake cycles and the occurrence of
poststroke apathy.

METHODS: Forty-six patients with a recent magnetic resonance imaging confirmed stroke were included. Main exclusion criteria were a mild to severe disability impeding home discharge from the hospital and the presence of apathy or dementia before stroke. Cerebrovascular lesions were evaluated by magnetic resonance imaging. At hospital discharge, an actigraph was used to measure patient's global activity as well as parameters of circadian rhythmicity (relative amplitude, interdaily stability, intradaily variability) and sleep (sleep duration, sleep efficiency, fragmentation index) over seven-days. Apathy was assessed at hospital discharge as well as at three-months using the Apathy Inventory and the Lille Apathy Rating Scale.

RESULTS: Of the 46 patients evaluated, 10 (22%) showed apathy three-months after stroke (median Apathy Inventory = 4.5). Before inclusion, these 10 subjects did not differ significantly from other patients concerning their sleep and, at inclusion, they did not differ concerning apathy, anxiety, depression, or cognitive and functional abilities. However, actigraphy measured at discharged identified significant alterations of sleep (P < 0.005). Future poststroke apathy patients exhibited a decrease in sleep efficiency (actual sleep time expressed as a percentage of time in bed) and an increase in the fragmentation index (degree of fragmentation during the sleep period) at three-months. No association was observed between poststroke apathy and the characteristics of cerebrovascular lesions (stroke location, extent of leucoencephalopathy, number of lacunes and microbleeds).

CONCLUSION: These results indicate that early poststroke alterations of sleep/wake circadian rhythms—easily evaluated by actigraphy—are associated with a higher risk of poststroke apathy at three-months. In terms of clinical outcomes, our results provide targets for very early identification of
patients at risk to develop apathy after stroke and for assessing when to start specific therapy to optimize rehabilitation efficiency.

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Circadian sleep-wake rhythm of older adults with intellectual disabilities.

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The circadian sleep-wake rhythm changes with aging, resulting in a more fragmented sleep-wake pattern. In individuals with intellectual disabilities (ID), brain structures regulating the sleep-wake rhythm might be affected. The aims of this study were to compare the sleep-wake rhythm of older adults with ID to that of older adults in the general population, and to investigate which factors are associated with the sleep-wake rhythm in older adults with ID. This study is part of the 'Healthy Aging and Intellectual Disabilities' study (HA-ID).

We applied actigraphy in 551 persons with ID and 58 persons in the general population, aged 50 years and over. Outcome measures were stability (interdaily stability), fragmentation (intradaily variability) and amplitude (relative amplitude) of the sleep-wake rhythm. Compared to older adults in the general population, the sleep-wake rhythm of older adults with ID was significantly less
stable (p=0.03), more fragmented (p<0.001) and had a lower relative amplitude (p<0.001). Multivariate regression analysis revealed that higher age, dementia, depression, visual impairment, severe hearing impairment, epilepsy and spasticity are independently associated with a more disturbed sleep-wake rhythm in this group. The sleep-wake rhythm is more stable in females and those living at a setting for more intensive care. Higher physical activity levels are strongly associated with both a less fragmented (p<0.001) and a more stable (p<0.001) sleep-wake rhythm. Higher age, dementia and depression are also associated with the sleep-wake rhythm in the general population. Neurological and sensory impairments that were associated with the sleep-wake rhythm in older adults with ID, are frequent known conditions in the ID population. Further research should focus on which factors specifically influence the sleep-wake rhythm in older adults with ID, and on the effects of more physical daytime activity on the sleep-wake rhythm in this population.

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Circadian timing and alignment in healthy adults: associations with BMI, body fat, caloric intake and physical activity.

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INTRODUCTION: Disruption of circadian rhythms is one of the proposed mechanisms linking late sleep timing to obesity risk but few studies have evaluated biological markers outside of the laboratory. The goal of this study was to determine the relationship between the timing and alignment of melatonin and sleep onset (phase angle) with body mass index (BMI), body fat and obesity-related behaviors. We hypothesized that circadian alignment (relationship of melatonin to sleep timing) rather than circadian (melatonin) timing would be associated with higher BMI, body fat, dietary intake and lower physical activity.

SUBJECTS/METHODS: Adults with sleep duration ≥6.5 h completed 7 days of wrist actigraphy, food diaries and SenseWear arm band monitoring. Circadian timing, measured by dim light melatonin onset was measured in the clinical research unit. Circadian alignment was calculated as the duration between dim light melatonin onset and average sleep onset time in the prior week (phase angle). Body fat was evaluated using dual-energy X-ray absorptiometry. Data were analyzed using bivariate correlations and multivariable regression analyses controlling for age, sex, sleep duration and evening light exposure.

RESULTS: Participants included 97 adults (61 F, age 26.8±7.3 years) with average sleep duration 443.7 (s.d.=50.4) minutes. Average phase angle was 2.2 h (s.d.=1.5). Circadian alignment was associated with circadian timing (P<0.001) and sleep duration (P=0.005). In multivariable analyses, later circadian timing was associated with lower BMI (P=0.04). Among males only, circadian alignment was associated with percent body fat (P=0.02) and higher android/gynoid fat ratio (P=0.04). Circadian alignment was associated with caloric intake...
carbohydrate intake (P=0.04) and meal frequency (P=0.03) among both males and females.

CONCLUSION: Circadian timing and alignment were not associated with increased BMI or body fat, among healthy adults with ≥6.5 h of sleep, but circadian alignment was associated with dietary intake. There may be sex differences in the relationship between circadian alignment and body fat.

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Conflict of interest statement: The other authors do not have conflicts of interest.


Circadian typology and the Alternative Five–Factor Model of personality.

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Two studies were carried out to explore the relationship between circadian typology and the Alternative Five–Factor Model of personality. In the first study, 379 participants (232 females) were administered the reduced version of the Morningness–Eveningness Questionnaire and the Zuckerman–Kuhlman Personality Questionnaire. Evening types reported higher impulsive sensation–
seeking scores than morning and intermediate types, whereas morning types scored higher than evening types on activity factor. In the second study, the association between morningness and activity personality factor was verified through the objective-actigraphic monitoring of the rest-activity cycle. Actigraphy allowed us to operationalise both circadian typology, through the computing of midpoint of sleep (early values, expressed in hours and minutes, correspond to an advanced phase of the sleep/wake cycle), and activity factor by the means of motor activity recording. Fifty-one individuals (30 females) wore an actigraph on the nondominant wrist continuously for 1 week. A negative correlation was observed between midpoint of sleep and mean diurnal motor activity, demonstrating that an early phase of the sleep/wake cycle (i.e. morningness preference) was related to higher diurnal motor activity. Assessed both subjectively and objectively, the results of both studies highlight a significant relationship between morningness and activity personality factor.


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Circadian urinary 6-sulphatoxymelatonin, cortisol excretion and locomotor activity in airline pilots during transmeridian flights.

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Airline pilots divided into two groups of age (over and under 50
years) were studied before, during and after westbound (Madrid–Mexico City–Madrid, n = 12) and eastbound (Madrid–Tokyo–Madrid, n = 21) flights. A group of 10 age-matched people staying in Madrid were submitted to the same tests and served as a control group. Changes in urinary 6-sulphatoxymelatonin (6-aMTs) and free cortisol excretion (determined in 6-hr intervals) were measured by radioimmunoassay. Using wrist actigraphy, the circadian locomotor activity rhythm (LAR) was also monitored. Maximal baseline excretion of 6-aMTs occurred between 00:00 and 12:00 hr and maximal excretion of cortisol took place between 6:00 and 12:00 hr in the control group. Analysed globally, older pilots exhibited significantly lower values of 6-aMTs than younger ones. In both flight directions, pilots maintained the pattern of excretion of 6-aMTs, corresponding to baseline. The return flight to Madrid from Mexico and Tokyo coincided with a maximum in 6-aMTs excretion. Pilots kept the cortisol pattern found in the control group, with those over 50 years of age exhibiting significantly lower cortisol values than the younger ones. A 7-hr delay in acrophase of LAR after 2 days in Mexico City was found after cosinor analysis, and similar pre-flight values were found after returning to Madrid. An 8–9-hr acrophase advance of LAR was observed after arriving in Tokyo, with acrophase on the post-return flight day still being advanced 3–4 hr as compared to pre-flight values. Decreases in the amplitude of LAR in older pilots were found at Mexico City, as well as at Tokyo stopover and on post-flight day. Data confirm the occurrence of internal desynchronization in airline crewmembers after transmeridian flights.

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Circadian variation in O6-alkylguanine-DNA alkyltransferase activity in circulating blood mononuclear cells of healthy human subjects.

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Cytotoxic agents such as chloroethylnitrosoureas (CENUs) mostly alkylate DNA on the O6-guanine position. This highly mutagenic lesion can be repaired by O6-alkylguanine-DNA alkyltransferase (AGT), which removes the alkyl group by accepting it to the cysteine residue of its active site. AGT activity displayed a circadian rhythm in mouse liver, coincident with that of CENU tolerability. We investigated whether AGT activity displayed a circadian rhythm in human circulating mononuclear cells (MNCs). The study was performed in 12 healthy volunteers aged 19 to 31 years. Circadian synchronization was verified with rest/activity cycle as assessed with wrist actigraphy and plasma cortisol and melatonin rhythms. Subjects were hospitalized for 24 hr and blood samples were obtained at 08:00, 12:00, 16:00, 20:00, 22:00, 00:00, 02:00, 04:00 and 08:00 overnight. MNCs were isolated on Ficoll immediately after blood sampling and frozen at -196 degrees C until AGT activity determination by HPLC. Mean AGT activity (+/- SEM) varied from 821 +/- 67 fmol/mg of total proteins at noon (trough), up to 1,055 +/- 80 fmol/mg at midnight (peak), i.e., by approximately 30%. A circadian rhythm was statistically validated with both analysis of variance (p < 0.009) and cosinor (p < 0.02) for AGT activity in MNCs (acrophase +/- SD at 00:30 +/- 210 min) as well as for MNC circulating count and for plasma cortisol and melatonin concentrations. Despite individual variations
in the extent of AGT activity rhythm (more or less pronounced according to subject), AGT activity displayed a circadian rhythm in human MNCs of our healthy study group subjects. The results warrant to further investigate AGT rhythmicity both in circulating MNCs and in target tissues of cancer patients, as a prerequisite for clinical testing of chronotherapy with alkylating agents.

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Clinical characteristics of obstructive sleep apnea in bipolar disorders.

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BACKGROUND: Obstructive sleep apnea (OSA) is one of the leading non-psychiatric comorbidities in bipolar disorders (BD). We sought to explore associations between risk of OSA in BD, clinical characteristics alongside with both subjective sleep complaints and objective sleep abnormalities.

METHODS: Euthymic patients with BD (n = 144) were assessed over a three-week period, by actigraphy, clinical interviews and questionnaires.

RESULTS: Of the study sample, 32 (22%) individuals were at high risk of OSA (HR-OSA) and 112 (78%) had a low risk (LR-OSA), as assessed with the
Berlin questionnaire. HR-OSA, compared to LR-OSA, were older (p = 0.031), had higher BMI (p < 0.0005), larger neck circumference (p = 0.002), and more residual depressive symptoms (p < 0.0005). HR-OSA was also associated with greater sleepiness (p = 0.003), poorer sleep quality (p = 0.003), insomnia complaints (p = 0.027), "languid" chronotype (p = 0.002), and higher actigraphy-derived fragmentation index (p = 0.015). Backward stepwise linear regression retained BMI and depressive symptoms (correct classification of 83% of participants). Classification increased up to 85.4% when adding sleepiness and languid-vigorous scales and up to 87.8% when adding fragmentation index. Combining ROC curve analysis and Youden Index provided best cut-offs (HR-OSA if cut-off greater than or equal to) of 29.84 for BMI (Sensibility(Se) = 0.47, Specificity(Spe) = 0.96) and 1.5 for MADRS total score (Se = 0.84, Spe = 0.58).

LIMITATIONS: No confirmation of OSA diagnosis with polysomnography. CONCLUSIONS: Higher BMI and residual depressive symptoms are the two best independent predictors of OSA in BD. Such information contributes to improving the screening and management of OSA in BD. TRIAL NUMBER: NCT02627404.

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Clinical Considerations Derived From the Administration of Melatonin to Children With Sleep Disorders.

BACKGROUND AND OBJECTIVES: Despite the numerous investigations carried out in relation to melatonin, there is a lack of knowledge about the specific melatonin secretion patterns in the diverse primary sleep disturbances. The objective of this study was to analyze the plasma melatonin concentrations in children with primary sleep disorders and the effects of melatonin therapy on their serum levels and their actigraphic sleep parameters.

METHODS: Fourteen participants (nine girls; seven to 14 years old) diagnosed with diverse primary sleep disorders were recruited. Four different melatonin secretion patterns were identified: low plasma melatonin levels, absence of a circadian rhythm, advanced acrophase, and delayed acrophase. A placebo (one week) was administered followed by three months of melatonin therapy (3 mg/night). Urinary 6-sulfatoxymelatonin levels, 24-hour plasma melatonin concentrations, and a seven-day actigraphic record were collected after both treatments.

RESULTS: After melatonin therapy, a significant increase ($P < 0.001$) of urinary 6-sulfatoxymelatonin excretion with a clear circadian variation was observed. Plasma melatonin concentrations were also significantly higher with a recovery in the circadian rhythm. Actual sleep time was significantly longer, with a substantial reduction in the sleep onset latency and night awakenings.
No severe side effects were reported.

CONCLUSIONS: The main clinical implication of this study is to demonstrate the efficacy of melatonin in three main circumstances: an insufficient hormone production, a disturbed circadian rhythm, and an advanced or delayed acrophase.
As ongoing work, we are exploring the effect of different doses of melatonin on the regulation of its concentrations and of its secretion rhythm.

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Clinical efficacy of individual cognitive behavior therapy for psychophysiological insomnia in 20 outpatients.

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AIM: Twenty patients (14 of them women) suffering from psychophysiological insomnia (PPI) were enrolled for cognitive behavior therapy (CBT). The mean age of the patients was 56.9 years, and the mean duration of insomnia morbidity was 8.9 years. Each received individual combined CBT treatments consisting of stimulus control, sleep reduction, cognitive therapy and sleep hygiene education over a period of 1 month.

METHODS: Just before the CBT and after its completion, sleep measurements were conducted that involved (i) sleep logs, Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), and the Pittsburgh Sleep Quality Index (PSQI); (ii) actigraphy measurement; (iii) dissociation between subjective and objective
evaluation of sleep calculated from sleep logs and actigraphy results; and (iv) correlation between DBAS and the aforementioned sleep parameters. Because the intention was to focus on patients' incorrect cognition about sleep, the definition 'changes in dissociation between the sleep log and actigraphically measured sleep' was used as the primary outcome and 'changes in DBAS score' as the secondary outcome.

RESULTS: After the CBT the following was found: (i) underestimation by PPI patients of the objective evaluation of sleep; (ii) a decrease in the dissociation between the subjective and objective evaluation of sleep; (iii) improvement of the DBAS; and (iv) improvement of sleep logs and actigraphy measurements. Moreover, there was a correlation between the improvement of PSQI, sleep logs and DBAS.

CONCLUSION: CBT for insomnia is able to redress incorrect cognition about sleep, leading to improvement of the disorder.

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The clinical impact of preoperative melatonin on postoperative outcomes in patients undergoing abdominal hysterectomy.


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BACKGROUND: Melatonin has sedative, analgesic, antiinflammatory, antioxidative, and chronobiotic effects. We determined the impact of oral melatonin premedication on anxiolysis, analgesia, and the potency of the rest/activity
METHODS: This randomized, double-blind, placebo-controlled study included 33 patients, ASA physical status I–II, undergoing abdominal hysterectomy. Patients were randomly assigned to receive either oral melatonin 5 mg (n = 17) or placebo (n = 16) the night before and 1 h before surgery. The analysis instruments were the Visual Analog Scale, the State-Trait Anxiety Inventory, and the actigraphy.

RESULTS: The number of patients that needed to be treated to prevent one additional patient reporting high postoperative anxiety and moderate to intense pain in the first 24 postoperative hours was 2.53 (95% CI, 1.41–12.22) and 2.20 (95% CI, 1.26–8.58), respectively. The number-needed-to-treat was 3 (95% CI, 1.35–5.0) to prevent high postoperative anxiety in patients with moderate to intense pain, when compared with 7.5 (95% CI, 1.36–infinity) in the absence of pain or mild pain. Also, the treated patients required less morphine by patient-controlled analgesia, as assessed by repeated measures ANOVA (F[1,31] = 6.05, P = 0.02). The rest/activity cycle, assessed by actigraphy, showed that the rhythmicity percentual of 24 h was higher in the intervention group in the first week after discharge ([21.16 +/- 8.90] versus placebo [14.00 +/- 7.10]; [t = -2.41, P = 0.02]).

CONCLUSIONS: This finding suggested that preoperative melatonin produced clinically relevant anxiolytic and analgesic effects, especially in the first 24 postoperative hours. Also, it improved the recovery of the potency of the rest/activity circadian rhythm.

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Clinical Relevance of the First Domomedicine Platform Securing Multidrug
Chronotherapy Delivery in Metastatic Cancer Patients at Home: The inCASA European Project.


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BACKGROUND: Telehealth solutions can improve the safety of ambulatory chemotherapy, contributing to the maintenance of patients at their home, hence improving their well-being, all the while reducing health care costs. There is, however, need for a practicable multilevel monitoring solution, encompassing relevant outputs involved in the pathophysiology of chemotherapy-induced toxicity. Domomedicine embraces the delivery of complex care and medical
procedures at the patient's home based on modern technologies, and thus it offers an integrated approach for increasing the safety of cancer patients on chemotherapy.

OBJECTIVE: The objective was to evaluate patient compliance and clinical relevance of a novel integrated multiparametric telemonitoring platform in cancer patients receiving multidrug chemotherapy at home.

METHODS: Self-measured body weight, self-rated symptoms using the 19-item MD Anderson Symptom Inventory (MDASI), and circadian rest-activity rhythm recording with a wrist accelerometer (actigraph) were transmitted daily by patients to a server via the Internet, using a dedicated platform installed at home. Daily body weight changes, individual MDASI scores, and relative percentage of activity in-bed versus out-of-bed (I<0) were computed. Chemotherapy was administered according to the patient medical condition. Compliance was evaluated according to the proportions of (1) patient-days with all data available (full) and (2) patient-days with at least one parameter available (minimal). Acceptability was assessed using the Whole Systems Demonstrator Service User Technology Acceptability Questionnaire. Linear discriminant analysis was used to identify the combination of parameters associated with subsequent unplanned hospitalization.

RESULTS: A total of 31 patients (males: 55% [17/31]; World Health Organization Performance Status=0: 29% [9/31]; age range: 35–91 years) participated for a median of 58 days (38–313). They received a total of 102 chemotherapy courses (64.7% as outpatients). Overall full compliance was 59.7% (522/874), with at least one data available for 830/874 patient-days (95.0%), during the 30-day per-protocol span. Missing data rates were similar for each parameter. Patients were altogether satisfied with the use of the platform. Ten toxicity-related hospitalizations occurred in 6 patients. The combination of weighted circadian function (actigraphy parameter I<0), body weight change, and MDASI scores
predicted for ensuing emergency hospitalization within 3 days, with an accuracy of 94%.

CONCLUSIONS: Multidimensional daily telemonitoring of body weight, circadian rest-activity rhythm, and patient-reported symptoms was feasible, satisfactory, and clinically relevant in patients on chemotherapy. This domedmedicine platform constitutes a unique tool for the further development of safe home-based chemotherapy administration.


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Conflict of interest statement: Conflicts of Interest: None declared.


Co-Sleeping among School-Aged Anxious and Non-Anxious Children: Associations with Sleep Variability and Timing.

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Little is known about the co-sleeping behaviors of school-aged children,
particularly among anxious youth who commonly present for the treatment of sleep problems. The current study examined the occurrence of co-sleeping in both healthy and clinically anxious children and its associated sleep patterns. A total of 113 children (ages 6-12), 75 with primary generalized anxiety disorder and 38 healthy controls, participated along with their primary caregiver. Families completed structured diagnostic assessments, and parents reported on their child's co-sleeping behaviors and anxiety severity. Children provided reports of anxiety severity and completed one week of wrist-based actigraphy to assess objective sleep patterns. A significantly greater proportion of anxious youth compared to healthy children co-slept, and greater anxiety severity was related to more frequent co-sleeping. Co-sleeping in anxious youth was associated with a delay in sleep timing and with greater sleep variability (i.e., more variable nightly sleep duration). All analyses controlled for child age, race/ethnicity, family income, and parental marital status. Co-sleeping is highly common in anxious school-aged children, with more than 1 in 3 found to co-sleep at least sometimes (2-4 times a week). Co-sleeping was even more common for youth with greater anxiety severity. Increased dependence on others to initiate and maintain sleep may contribute to poorer sleep in this population via shifted schedules and more variable sleep patterns.

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Cognitive behavior therapy for chronic insomnia in occupational health services.

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INTRODUCTION: The aim of this study was to examine the implementation and effectiveness of a cognitive behavioral group intervention model for chronic insomnia (CBT-I) in occupational health services (OHS). We also studied if insomnia symptoms and intervention effects differed on work days and days off.

METHODS: The study design was a non-randomized group intervention, including a waiting period prior to CBT as a control condition. We followed up the results for a period of 6 months. Outcomes were assessed using a sleep diary, questionnaires, and actigraphy. The CBT-I groups were led by trained OHS nurses.

RESULTS: A total of 26 participants completed the study. The intervention improved significantly participants' different self-reported sleep variables, perceived severity of insomnia, sleep-related dysfunctional cognitions, and psychiatric and somatic symptoms. The effects lasted, and partly increased during the follow-up. The participants generally slept significantly better on days off than on work days, but the treatment improved sleep on both.

CONCLUSIONS: The study showed that a non-pharmacological treatment of insomnia can be implemented into OHS with a reasonable amount of effort and that the treatment delivered by trained OHS nurses yields promising results. These findings, however, need to be interpreted cautiously, due to the non-randomized design and small sample size.

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A cognitive-behavioral and mindfulness-based group sleep intervention improves behavior problems in at-risk adolescents by improving perceived sleep quality.

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OBJECTIVE: The aim of this study was to test whether a cognitive-behavioral and mindfulness-based group sleep intervention would improve behavior problems in at-risk adolescents, and whether these improvements were specifically related to improvements in sleep.

METHOD: Secondary analysis of a randomized controlled trial conducted with 123
adolescent participants (female = 60%; mean age = 14.48, range 12.04–16.31 years) who had high levels of sleep problems and anxiety symptoms. Participants were randomized into either a sleep improvement intervention (n = 63) or an active control "study skills" intervention (n = 60). Participants completed sleep and behavior problems questionnaires, wore an actiwatch and completed a sleep diary for five school nights, both before and after the intervention.

RESULTS: Parallel multiple mediation models showed that postintervention improvements in social problems, attention problems, and aggressive behaviors were specifically mediated by moderate improvements in self-reported sleep quality on school nights, but were not mediated by moderate improvements in actigraphy-assessed sleep onset latency or sleep diary-measured sleep efficiency on school nights.

CONCLUSION: This study provides evidence, using a methodologically rigorous design, that a cognitive-behavioral and mindfulness-based group sleep intervention improved behavior problems in at-risk adolescent by improving perceived sleep quality on school nights. These findings suggest that sleep interventions could be directed towards adolescents with behavior problems.

CLINICAL TRIAL REGISTRATION: This study was part of The SENSE Study (Sleep and Education: learning New Skills Early). URL: ACTRN12612001177842; http://www.anzctr.org.au/TrialSearch.aspx?searchTxt=ACTRN12612001177842&isBasic=True.

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BACKGROUND: Patients with bipolar disorder experience sleep disturbance, even in euthymic phases. Changes in sleep pattern are frequent signs of a new episode of (hypo)mania or depression. Cognitive behavioral therapy for insomnia (CBT-I) is an effective treatment for primary insomnia, but there are no published results on the effects of CBT-I in patients with bipolar disorder. In this randomized controlled trial, we wish to compare CBT-I and treatment as usual with treatment as usual alone to determine its effect in improving quality of sleep, stabilizing minor mood variations and preventing new mood episodes in euthymic patients with bipolar disorder and comorbid insomnia.

METHODS: Patients with euthymic bipolar I or II disorder and insomnia, as verified by the Structured Clinical Interview for DSM Disorders (SCID-I) assessment, will be included. The patients enter a three-week run-in phase in which they complete a sleep diary and a mood diary, are monitored for seven consecutive days with an actigraph and on two of these nights with polysomnography in addition before randomization to an eight-week treatment trial. Treatment as usual consists of pharmacological and supportive psychosocial treatment. In this trial, CBT-I will consist of sleep restriction, psychoeducation about sleep, stabilization of the circadian rhythm, and challenging and correcting sleep state misperception, in three to eight sessions.

DISCUSSION: This trial could document a new treatment for insomnia in bipolar disorder with possible effects on sleep and on stability of mood. In addition, more precise information can be obtained about the character of sleep disturbance in bipolar disorder.
Cognitive Behavioral Therapy for Insomnia in Older Veterans Using Nonclinician Sleep Coaches: Randomized Controlled Trial.


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OBJECTIVES: To test a new cognitive behavioral therapy for insomnia (CBT-I) program designed for use by nonclinicians.

DESIGN: Randomized controlled trial.
SETTING: Department of Veterans Affairs healthcare system.
PARTICIPANTS: Community-dwelling veterans aged 60 and older who met diagnostic criteria for insomnia of 3 months duration or longer (N = 159).
INTERVENTION: Nonclinician "sleep coaches" delivered a five-session manual-based CBT-I program including stimulus control, sleep restriction, sleep hygiene, and cognitive therapy (individually or in small groups), with weekly telephone behavioral sleep medicine supervision. Controls received five sessions of general sleep education.
MEASUREMENTS: Primary outcomes, including self-reported (7-day sleep diary) sleep onset latency (SOL-D), wake after sleep onset (WASO-D), total wake time (TWT-D), and sleep efficiency (SE-D); Pittsburgh Sleep Quality Index (PSQI); and objective sleep efficiency (7-day wrist actigraphy, SE-A) were measured at baseline, at the posttreatment assessment, and at 6- and 12-month follow-up. Additional measures included the Insomnia Severity Index (ISI), depressive symptoms (Patient Health Questionnaire-9 (PHQ-9)), and quality of life (Medical Outcomes Study 12-item Short-form Survey version 2 (SF-12v2)).
RESULTS: Intervention subjects had greater improvement than controls between the baseline and posttreatment assessments, the baseline and 6-month assessments, and the baseline and 12-month assessments in SOL-D (-23.4, -15.8, and -17.3 minutes, respectively), TWT-D (-68.4, -37.0, and -30.9 minutes, respectively), SE-D (10.5%, 6.7%, and 5.4%, respectively), PSQI (-3.4, -2.4, and -2.1 in total score, respectively), and ISI (-4.5, -3.9, and -2.8 in total score, respectively) (all P < .05). There were no significant differences in SE-A, PHQ-9, or SF-12v2.
CONCLUSION: Manual-based CBT-I delivered by nonclinician sleep coaches improves sleep in older adults with chronic insomnia.

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Cognitive behavioral therapy for insomnia in stable heart failure: Protocol for a randomized controlled trial.

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BACKGROUND: Chronic insomnia is associated with disabling symptoms and decrements in functional performance. It may contribute to the development of heart failure (HF) and incident mortality. In our previous work, cognitive-behavioral therapy for insomnia (CBT-I), compared to HF self-management education, provided as an attention control condition, was feasible, acceptable, and had large effects on insomnia and fatigue among HF patients.

OBJECTIVES: The purpose of this randomized controlled trial (RCT) is to evaluate the sustained effects of group CBT-I compared with HF self-management education (attention control) on insomnia severity, sleep characteristics, daytime symptoms, symptom clusters, functional performance, and health care utilization among patients with stable HF. We will estimate the cost-effectiveness of CBT-I and explore the effects of CBT-I on event-free survival (EFS).

METHODS: Two hundred participants will be randomized in clusters to a single center parallel group (CBT-I vs. attention control) RCT. Wrist actigraphy and self-report will elicit insomnia, sleep characteristics, symptoms, and functional performance. We will use the psychomotor vigilance test to evaluate sleep loss effects and the Six Minute Walk Test to evaluate effects on daytime function. Medical record review and interviews will elicit health care utilization and EFS. Statistical methods will include general linear mixed models and latent transition analysis. Stochastic cost-effectiveness analysis with a competing risk approach will be employed to conduct the cost-effectiveness analysis.

DISCUSSION: The results will be generalizable to HF patients with chronic...
comorbid insomnia and pave the way for future research focused on the dissemination and translation of CBT-I into HF settings.

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Cognitive behavioral therapy for patients with primary insomnia or insomnia associated predominantly with mixed psychiatric disorders: a randomized clinical trial.

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OBJECTIVE: This study was conducted to evaluate the efficacy of cognitive behavioral therapy (CBT) against a sleep hygiene education control therapy in patients with primary or comorbid insomnia.

DESIGN AND SETTING: Randomized, parallel-group, clinical trial conducted at a single Veterans Affairs medical center, with recruitment from March 2001 to June 2005.

PARTICIPANTS: Eighty-one adults (n = 11 women; mean age, 54.2 years) with chronic primary (n = 40) or comorbid insomnia associated predominantly with mixed psychiatric disorders (n = 41).

INTERVENTIONS: Patients, screened via structured interviews and diagnostic polysomnography, were randomly assigned to receive CBT (sleep education, stimulus control, and time-in-bed restrictions; 20 patients with primary and 21 with comorbid insomnia), or sleep hygiene (SH: education about aspects of lifestyle and the bedroom environment that affect sleep; 20 patients with...
primary and 20 with comorbid insomnia). Outpatient treatment included 4 biweekly sessions with a posttreatment assessment and a follow-up conducted at 6 months. MEASURES AND RESULTS: Participants completed actigraphy and sleep diaries for 2 weeks prior to therapy, during a 2-week posttreatment assessment, and during 2 weeks at follow-up. They also completed questionnaires measuring global insomnia symptoms, general sleep quality, and sleep-disruptive beliefs before treatment, immediately following treatment, and at the follow-up time point. Consistent with previous studies, CBT outperformed sleep hygiene across several study outcome measures for the sample as a whole. Statistical analyses showed no significant 3-way interaction of treatment group, time, and insomnia type for any of the sleep or questionnaire measures, suggesting the benefits of CBT over sleep hygiene were comparable for patients with primary insomnia and comorbid insomnia. Moreover, only 1 of several indexes of clinically notable improvement suggested a significantly better response to CBT by patients with primary insomnia, as compared with those with comorbid insomnia.

CONCLUSIONS: A fixed 4-session "dose" of CBT produced similar benefits for patients with primary and those with comorbid insomnia across most measures examined. Thus, CBT appears to be a viable psychological insomnia therapy both for those with primary insomnia and for groups composed mainly of patients with insomnia and nonpsychotic psychiatric conditions.

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Cognitive behavioral therapy for shift workers with chronic insomnia.
OBJECTIVE: Shift work is a challenge in the screening and treatment of chronic insomnia. The aim of this study was to examine the implementation and effectiveness of a cognitive behavioral group intervention for insomnia (CBT-I) among shift workers with chronic insomnia. We also studied whether insomnia symptoms and intervention effects differed on work days and days off.

METHODS: The study design was a non-randomized group intervention, including a waiting period prior to CBT-I as a control condition. A total of 19 media workers who worked irregular hours and had non-organic insomnia with features of psychological insomnia completed the study. We followed up with the results for a period of 6 months. Outcomes were assessed using a sleep diary, questionnaires, and actigraphy. The CBT-I groups were led by trained nurses of occupational health services (OHS).

RESULTS: The post-intervention results showed significant improvements in self-reported and actigraphic sleep onset latency, and in self-reported sleep efficiency, sleep quality, and restedness. In addition, the perceived severity of insomnia, sleep-related dysfunctional cognitions, psychiatric and somatic symptoms, and the mental component of health-related quality of life improved significantly. The improvements lasted and even strengthened over the follow-up period. The participants generally slept significantly better on days off than on work days, but the treatment improved sleep on both.

CONCLUSIONS: The study showed that non-pharmacological treatment of insomnia can be implemented among shift workers with chronic insomnia, and delivery of the treatment by trained OHS nurses yields promising results. Some caution, however,
is needed when interpreting the results because of the non-randomized study
design and small sample size.

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Cognitive-behavioral treatment for comorbid insomnia and osteoarthritis pain in primary care: the lifestyles randomized controlled trial.

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OBJECTIVES: To assess whether older persons with osteoarthritis (OA) pain and insomnia receiving cognitive-behavioral therapy for pain and insomnia (CBT-PI), a cognitive-behavioral pain coping skills intervention (CBT-P), and an education-only control (EOC) differed in sleep and pain outcomes.

DESIGN: Double-blind, cluster-randomized controlled trial with 9-month follow-up.


PARTICIPANTS: Three hundred sixty-seven older adults with OA pain and insomnia.

INTERVENTIONS: Six weekly group sessions of CBT-PI, CBT-P, or EOC delivered in participants' primary care clinics.

MEASUREMENTS: Primary outcomes were insomnia severity and pain severity. Secondary outcomes were actigraphically measured sleep efficiency and arthritis symptoms.

RESULTS: CBT-PI reduced insomnia severity (score range 0–28) more than EOC (adjusted mean difference = −1.89, 95% confidence interval = −2.83 to
and CBT-P (adjusted mean difference = -2.03, 95% CI = -3.01 to -1.04; P < .001) and improved sleep efficiency (score range 0-100) more than EOC (adjusted mean difference = 2.64, 95% CI = 0.44-4.84; P = .02). CBT-P did not improve insomnia severity more than EOC, but improved sleep efficiency (adjusted mean difference = 2.91, 95% CI = 0.85-4.97; P = .006). Pain severity and arthritis symptoms did not differ between the three arms. A planned analysis in participants with severe baseline pain revealed similar results.

CONCLUSION: Over 9 months, CBT of insomnia was effective for older adults with OA pain and insomnia. The addition of CBT for insomnia to CBT for pain alone improved outcomes.

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Cognitive behavioural therapy interventions for insomnia among shift workers: RCT in an occupational health setting.


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INTRODUCTION: The aim of the study was to compare the effectiveness of cognitive behavioural therapy interventions for insomnia (CBT-I) to that of a sleep hygiene intervention in a randomized controlled design among shift workers. We also studied whether the features of shift work disorder (SWD) affected the results.

METHODS: A total of 83 shift workers with insomnia disorder were partially randomized into a group-based CBT-I, self-help CBT-I, or sleep hygiene control intervention. The outcomes were assessed before and after the interventions and at 6-month follow-up using questionnaires, a sleep diary, and actigraphy.

RESULTS: Perceived severity of insomnia, sleep-related dysfunctional beliefs, burnout symptoms, restedness, recovery after a shift, and actigraphy-based total sleep time improved after the interventions, but we found no significant differences between the interventions. Mood symptoms improved only among the group-based CBT-I intervention participants. Non-SWD participants had more mental diseases and symptoms, used more sleep-promoting medication, and had pronounced insomnia severity and more dysfunctional beliefs than those with SWD. After the interventions, non-SWD participants showed more prominent improvements than those with SWD.

CONCLUSIONS: Our results showed no significant differences between the sleep improvements of the shift workers in the CBT-I interventions and of those in the sleep hygiene control intervention. Alleviation of mood symptoms seemed to be the main added value of the group-based CBT-I intervention compared to the control
intervention. The clinical condition of the non-SWD participants was more severe and these participants benefited more from the interventions than the SWD participants did.

TRIAL REGISTRATION: ClinicalTrials.gov, NCT02523079.

DOI: 10.1007/s00420-019-01504-6
PMID: 31853633

Cohort profile: the Baependi Heart Study—a family-based, highly admixed cohort study in a rural Brazilian town.


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PURPOSE: Cardiovascular disease (CVD) is a major challenge to global health. The same epidemiological transition scenario is replayed as countries develop, but with variations based on environment, culture and ethnic mixture. The Baependi Heart Study was set up in 2005 to develop a longitudinal family-based cohort study that reflects on some of the genetic and lifestyle-related peculiarities of the Brazilian populations, in order to evaluate genetic and environmental influences on CVD risk factor traits.

PARTICIPANTS: Probands were recruited in Baependi, a small rural town in the state of Minas Gerais, Brazil, following by first-degree and then increasingly more distant relatives. The first follow-up wave took place in 2010, and the second in 2016. At baseline, the study evaluated 1691 individuals across 95 families. Cross-sectional data have been collected for 2239 participants.

FINDINGS TO DATE: Environmental and lifestyle factors and measures relevant to cardiovascular health have been reported. Having expanded beyond cardiovascular health outcomes, the phenotype datasets now include genetics, biochemistry, anthropometry, mental health, sleep and circadian rhythms. Many of these have yielded heritability estimates, and a shared genetic background of anxiety and depression has recently been published. In spite of universal access to electricity, the population has been found to be strongly shifted towards morningness compared with metropolitan areas.

FUTURE PLANS: A new follow-up, marking 10 years of the study, is ongoing in 2016, in which data are collected as in 2010 (with the exception of the neuropsychiatric protocol). In addition to this, a novel questionnaire package collecting information about intelligence, personality and spirituality is being planned. The data set on circadian rhythms and sleep will be amended through additional questionnaires, actimetry, home sleep EEG recording and dim light.
melatonin onset (DLMO) analysis. Finally, the anthropometric measures will be expanded by adding three-dimensional facial photography, voice recording and anatomical brain MRI.

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Conflict of interest statement: Conflicts of Interest: None declared.


Common genetic variants in ARNTL and NPAS2 and at chromosome 12p13 are associated with objectively measured sleep traits in the elderly.

Evans DS(1), Parimi N, Nievergelt CM, Blackwell T, Redline S, Ancoli-Israel S, Orwoll ES, Cummings SR, Stone KL, Tranah GJ; Study of Osteoporotic Fractures (SOF); Osteoporotic Fractures in Men (MrOS) Study Group.

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Comment in

STUDY OBJECTIVES: To determine the association between common genetic variation in the clock gene pathway and objectively measured actigraphic sleep and activity rhythm traits.

DESIGN: Genetic association study in two population-based cohorts of elderly participants: the Study of Osteoporotic Fractures (SOF) and the Osteoporotic Fractures in Men (MrOS) study.


PARTICIPANTS: SOF participants (n = 1,407, 100% female, mean age 84
years) and MrOS participants (n = 2,527, 100% male, mean age 77 years) with actigraphy and genotype data. INTERVENTIONS: N/A. MEASUREMENTS AND RESULTS: Common genetic variation in 30 candidate genes was captured using 529 single nucleotide polymorphisms (SNPs). Sleep and activity rhythm traits were objectively measured using wrist actigraphy. In a region of high linkage disequilibrium on chromosome 12p13 containing the candidate gene GNB3, the rs1047776 A allele and the rs2238114 C allele were significantly associated with higher wake after sleep onset (meta-analysis: rs1047776 PADD = 2 \times 10^{-5}, rs2238114 PADD = 5 \times 10^{-5}) and lower LRRC23 gene expression (rs1047776: \rho = -0.22, P = 0.02; rs2238114: \rho = -0.50, P = 5 \times 10^{-8}). In MrOS participants, SNPs in ARNTL and NPAS2, genes coding for binding partners, were associated with later sleep and wake onset time (sleep onset time: ARNTL rs3816358 P2DF = 1 \times 10^{-4}, NPAS2 rs3768984 P2DF = 5 \times 10^{-5}; wake onset time: rs3816358 P2DF = 3 \times 10^{-3}, rs3768984 P2DF = 2 \times 10^{-4}) and the SNP interaction was significant (sleep onset time PINT = 0.003, wake onset time PINT = 0.001). A SNP association in the CLOCK gene replicated in the MrOS cohort, and rs3768984 was associated with sleep duration in a previously reported study. Cluster analysis identified four clusters of genetic associations. CONCLUSIONS: These findings support a role for common genetic variation in clock genes in the regulation of inter-related sleep traits in the elderly. CITATION: Evans DS; Parimi N; Nievergelt CM; Blackwell T; Redline S; Ancoli-Israel S; Orwoll ES; Cummings SR; Stone KL; Tranah GJ. Common genetic variants in ARNTL and NPAS2 and at chromosome 12p13 are associated with objectively measured sleep traits in the elderly. SLEEP 2013;36(3):431-446.

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PMCID: PMC3571755
PMID: 23449886 [Indexed for MEDLINE]
A common polymorphism near PER1 and the timing of human behavioral rhythms.


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OBJECTIVE: Circadian rhythms influence the timing of behavior, neurological diseases, and even death. Rare mutations in homologs of evolutionarily conserved clock genes are found in select pedigrees with extreme sleep timing, and there is suggestive evidence that certain common polymorphisms may be associated with self-reported day/night preference. However, no common polymorphism has been associated with the timing of directly observed human behavioral rhythms or other physiological markers of circadian timing at the population level.

METHODS: We performed a candidate gene association study with replication, evaluating associations between polymorphisms in homologs of evolutionarily conserved clock genes and the timing of behavioral rhythms measured by actigraphy. For validated polymorphisms, we evaluated associations with transcript expression and time of death in additional cohorts.

RESULTS: rs7221412, a common polymorphism near period homolog 1 (PER1), was associated with the timing of activity rhythms in both the discovery and replication cohorts (joint p = 2.1 × 10(-7) ). Mean activity timing was delayed by 67 minutes in rs7221412(GG) versus rs7221412(AA) homozygotes.
rs7221412 also showed a suggestive time-dependent relationship with both cerebral cortex (p = 0.05) and CD14+ CD16- monocyte (p = 0.02) PER1 expression and an interesting association with time of death (p = 0.015) in which rs7221412(GG) individuals had a mean time of death nearly 7 hours later than rs7221412(AA/AG).

INTERPRETATION: A common polymorphism near PER1 is associated with the timing of human behavioral rhythms, and shows evidence of association with time of death. This may be mediated by differential PER1 expression. These results may facilitate individualized scheduling of shift work, medical treatments, or monitoring of vulnerable patient populations.

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Community violence concerns and adolescent sleep.

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OBJECTIVE: The goal of this study was to examine links between concerns about community violence and objective and subjective sleep parameters in an
adolescent sample. Sex was considered as a moderator of effects.

DESIGN: The study used a cross-sectional design.

PARTICIPANTS: The community-based sample included 252 adolescents (53% girls) with an average age of 15.79 years (SD = 0.81) from the Southeastern United States. The sample included 34% African American and 66% European American adolescents from a wide range of socioeconomic backgrounds.

MEASUREMENTS: Adolescent-reported community violence concerns were assessed using a composite of 3 separate subscales that measured perceived community safety and threats of community and school violence. Sleep duration and quality were assessed using actigraphy, and subjective sleep problems and daytime sleepiness were measured with subscales of the School Sleep Habits Survey.

RESULTS: Community violence predicted lower sleep efficiency, more long-wake episodes, and more sleep/wake problems and sleepiness. Sex-related moderation effects revealed that girls in the sample were more vulnerable to the effects of violence concerns on their objective sleep quality.

CONCLUSIONS: Findings highlight the role of community violence concerns on adolescents' sleep, revealing that greater community violence concerns are linked with lower levels of actigraphy-based and subjective reports of sleep quality, particularly for adolescent girls. Consideration of the mechanisms by which violence concerns may affect sleep is discussed.

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Conflict of interest statement: The authors declare no conflicts of interest.


Commuting and Sleep: Results From the Hispanic Community Health Study/Study of
Latinos Sueño Ancillary Study.

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INTRODUCTION: Commute time is associated with reduced sleep time, but
previous studies have relied on self-reported sleep assessment. The present study
investigated the relationships between commute time for employment and objective
sleep patterns among non-shift working U.S. Hispanic/Latino adults.

METHODS: From 2010 to 2013, Hispanic/Latino employed, non-shift-
working adults (n=760, aged 18–64 years) from the Sueño study, ancillary to the
Hispanic Community Health Study/Study of Latinos, reported their total daily
commute time
to and from work, completed questionnaires on sleep and other health
behaviors, and wore wrist actigraphs to record sleep duration, continuity, and variability for 1 week. Survey linear regression models of the actigraphic and self-reported sleep measures regressed on categorized commute time (short: 1–44 minutes; moderate: 45–89 minutes; long: ≥90 minutes) were built adjusting for relevant covariates. For associations that suggested a linear relationship, continuous commute time was modeled as the exposure. Moderation effects by age, sex, income, and depressive symptoms also were explored.

RESULTS: Commute time was linearly related to sleep duration on workdays such that each additional hour of commute time conferred 15 minutes of sleep loss (p=0.01). Compared with short commutes, individuals with moderate commutes had greater sleep duration variability (p=0.04) and lower interdaily stability (p=0.046, a measure of sleep/wake schedule regularity). No significant associations were detected for self-reported sleep measures.

CONCLUSIONS: Commute time is significantly associated with actigraphy-measured sleep duration and regularity among Hispanic/Latino adults. Interventions to shorten commute times should be evaluated to help improve sleep habits in this minority population.

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Comparative analysis of actigraphy performance in healthy young subjects.

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Sleep-related health disorders are increasing worldwide; diagnosis and treatment of such sleep diseases are commonly invasive and sometimes unpractical or expensive. Actigraphy has been recently introduced as a tool for the study of sleep and circadian disorders; however, there are several devices that
claim to be useful for research and have not been thoroughly tested. This comparative study provides activity, sleep and temperature information regarding several of the most commonly used actigraphers: Micro-Mini Motion Logger; Act Trust; Misfit Flash; Fitbit Flex & Thermochron. Twenty-two healthy young subjects were assessed with five different commercial actigraphs (Micro-Mini Motionlogger Watch, Condor Act Trust, MisFit Flash and Fitbit Flex) and a temperature recorder (Thermochron), and also completed a sleep diary for a week. There were not significant differences in the analysis of rest-activity pattern between devices. Temperature rhythm comparison between the Act Trust and the Thermochron showed significant differences in rhythm percentage (p<0.05) and mesor (p<0.0563) but not in amplitude or acrophase. Although data accessibility and ease of use was very different for the diverse devices, there were no significant differences for sleep onset, total sleep time and sleep efficiency recordings, where applicable. In conclusion, depending on the type of study and analysis desired (as well as cost and compliance of use), we propose some relative advantages for the different actigraphy/temperature recording devices.

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PMID: 28154740


[Comparative study of actigraphy and ambulatory polysomnography in the assessment of adaptation to night shift work in nurses].

[Article in French]

Delafosse JY(1), Léger D, Quera-Salva MA, Samson O, Adrien J.

Author information:
Night shift work is common in hospitals to assure continuous care. This practice, however, induces difficulties due to changes in the sleep/awake cycle of hospital workers. The aims of the present study were to validate actigraphy in comparison with polysomnography for sleep evaluation and to assess nurses' adaptation to sleep/wake cycles when on a permanent night shift schedule. Actigraphy and ambulatory polysomnography were performed in fifteen night shift nurses employed in hospital on a full time basis, during their work and their rest periods. Our first findings showed that actigraphy gave reliable results compared with polysomnography in evaluation of total sleep time. In addition, it was found that seven of the nurses exhibited, during their work periods, an approximately five-hour delay in the acrophase of their rest/activity rhythm compared with their rest periods. In contrast, five other nurses whose acrophase did not change between work and rest periods, exhibited sleep episodes of more than 100 minutes duration at work. These results confirm data in the literature and show that some nurses cannot adjust the circadian rhythm of their inner biological clock to their nocturnal schedules. Actigraphy seems to be an efficient, low cost and easy method for measuring total sleep time as well as for assessing the inability of nurses to adapt to permanent night shift work.

PMID: 10891799  [Indexed for MEDLINE]


A comparative study of circadian rhythm functioning and sleep in people with Asperger syndrome.

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The circadian rhythm functioning and sleep patterns of 10 adults with Asperger syndrome were investigated using actigraphy. When compared with data from neurotypical adults, both statistical and clinically significant differences were found between the two groups, with the adults with Asperger syndrome showing marked abnormalities in both the quantity and the quality of sleep recorded. Examination of the actigraphic data indicated low sleep efficiency and high fragmentation as being characteristic of the sleep of participants with Asperger syndrome. These individuals also showed lower-amplitude circadian rhythms that were less strongly linked to environmental synchronizers, but no evidence of significant desynchronization of circadian rhythm. Possible mechanisms for these abnormalities and implications for clinical practice are discussed.

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PMID: 17088273 [Indexed for MEDLINE]

Comparing Subjective With Objective Sleep Parameters Via Multisensory Actigraphy in German Physical Education Students.


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This study compared subjective with objective sleep parameters among 72 physical education students. Furthermore, the study determined whether 24-hr recording differs from nighttime recording only. Participants wore the SenseWear Armband™ for three consecutive nights and kept a sleep log. Agreement rates ranged from moderate to low for sleep onset latency (ICC = 0.39 to 0.70) and wake after sleep onset (ICC = 0.22 to 0.59), while time in bed (ICC = 0.93 to 0.95) and total sleep time (ICC = 0.90 to 0.92) revealed strong agreement during this period. Comparing deviations between 24-hr wearing time (n = 24) and night-only application (n = 20) revealed no statistical difference (p > 0.05). As athletic populations have yet to be investigated for these purposes, this study provides useful indicators and practical implications for future studies.

DOI: 10.1080/15402002.2015.1017096
PMID: 26372692  [Indexed for MEDLINE]


Comparison between fatigue, sleep disturbance, and circadian rhythm in cancer inpatients and healthy volunteers: evaluation of diagnostic criteria for cancer-related fatigue.


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The aim of this study was to evaluate whether diagnostic criteria for cancer-related fatigue syndrome (CRFS) could be rigorously applied to cancer inpatients, and to explore the relationship between subjective fatigue and objective measures of physical activity, sleep, and circadian rhythm. Female
cancer patients (n=25) and a comparison group of subjects without cancer (n=25) were studied. Study participants completed a structured interview for CRFS and questionnaires relating to fatigue, psychological symptoms, and quality of life (QoL). Wrist actigraphs worn for 72 hours were used as an objective measure of activity, sleep, and circadian rhythm. Compared to controls, cancer patients were more fatigued, had worse sleep quality, more disrupted circadian rhythms, lower daytime activity levels, and worse QoL. After exclusion of subjects with "probable" mood disorders, the prevalence of CRFS was 56%. Fatigue severity among the cancer patients was significantly correlated with low QoL, depression, constipation, and decreased self-reported physical functioning. It can be concluded that the diagnostic criteria for CRFS can be applied to cancer inpatients but strict application requires a rigorous assessment of psychiatric comorbidity. Despite cancer inpatients having greater impairments of sleep and circadian rhythm, it was found that fatigue severity did not appear to be related to these impairments.

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PMID: 16939849 [Indexed for MEDLINE]


Comparison between informant-observed and actigraphic assessments of sleep-wake rhythm disturbances in demented residents of homes for the elderly.

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OBJECTIVE: Sleep-wake rhythm disturbances frequently occur in demented elderly and are of clinical relevance because they herald accelerated functional decline
and institutionalization. Assessment of sleep–wake rhythm disorders is therefore of significant importance and can be performed by questionnaires or actigraphy, i.e., the recording of wrist activity. The present study investigates the relation of these two types of measurement by simultaneously assessing actigraphy and the Circadian Sleep Inventory for Normal and Pathological States (CSINAPS).

METHODS: Seventy-eight elderly subjects, mean age 85+/-6 years, living in group care facilities of 12 homes for the elderly, wore an actigraph for two weeks. Caregivers completed the nurse informant CSINAPS. Spearman rank correlations and Mann-Whitney U tests were calculated over the equivalent sleep–wake rhythm parameters as derived from actigraphy and from the CSINAPS.

RESULTS: Good correlations were found between questionnaire items about habitual timing of sleep and wakefulness and their actigraphic counterparts. Caregivers overestimated the actual sleep time between sleep onset and offset by 96 minutes. Questionnaire reports of sleep disturbances like wandering at night were also reflected in actigraphy parameters. However, the questionnaire and actigraphy variables correlate only modestly and may complement each other. In our study, both actigraphy and the CSINAPS seemed to miss the previously established high prevalence of sleep–disordered breathing (SDB) and leg movements during sleep (LM).

CONCLUSION: The assessment of sleep and wake disturbances in demented elderly is best served by parallel use of a questionnaire like the CSINAPS and actigraphy. Moreover, if SDB and LM are a focus of interest, additional assessments are needed.

DOI: 10.1097/01.JGP.0000192481.27931.c5
PMID: 16473974 [Indexed for MEDLINE]

Comparison between subjective and actigraphic measurement of sleep and sleep rhythms.

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Sleep is often assessed in circadian rhythm studies and long-term monitoring is required to detect any changes in sleep over time. The present study aims to investigate the ability of the two most commonly employed methods, actigraphy and sleep logs, to identify circadian sleep/wake disorders and measure changes in sleep patterns over time. In addition, the study assesses whether sleep measured by both methods shows the same relationship with an established circadian phase marker, urinary 6-sulphatoxymelatonin. A total of 49 registered blind subjects with different types of circadian rhythms were studied daily for at least four weeks. Grouped analysis of all study days for all subjects was performed for all sleep parameters (1062-1150 days data per sleep parameter). Good correlations were observed when comparing the measurement of sleep timing and duration (sleep onset, sleep offset, night sleep duration, day-time nap duration). However, the methods were poorly correlated in their assessment of transitions between sleep and wake states (sleep latency, number and duration of night awakenings, number of day-time naps). There were also large and inconsistent differences in the measurement of the absolute sleep parameters. Overall, actigraphs recorded a shorter sleep latency, advanced onset time, increased number and duration of night awakenings, delayed offset, increased night sleep duration and increased number and duration of naps compared with the subjective sleep logs. Despite this, there was good agreement between the methods for measuring changes in sleep.
patterns over time. In particular, the methods agreed when assessing changes in sleep in relation to a circadian phase marker (the 6-sulphatoxymelatonin (aMT6s) rhythm) in both entrained (n = 30) and free-running (n = 4) subjects.

DOI: 10.1046/j.1365-2869.1999.00155.x
PMID: 10476003 [Indexed for MEDLINE]


Comparison of 7 versus 14 days wrist actigraphy monitoring in a sleep disorders clinic population.

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Wrist actigraphy is a valid measure to assess sleep and circadian rhythm abnormalities. It is listed in the diagnostic criteria for sleep disorders where single night polysomnography is insufficient (ICSD-2). However, an optimal recording time remains unclear. We hypothesised that seven days would provide sufficient data for analysis, similar to recordings for 14 days. We analysed three consecutive years of actigraphy data obtained within a tertiary sleep referral centre. Data were recorded continuously for two weeks using an AW4 actiwatch (Cambridge NeuroTechnology, Cambridge, UK; Mini Mitter Co, Sunriver, OR). Parameters, including sleep efficiency (SE), sleep latency (SL), sleep fragmentation index (SFI), total sleep time (TST) and wake after sleep onset (WASO) were analysed using GraphPad Prism (Version 5.02, GraphPad Software Inc, San Diego, CA) and classified into week one, week two and an overall average for the duration of 14 days. In addition, two experienced consultants working in the
sleep laboratory compared the results of week one versus week two independently, visually analysing the data for circadian rhythmicity and fragmentation of the pattern, allowing calculation of the intraclass correlation coefficient (ICC), κ. The actigraphies of 239 patients (51.9% male; age 42 (16) years) were analysed. There was no difference in SE, SL, SFI or WASO between week one, week two and 14 days average recording. A small difference was found between TST week one (399.9 minutes, 95% CI 389.9–409.9 minutes) and TST week two (388.7 minutes, 95% CI 378.3–399.1 minutes), but not between TST for 14 days average recording (394.3 minutes, 95% CI 384.7–403.9 minutes) and either week. Independent scorers achieved a good agreement in the rhythmicity of the sleep pattern (ICC κ 0.734, p < 0.001) and a low agreement for the fragmentation of the pattern (ICC κ 0.380, p < 0.001). One week of wrist actigraphy recording provides similar data to two week actigraphies, despite subtle differences between the weeks. One week wrist actigraphy could be recommended as standard compared to longer recordings to maximise efficiency of the clinical service. Further studies are required to validate our results in specific clinical subgroups.

DOI: 10.3109/07420528.2013.858163
PMID: 24304408 [Indexed for MEDLINE]


Comparison of actigraphic, polysomnographic, and subjective assessment of sleep parameters in sleep-disordered patients.

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OBJECTIVE: Comparison of polysomnography (PSG)-derived sleep parameters (total sleep time, sleep efficiency, and number of awakenings) to those derived from actigraphy and subjective questionnaires.

BACKGROUND: Actigraphy is commonly used to assist sleep specialists in the diagnosis of various sleep and circadian-rhythm disorders. However, few validation studies incorporate large sample sizes, typical sleep clinic patients, or comparisons with subjective reports of sleep parameters.

METHODS: Clinical series with 100 consecutive sleep-disordered patients (69 men, 31 women, mean age of 49+/−14.7 years) at a tertiary sleep disorders center. Sensitivity, specificity, and accuracy measures were obtained from epoch-by-epoch comparison of PSG and actigraphic data. Subjective sleep parameter data were derived from questionnaires given to subjects in the morning following their recording night.

RESULTS: We found that total sleep time and sleep efficiency did not significantly differ between PSG data and the combined data obtained from actigraphy and subjective reports. Using a high-threshold (low-wake-sensitivity) actigraphic algorithm, the number of awakenings was not significantly different from those detected by PSG.

CONCLUSIONS: We recommend the use of subjective data as an adjunct to actigraphic data in estimating total sleep time and sleep efficiency in sleep-disordered patients, especially those with disorders of excessive somnolence.

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PMID: 14592388

A comparison of actigraphy and sleep diaries for infants' sleep behavior.

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Detecting the effectiveness of behavioral interventions to reduce infant night-waking requires valid sleep measures. Although viewed as an objective measure, actigraphy has overestimated night-waking. Sleep diaries are criticized for only documenting night-waking with infant crying. To support potential outcome measure validity, we examined differences between sleep diaries and actigraphy in detecting night-waking and sleep duration. We recruited 5.5 to 8-month-old infants for a behavioral sleep intervention trial conducted from 2009 to 2011. Intervention (sleep education and support) and control groups (safety education and support) collected infant diary and actigraphy data for 5 days. We compared night-time sleep actigraphy with diary data at baseline (194 cases), and 6 weeks (166 cases) and 24 weeks post-education (118 cases). We hypothesized numbers of wakes and wakes of ≥20 min would be higher and longest sleep time and total sleep time shorter by actigraphy compared with diaries. Using paired t-tests, there were significantly more actigraphy night wakes than diary wakes at baseline (t = 29.14, df = 193, p < 0.001), 6 weeks (t = 23.99, df = 165, p < 0.001), and 24 weeks (t = 22.01, df = 117, p < 0.001); and significantly more night wakes of ≥20 min by actigraphy than diary at baseline (t = 5.03, df = 183, p < 0.001), and 24 weeks (t = 2.19, df = 107, p < 0.05), but not 6 weeks (t = 1.37, df = 156, n.s.). Longest sleep duration was significantly higher by diary than actigraphy at baseline (t = 14.71, df = 186, p < 0.001), 6
weeks
(t = 7.94, df = 158, p < 0.001), and 24 weeks (t = 17.18, df = 114, p < 0.001).
Night sleep duration was significantly higher by diary than actigraphy at
baseline (t = 9.46, df = 185, p < 0.001), 6 weeks (t = 13.34, df = 158,
p < 0.001), and 24 weeks (t = 13.48, df = 114, p < 0.001).
Discrepancies in
actigraphy and diary data may indicate accurate actigraphy recording
of movement
but not sleep given active infant sleep and self-soothing.

DOI: 10.3389/fpsyt.2015.00019
PMCID: PMC4325935
PMID: 25729371

Comparison of arbitrary definitions of circadian time periods with those
determined by wrist actigraphy in analysis of ABPM data.

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Determining blood pressure (BP) values at different daily time periods
is a well
recognised measure to assess the risk of end-organ damage. However,
the use of
various definitions of these periods, eg, day vs night, sleep vs wake or
arbitrary definitions, makes clinical decisions based on available
data
difficult. In the present study, we compared BP loads in actual sleep-

wake
periods to default day-night definition provided by the ambulatory BP
monitoring
(ABPM) software (day 06.00 to 22.00; night 22.00 to 06.00) as well as to an
arbitrary definition of sleep-wake periods in children published in
Soergel et al
(J Pediatr 1997; 130: 178-184)1 (awake 08.00 to 20.00 and sleep 00.00
to 06.00.
We used an actigraphy, an accelerometer, to define the actual sleep-
wake periods  
in 46 patients with essential hypertension who are on various treatment regimens.  
BP data was obtained by using Spacelabs 90207 monitors for a full 24 h. There  
were significant differences between actual sleep-wake and default definition for  
BP load. No similar finding was noted when arbitrary definition was used. The  
proportion of hypertensives was not significantly different when default and  
arbitrary definitions were used. Classification of dippers and non-dippers is  
greatly affected by the definition of sleep interval using the default method.  
Although some of the misclassifications were not statistically significant, their  
clinical importance must be considered. Determination of sleep and wake periods  
for analysis of ABPM data should be based on careful determination of actual  
periods. Using other definitions may not provide complete information or  
accommodate for individual variation.

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PMID: 10578220  [Indexed for MEDLINE]


Comparison of arbitrary definitions of circadian time periods with those  
determined by wrist actigraphy in analysis of ABPM data.

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Determining blood pressure (BP) values at different daily time periods is a well  
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for analysis of ABPM data should be based on careful determination of
actual
periods. Using other definitions may not provide complete information or
accommodate for individual variation.

DOI: 10.1038/sj.jhh.1000849
PMID: 10449208  [Indexed for MEDLINE]


Comparison of diurnal systolic blood pressure change as defined by wrist
actigraphy, fixed time periods and cusum.

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AIMS: To assess whether differences exist in nocturnal blood pressure (BP) levels and the diurnal BP change when using fixed time and wrist actigraphy methods to define the night-time period.

METHODS: Untreated hypertensive (n = 48) and normotensive (n = 33) subjects (mean age 67 years; range 29–90) underwent simultaneous 24-h ambulatory BP monitoring and wrist actigraphy monitoring. The diurnal BP change and nocturnal BP levels were assessed using two fixed night-time definitions—a reference period of 22.00–06.59 and also 00.00–05.59, as well as unedited and edited actigraph values and cumulative sums (cusums) analysis.

RESULTS: The reference definition of night-time 22.00–06.59 resulted in the highest values for night-time BP compared to other definitions (p < 0.05), although actigraph defined night-time BP values were not significantly different from the more restrictive definition of night-time (00.00–05.59). Restrictive night-time, edited and unedited actigraph and cusums values for the day-night difference were all significantly greater than the value calculated using the reference night-time period. Dipping status changed significantly depending on which definition of night-time was used.

CONCLUSIONS: Significant differences exist in nocturnal BP levels and circadian change between the various methods for defining night-time. The routine use of wrist actigraphy does not however appear to alter the value of night-time BP levels when compared to a more restrictive fixed-time definition of night-time.

DOI: 10.3109/08037059609079674
PMID: 8809372 [Indexed for MEDLINE]


Comparison of Online and Face-to-Face Parent Education for Children with Autism
Many children with autism spectrum disorder (ASD) have sleep disorders. Face-to-face (F2F) sessions have empowered parents to help their child sleep. Our goal was whether online technologies could provide similar improvements in children's sleep while also improving parents' quality of life. Identical programs were taught in two sessions to F2F and online parents. Measurements were compared from baseline to 4 and 8 weeks post teaching sessions. Twenty-three participants completed the program. Parent quality of life improved for both groups. Parent fatigue scores were improved and sustained for the online group. The total sleep score improved for both groups, while the online group had sustained decreases in night wakings. Online methods can conveniently help improve sleep for children with ASD.

DOI: 10.1007/s10803-018-3832-2
PMID: 30506358 [Indexed for MEDLINE]


Comparison of the actigraph versus patients' diary information in defining circadian time periods for analyzing ambulatory blood pressure monitoring data.
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BACKGROUND: Assessment of 24-h changes in blood pressure is one of the unique features that ambulatory blood pressure monitoring (ABPM) can provide. Most studies agree that sleep/wake periods should be based on patients' actual sleep and wake times. Actual wake and sleep time determinations are often based on patients' diary information. Several publications indicate that actigraphy is, at least, as accurate as activity diary in determining sleep/wake periods.

OBJECTIVES: To compare subjects' compliance with actigraphy and diary keeping and to compare actigraphy and diary data in determination of sleep and wake times, mean blood pressures, classification of hypertension, and assessment of nocturnal dipping status.

METHODS: We evaluated ABPM studies of 62 subjects. Blood pressure data were obtained using Spacelabs monitors for 24h. Sleep and wake times were determined by both the actigraph and patients' activity diary.

RESULTS: In the 62 studies, 56 subjects had successful actigraphy (90%), 44 had activity diary completion (71%), and 38 subjects had both (61%). There was no statistically significant difference between the mean wake and sleep onset using the two methods, but up to 3 hours' difference in wake or sleep onset was noted in some studies. Although the two methods did not significantly affect the calculated systolic blood pressure (SBP) or diastolic blood pressure (DBP) loads in either awake or sleep periods, approximately 55% of the subjects' dipping status was changed when diary information on sleep time was used compared to actigraph.

CONCLUSIONS: Our data indicate that in children and young adults, compliance with
the actigraph was superior to diary completion and use of the actigraphy method rather than diary information changed the interpretation of some ABPM data. Our study suggested that actigraphy is superior to diary keeping in providing the information needed for appropriate interpretation of some ABPM data.

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PMID: 11248757 [Indexed for MEDLINE]


A comparison of the characteristics of disease-free breast cancer survivors with or without cancer-related fatigue syndrome.


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PURPOSE: To determine the prevalence of cancer-related fatigue syndrome (CRFS) in a population of disease-free breast cancer survivors and to investigate the relationship between CRFS and clinical variables.

PATIENTS AND METHODS: Women (200) were recruited. All participants were between 3 months and 2 years after completion of primary therapy for breast cancer and were disease free. Subjects completed a diagnostic interview for CRFS and structured psychiatric interview. Participants also completed quality of life, mood and fatigue questionnaires, and provided a blood sample for haematological and biochemical analysis and a 24-h urine specimen for cortisol estimation. Subjects wore a wrist actigraph for 7 days to measure activity and sleep.

RESULTS: Sixty women (30% of participants) were found to fulfil the criteria for CRFS. There were statistically significant differences between fatigued and non-fatigued women with respect to fatigue severity (p<0.01), mood
(p<0.01) and quality of life scores (p<0.05). There were significant differences in blood variables including raised total white cell count and lower sodium (all p<0.02). There was no difference in the 24h urinary free cortisol levels. Actigraphic data demonstrated significant differences in sleep quality and disturbance, but not in overall levels of daytime activity or circadian rhythm.

CONCLUSION: CRFS affects 30% of women after breast cancer treatment and has significant effects on quality of life and mood. There is some evidence that CRFS is related to sleep disturbance or to a persistent inflammatory or immune response.

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PMCID: PMC2653618
PMID: 18977131 [Indexed for MEDLINE]


Comparison of the Effects of Quetiapine XR and Lithium Monotherapy on Actigraphy-Measured Circadian Parameters in Patients With Bipolar II Depression.


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PURPOSE/BACKGROUND: The aim of this study was to evaluate the effects of quetiapine XR and lithium on actigraphy-measured circadian parameters in patients with bipolar II depression.
METHODS/PROCEDURES: This was an 8-week, open-label, prospective, randomized comparative study. The assessments included the 17-item Hamilton Depression Rating Scale score and actigraphic measures concerning the previous 7 days, collected at each visit (weeks 0 [baseline], 1, 2, 4, 6, and 8); the actigraphic data were analyzed with a cosinor analysis.

FINDINGS/RESULTS: Medication, time, and the interaction between medication and time were significantly associated with acrophase for the entire group (Ps = 0.003, 0.020, and 0.042, respectively). More specifically, acrophase was significantly delayed at weeks 1 and 6 (Ps = 0.004 and 0.039, respectively) in the quetiapine XR group. The F statistics significantly increased over time for the entire group (P < 0.001), and there was a significant increase in F statistics on weeks 4 and 6 in the quetiapine XR group (Ps = 0.016 and 0.020, respectively) and on weeks 4 and 8 in the lithium group (Ps = 0.001 and 0.016, respectively). In addition, scores on the 17-item Hamilton Depression Rating Scale were significantly associated with the F statistics during 8 weeks for the entire group (P = 0.008).

IMPLICATIONS/CONCLUSIONS: Both quetiapine XR and lithium affected several circadian parameters, including peak activity time and robustness of circadian rhythm, but exerted different effects on acrophase in patients with bipolar II depression. In particular, clinical depressive symptoms were associated with robustness of circadian rhythm during the course of the 8-week treatment.

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Comparison of three actigraphic algorithms used to evaluate sleep in
patients with obstructive sleep apnea.


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PURPOSE: Actigraphy is a non-invasive and valid method to detect sleep/wake status. However, the technique lacks reliability in patients with sleep-disordered breathing and its results may depend on the algorithm employed.

METHODS: We compared three currently used algorithms (the Cole-Kripke, Sadeh, and University of California San Diego [UCSD]) and determined which is the most reliable in patients with obstructive sleep apnea (OSA) assessing total sleep time. After identification of the most reliable algorithm, we compared total sleep time with the severity of obstructive sleep apnea.

RESULTS: The mean total sleep time was not significantly different from that yielded by polysomnography when the UCSD algorithm was employed (p = 0.798) and UCSD algorithm was associated with the smallest bias. The correlation levels (with polysomnographic data) were mild-to-modest when the results yielded by all algorithms were evaluated, but were highest when the UCSD algorithm was employed (UCSD, r = 0.498, p < 0.001; Cole-Kripke, r = 0.389, p < 0.01; Sadeh, r = 0.272, p = 0.057). Actigraphic measures of mean total sleep time underestimated sleep in patients with severe obstructive sleep apnea (apnea-hypopnea index [AHI] ≥30), and the correlation was low (r = 0.317, p = 0.116), but overestimated sleep, with high correlations, in patients with mild (5 ≤ AHI < 15) and moderate OSA (15 ≤ AHI < 30; r = 0.859, p < 0.001; r = 0.842, p < 0.001, respectively).

CONCLUSIONS: Among the three actigraphic algorithms tested in this study, sleep duration estimated by the UCSD algorithm was the most correlated with polysomnography data in an OSA population. However, none of them was
reliable enough for estimating sleep time in patients with sleep-disordered breathing, especially in patients with severe OSA.

DOI: 10.1007/s11325-012-0689-z
PMID: 22447172 [Indexed for MEDLINE]


Comparison of Wearable Activity Tracker with Actigraphy for Sleep Evaluation and Circadian Rest-Activity Rhythm Measurement in Healthy Young Adults.

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OBJECTIVE: The purpose of this study was to evaluate the applicability of data obtained from a wearable activity tracker (Fitbit Charge HR) to medical research. This was performed by comparing the wearable activity tracker (Fitbit Charge HR) with actigraphy (Actiwatch 2) for sleep evaluation and circadian rest-activity rhythm measurement.

METHODS: Sixteen healthy young adults (female participants, 62.5%; mean age, 22.8 years) wore the Fitbit Charge HR and the Actiwatch 2 on the same wrist; a sleep
log was recorded over a 14-day period. We compared the sleep variables and circadian rest-activity rhythm measures with Wilcoxon signed-rank tests and Spearman's correlations. 

RESULTS: The periods and acrophases of the circadian rest-activity rhythms and the sleep start times did not differ and correlated significantly between the Fitbit Charge HR and the Actiwatch 2. The Fitbit Charge HR tended to overestimate the sleep durations compared with the Actiwatch 2. However, the sleep durations showed high correlation between the two devices for all days. 

CONCLUSION: We found that the Fitbit Charge HR showed high accuracy in sleep evaluation and circadian rest-activity rhythm measurement when compared with actigraphy for healthy young adults. The results suggest that the Fitbit Charge HR could be applicable on medical research as an alternative tool to actigraphy for sleep evaluation and measurement of the circadian rest-activity rhythm.

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PMID: 28326116


Comparisons of short-term efficacy between individual and group cognitive behavioral therapy for primary insomnia.


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The purpose of this study was to compare the efficacy of individual and group cognitive behavioral therapy for insomnia (CBT-I) in outpatients with primary insomnia diagnosed by DSM-IV-TR. The participants were 20 individually treated
(I-CBT-I) and 25 treated in a group therapy format (three to five patients per group) (G-CBT-I), which showed no significant difference regarding demographic variables between groups. The same components of CBT-I stimulus control therapy, sleep restriction therapy, cognitive therapy, and sleep hygiene education were applied on both groups. The short-term outcome (4 weeks after treatment) was measured by sleep logs, actigraphy, the Pittsburgh Sleep Quality Index (PSQI), and the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), and was compared between I-CBT-I and G-CBT-I. The results indicated that CBT-I was effective in improving subjective and objective sleep parameters and subjective sleep evaluations for both individual and group treatment. However, I-CBT-I resulted in significantly better improvements over G-CBT-I, in (i) objective and subjective sleep onset latency time, (ii) objective sleep efficacy and moving time during sleeping, (iii) overall sleep quality and duration of actual sleep time in PSQI, (iv) consequences of insomnia, control and predictability of sleep, sleep requirement expectation, and sleep-promoting practices in DBAS. The present study suggested the superiority of I-CBT-I over G-CBT-I in clinical settings, and further evaluations are necessary.

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PMCID: PMC3787783
PMID: 24098091

eCollection 2016.

COMPASS: Continuous Open Mouse Phenotyping of Activity and Sleep Status.

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Background Disruption of rhythms in activity and rest occur in many diseases, and provide an important indicator of healthy physiology and behaviour. However, outside the field of sleep and circadian rhythm research, these rhythmic processes are rarely measured due to the requirement for specialised resources and expertise. Until recently, the primary approach to measuring activity in laboratory rodents has been based on voluntary running wheel activity. By contrast, measuring sleep requires the use of electroencephalography (EEG), which involves invasive surgical procedures and time-consuming data analysis.

Methods Here we describe a simple, non-invasive system to measure home cage activity in mice based upon passive infrared (PIR) motion sensors. Careful calibration of this system will allow users to simultaneously assess sleep status in mice. The use of open-source tools and simple sensors keeps the cost and the size of data-files down, in order to increase ease of use and uptake. Results In addition to providing accurate data on circadian activity parameters, here we show that extended immobility of >40 seconds provides a reliable indicator of sleep, correlating well with EEG-defined sleep (Pearson's r >0.95, 4 mice).

Conclusions Whilst any detailed analysis of sleep patterns in mice will require EEG, behaviourally-defined sleep provides a valuable non-invasive means of simultaneously phenotyping both circadian rhythms and sleep. Whilst previous approaches have relied upon analysis of video data, here we show that simple motion sensors provide a cheap and effective alternative, enabling real-time analysis and longitudinal studies extending over weeks or even months. The data files produced are small, enabling easy deposition and sharing. We have named this system COMPASS – Continuous Open Mouse Phenotyping of Activity and Sleep.
Status. This simple approach is of particular value in phenotyping screens as well as providing an ideal tool to assess activity and rest cycles for non-specialists.

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PMCID: PMC5140024
PMID: 27976750

Conflict of interest statement: No competing interests were disclosed.


Complete or partial circadian re-entrainment improves performance, alertness, and mood during night-shift work.

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STUDY OBJECTIVES: To assess performance, alertness, and mood during the night shift and subsequent daytime sleep in relation to the degree of re-alignment (re-entrainment) of circadian rhythms with a night-work, day-sleep schedule.

DESIGN: Subjects spent 5 consecutive night shifts (11:00 pm-7:00 am) in the lab and slept at home in darkened bedrooms (8:30 am-3:30 pm). Subjects were categorized by the degree of re-entrainment attained after the 5 night shifts.

Completely re-entrained: temperature minimum in the second half of daytime sleep;
partially re-entrained: temperature minimum in the first half of daytime sleep;
not re-entrained: temperature minimum did not delay enough to reach daytime sleep.

SETTING: See above.

PARTICIPANTS: Young healthy adults (n = 67) who were not shift workers.

INTERVENTIONS: Included bright light during the night shifts, sunglasses worn outside, a fixed dark daytime sleep episode, and melatonin. The
effects of various combinations of these interventions on circadian re-entrainment were previously reported. Here we report how the degree of re-entrainment affected daytime sleep and measures collected during the night shift.

MEASUREMENTS AND RESULTS: Salivary melatonin was collected every 30 minutes in dim light (<20 lux) before and after the night shifts to determine the dim light melatonin onset, and the temperature minimum was estimated by adding a constant (7 hours) to the dim light melatonin onset. Subjects kept sleep logs, which were verified by actigraphy. The Neurobehavioral Assessment Battery was completed several times during each night shift. Baseline sleep schedules and circadian phase differed among the 3 re-entrainment groups, with later times resulting in more re-entrainment. The Neurobehavioral Assessment Battery showed that performance, sleepiness, and mood were better in the groups that re-entrained compared to the group that did not re-entrain, but there were no significant differences between the partial and complete re-entrainment groups. Subjects slept almost all of the allotted 7 hours during the day, and duration did not significantly differ among the re-entrainment groups.

CONCLUSIONS: In young people, complete re-entrainment to the night-shift day-sleep schedule is not necessary to produce substantial benefits in neurobehavioral measures; partial re-entrainment (delaying the temperature minimum into the beginning of daytime sleep) is sufficient. The group that did not re-entrain shows that a reasonable amount of daytime sleep is not enough to produce good neurobehavioral performance during the night shift. Therefore, some re-alignment of circadian rhythms is recommended.

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PMID: 15532201  [Indexed for MEDLINE]

Complex effects of melatonin on human circadian rhythms in constant dim light.

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In humans, the pineal hormone melatonin can phase shift a number of circadian rhythms (e.g., "fatigue", endogenous melatonin, core body temperature) together with the timing of prolactin secretion. It is uncertain, however, whether melatonin can fully entrain all human circadian rhythms. In this study, the authors investigated the effects of daily melatonin administration on sighted individuals kept in continuous very dim light. A total of 10 normal, healthy males were maintained in two separate groups in partial temporal isolation under constant dim light (< 8 lux) with attenuated sound and ambient temperature variations but with knowledge of clock time for two periods of 30 days. In these circumstances, the majority of individuals free run with a mean period of 24.3 h.

In a double-blind, randomized crossover design, subjects received 5 mg melatonin at 20:00 h on Days 1 to 15 (Melatonin 1st) followed by placebo on Days 16 to 30 (Placebo 2nd) or vice versa (Placebo 1st, Melatonin 2nd) during Leg 1 with treatment reversed in Leg 2. The variables measured were melatonin (as 6-sulphatoxymelatonin), rectal temperature, activity, and sleep (actigraphy and logs). In the experiment, 9 of the 10 subjects free ran with Placebo 1st, whereas Melatonin 1st stabilized the sleep-wake cycle to 24 h in 8 of 10 individuals. In addition, 2 individuals showed irregular sleep with this treatment. In some subjects, there was a shortening of the period of the temperature rhythm without synchronization. Melatonin 2nd induced phase advances (5 of 9 subjects), phase delays (2 of 9 subjects), and stabilization (2 of 9 subjects) of the
sleep-wake cycle with subsequent synchronization to 24 h in the majority of individuals (7 of 9). Temperature continued to free run in 4 subjects. Maximum phase advances in core temperature were seen when the first melatonin treatment was given approximately 2 h after the temperature acrophase. These results indicate that melatonin was able to phase shift sleep and core temperature but was unable to synchronize core temperature consistently. In the majority of subjects, the sleep-wake cycle could be synchronized.

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Compliance with the Australian 24-hour movement guidelines for the early years: associations with weight status.


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(5)Illawarra Health and Medical Research Institute, University of Wollongong, Wollongong, Australia.

BACKGROUND: For effective public health and surveillance it is important to document the proportion of young children who meet the new Australian
Integrated
24 h Movement Guidelines for the Early Years and how these associate
with health
outcomes. We aimed to (i) assess compliance with the new Integrated
24 h Movement
Guidelines for the Early Years in a sample of Australian toddlers; and
(ii)
ascertain whether compliance with the guidelines associates with
weight status.
METHODS: The sample comprised 202 toddlers (104 girls) aged
19.74 ± 4.07 months
from the GET UP!
STUDY: Participants wore accelerometers (Actigraph GT3X+) for 24 h
over 7
consecutive days to assess physical activity, sedentary time and
sleep. Parents
reported participants' screen time. Weight and height were measured
and body mass
index (BMI) z-scores by age and sex were calculated. Analysis of
Covariance
(ANCOVA) was performed to test differences in BMI z-scores between
participants
complying with (i) none or any individual guideline, (ii) any
combination of
meeting two guidelines, and (iii) those who met all three guidelines,
adjusting
for child age, gender and socioeconomic status.
RESULTS: Only 8.9% of the sample met the overall 24 h movement
guidelines. Most
of the sample met the physical activity (96.5%) and sleep (79.7%)
guidelines but
only 11.4% met the sedentary behavior guideline. Average BMI Z-scores
did not
significantly differ between children who complied with none or any
individual
guideline, any combination of meeting two guidelines, and those who
met all three
guidelines (p > 0.05). Although the lack of significant differences,
participants
who accomplished any combination of two guidelines or all three
guidelines appear
to have had a lower BMI Z-score than those complying with one of the
guidelines
or none.
CONCLUSIONS: Just under 9% of our sample met the overall Australian
24 h Movement
Guidelines for the Early Years. BMI was not associated with the
accomplishment of
any of the 24-h Movement Guidelines. Strategies to promote adherence
to the 24-h
movement guidelines in toddlers, particularly for screen time, are necessary, as promoting health-related behaviors in early childhood has the potential to provide children a strong foundation for lifelong physical and mental health.

DOI: 10.1186/s12889-017-4857-8
PMCID: PMC5773912
PMID: 29219095 [Indexed for MEDLINE]


Concurrent and longitudinal relations between children's sleep and cognitive functioning: the moderating role of parent education.

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Relations between children's sleep and cognitive functioning were examined over 2 years, and race and socioeconomic status were assessed as moderators of effects. Third-grade African American and European American children (N = 166; M = 8.72 years) participated at Time 1 and again 2 years later (N = 132). At both Time 1 and Time 2, sleep was examined via self-report and actigraphy. Children were administered selected tests from the Woodcock-Johnson III Tests of Cognitive Abilities, and Stanford Achievement Test scores were obtained from schools. Children's sleep was related to intellectual ability and academic achievement. Results build substantially on an emerging literature supportive of the importance of sleep in children.

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Continuous subcutaneous hydrocortisone infusion versus oral hydrocortisone replacement for treatment of addison's disease: a randomized clinical trial.


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Comment in

CONTEXT: Conventional glucocorticoid replacement therapy fails to mimic the physiological cortisol rhythm, which may have implications for morbidity and mortality in patients with Addison's disease.
OBJECTIVE: The objective of the study was to compare the effects of continuous sc hydrocortisone infusion (CShI) with conventional oral hydrocortisone (OHC) replacement therapy.
DESIGN, PATIENTS, AND INTERVENTIONS: This was a prospective crossover, randomized, multicenter clinical trial comparing 3 months of treatment with thrice-daily OHC vs CShI. From Norway and Sweden, 33 patients were enrolled from registries and clinics. All patients were assessed at baseline and
after 8 and 12 weeks in each treatment arm.

MAIN OUTCOME MEASURES: The morning ACTH level was the primary outcome measure. Secondary outcome measures were effects on metabolism, health-related quality of life (HRQoL), sleep, and safety.

RESULTS: CSHI yielded normalization of morning ACTH and cortisol levels, and 24-hour salivary cortisol curves resembled the normal circadian variation. Urinary concentrations of glucocorticoid metabolites displayed a normal pattern with CSHI but were clearly altered with OHC. Several HRQoL indices in the vitality domain improved over time with CSHI. No benefit was found for either treatments for any subjective (Pittsburgh Sleep Quality Index questionnaire) or objective (actigraphy) sleep parameters.

CONCLUSION: CSHI safely brought ACTH and cortisol toward normal circadian levels without adversely affecting glucocorticoid metabolism in the way that OHC did. Positive effects on HRQoL were noted with CSHI, indicating that physiological glucocorticoid replacement therapy may be beneficial and that CSHI might become a treatment option for patients poorly controlled on conventional therapy.

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Contribution of the rest-activity circadian rhythm to quality of life in cancer patients.

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Quality of life (QoL) is estimated from patients scores to items
related to everyday life, including rest and activity. The rest–activity rhythm reflects endogenous circadian clock function. The relation between the individual rhythm in activity and QoL was investigated in 200 patients with metastatic colorectal cancer. Patients wore a wrist actigraph (Ambulatory Monitoring Inc., New York, NY) for 3–5 d before chronotherapy, and completed a QoL questionnaire developed by the European Organization for Research and Treatment of Cancer (QLQ-C30) plus the Hospital Anxiety and Depression Scale. The rest–activity circadian rhythm was characterized by the mean activity level (m), autocorrelation coefficient at 24h (r24), and the dichotomy index (I < 0), a ratio between the amount of activity while in and out of bed. The distribution of the rest–activity cycle parameters and that of QoL scores was independent of sex, age, primary tumor, number of metastatic sites, and prior treatment. Both the 24h rhythm indicators were positively correlated with global QoL score as well as physical, emotional, and social functioning. Negative correlations were found between m, r24, or I < 0 and fatigue, appetite loss, and nausea. The rest–activity circadian rhythm appeared to be an objective indicator of physical welfare and QoL. This analysis suggests that circadian function may be one of the biological determinants of QoL in cancer patients.

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Correcting delayed circadian phase with bright light therapy predicts improvement in ADHD symptoms: A pilot study.

Fargason RE(1), Fobian AD(1), Hablitz LM(1), Paul JR(1), White BA(1),
Attention-deficit/hyperactivity disorder (ADHD) is a common condition with comorbid insomnia reported in >70% of children and adults. These patients demonstrate delays in sleep-wake rhythms, nocturnal rise in melatonin, and early morning rise in cortisol. Given that standard psychopharmacologic treatments for ADHD often do not completely control symptoms in participants with circadian rhythm delay, we sought to test whether bright light therapy (BLT) advances circadian rhythms and further reduces ADHD symptoms over standard treatments. In addition to standard of care, participants with ADHD diagnosis underwent 1 week of baseline assessment followed by 2-weeks of 30-min morning 10,000-lux BLT beginning 3 h after mid-sleep time. Participants minimized overhead light after 4 p.m., wore an actigraphy watch, and recorded BLT time on daily sleep logs. Dim Light Melatonin Onset (DLMO) was assessed at baseline and after 2-week treatment. ADHD symptoms were measured by the ADHD-Rating Scales (ADHD-RS). BLT significantly advanced the phase of DLMO by 31 min [mean time (SEM), 20:36 (0:21) advanced to 20:05 (0:20)] and mid-sleep time by 57 min [4:37 (0:22) advanced to 3:40 (0:16); paired t-tests, p = 0.002 and 0.004, respectively). Phase advances (in DLMO or mid-sleep time) were significantly correlated with decreased ADHD-RS total scores (p = 0.027 and 0.044) and Hyperactive-Impulsive sub-scores (p = 0.014 and 0.013, respectively). Actigraphy analysis for a subset of 8 participants with significant DLMO phase advance revealed no significant changes.
in total sleep time, sleep efficiency, wake after sleep onset, or percent wake during sleep interval. This is the first successful use of BLT for advancing melatonin phase and improving ADHD symptoms in adults. BLT may be a complementary treatment for both delayed sleep timing and ADHD symptoms in adults.

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eCollection 2017.

Correction: Multiscale adaptive analysis of circadian rhythms and intradaily variability: Application to actigraphy time series in acute insomnia subjects.

PLOS ONE Staff.

Erratum for


[This corrects the article DOI: 10.1371/journal.pone.0181762].

DOI: 10.1371/journal.pone.0188674
PMCID: PMC5695844
PMID: 29155866


Correction to: Actigraphy assessments of circadian sleep-wake cycles in the Vegetative and Minimally Conscious States.

Cruse D(1), Thibaut A(2), Demertzi A(2), Nantes JC(2), Bruno MA(2), Gosseries O(2), Vanhaudenhuyse A(2), Bekinschtein TA(2), Owen AM(2), Laureys S(2).

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Erratum for

The original article [1] contains an error affecting the actigraphy
time-stamps throughout the article, particularly in Table 1.

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PMID: 30097009

Correlates of adolescent sleep time and variability in sleep time: the
role of individual and health related characteristics.

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OBJECTIVES: Adolescents are predisposed to short sleep duration and irregular
sleep patterns due to certain host characteristics (e.g., age, pubertal status,
gender, ethnicity, socioeconomic class, and neighborhood distress) and
health-related variables (e.g., ADHD, asthma, birth weight, and BMI).
The aim of the current study was to investigate the relationship between such
variables and actigraphic measures of sleep duration and variability.
METHOD: Cross-sectional study of 247 adolescents (48.5% female, 54.3%
ethnic minority, mean age of 13.7 years) involved in a larger community-based
cohort study.
RESULTS: Significant univariate predictors of sleep duration included
gender, minority ethnicity, neighborhood distress, parent income, and BMI. In
multivariate models, gender, minority status, and BMI were significantly
associated with sleep duration (all p<.05), with girls, non-minority adolescents, and those of a lower BMI obtaining more sleep. Univariate models demonstrated that age, minority ethnicity, neighborhood distress, parent education, parent income, pubertal status, and BMI were significantly related to variability in total sleep time. In the multivariate model, age, minority status, and BMI were significantly related to variability in total sleep time (all p<.05), with younger adolescents, non-minority adolescents, and those of a lower BMI obtaining more regular sleep.

CONCLUSIONS: These data show differences in sleep patterns in population sub-groups of adolescents which may be important in understanding pediatric health risk profiles. Sub-groups that may particularly benefit from interventions aimed at improving sleep patterns include boys, overweight, and minority adolescents.

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Correlates of nocturnal sleep duration, nocturnal sleep variability, and nocturnal sleep problems in toddlers: results from the GET UP! Study.


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OBJECTIVE: To explore the correlates of nocturnal sleep duration, nocturnal sleep variability, and nocturnal sleep problems in a sample of Australian toddlers.

METHODS: Participants were 173 toddlers (average age 19.7 ± 4.1 months) from the GET UP! Study: Nocturnal sleep duration, nocturnal sleep variability, nap(s) and physical activity were measured using 24-h accelerometry (Actigraph GT3X+) over seven consecutive days. Nocturnal sleep problems were assessed using the Tayside Children's Sleep Questionnaire. Screen time was reported by the parents. Logistic regression models were used to examine the associations between potential correlates (ie, age, sex, socio-economic status, weight status, physical activity, screen time, nap(s), bedtimes, and wake-up times) and nocturnal sleep characteristics.

RESULTS: Older children were more likely to have greater sleep variability (OR: 1.97; 95% CI: 1.08-3.61). Less physical activity (OR: 2.38; 95% CI: 1.27-4.45),
shorter nap(s) (OR: 2.42, 95% CI: 1.29–4.55), and later wake-up times (OR: 4.42; 95% CI: 2.32–8.42) were associated with higher odds of having longer nocturnal sleep duration. Late bedtimes were associated with shorter nocturnal sleep duration (OR: 0.09; 95% CI: 0.04–0.18) and with greater nocturnal sleep variability (OR: 1.97; 95% CI: 1.06–3.68). None of the potential correlates were associated with nocturnal sleep problems.

CONCLUSION: The present study identifies several correlates of nocturnal sleep duration (total physical activity, nap(s), bedtime, and wake-up time) and nocturnal sleep variability (age and bedtime), whereas no correlates were identified for nocturnal sleep problems. The association between late bedtimes and shorter nocturnal sleep duration and greater nocturnal variability suggests that these may be modifiable targets for future sleep interventions in early childhood.

TRIAL REGISTRATION: Australian New Zealand Clinical Trials Registry: ACTRN12616000471482, 11/04/2016, retrospectively registered.

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PMID: 30508780 [Indexed for MEDLINE]
BACKGROUND: The socioecological model proposes a wide array of factors that influence behaviours. There is a need to understand salient correlates of these activity behaviours in a specific population. However, few studies identified socio-demographic, behavioural, physical, and psychological correlates of objectively-assessed physical activity and sedentary time in young adults.

METHODS: This was a cross-sectional analysis of participants in the Raine Study (a pregnancy cohort started in 1989). Australian young adults (mean 22.1 years ± SD 0.6) wore Actigraph GT3X+ accelerometers on the hip 24 h/day for seven days to assess moderate-to-vigorous physical activity (MVPA) and sedentary time (n = 256 women, n = 219 men). Potential correlates were assessed via clinical assessment and questionnaire and included socio-demographic variables (ethnicity, relationship status, work/study status, education, mothers education), health behaviours (food intake, alcohol consumption, smoking status, sleep quality), and physical and psychological health aspects (anthropometrics, diagnosed disorders, mental health, cognitive performance). Backwards elimination (p < 0.2
for retention) with mixed model regressions were used and the gender-stratified analyses were adjusted for demographic variables, waking wear time and number of valid days.

RESULTS: Increased time spent in MVPA was associated with: being single (IRR 1.44 vs in a relationship living together, 95%CI: 1.17, 1.77, p = .001) in women; and better sleep quality in men (lower scores better IRR 0.97, 95%CI: 0.93, 1.00).

Less time spent sedentary was associated with: lower mother's education (-32.1 min/day, 95%CI -52.9, 11.3, p = 0.002 for having mother with no university degree vs at least a baccalaureate degree) and smoking (-44.3 min/day, 95%CI: -72.8, -15.9, p = .0002) for women; lower education status (-32.1 min/day, 95%CI: -59.5, -4.8, p = 0.021 for having no university degree vs at least a baccalaureate degree) and lower depression scores in men (-2.0, 95%CI: -3.5, -0.4, p = 0.014); more alcoholic drinks per week for women (-1.9 min/day, 95%CI: -3.1, -0.6, p = 0.003) and men (-1.0, 95%CI: -1.8, -0.3, p = 0.007).

CONCLUSIONS: Less desirable correlates were associated with positive levels of activity in young Australian adult women and men. Interventions to increase MVPA and decrease sedentary activity in young adults need to specifically consider the life stage of young adults.

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PMCID: PMC6060463
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Correlates of sedentary time in children: a multilevel modelling approach.

BACKGROUND: Sedentary behaviour (SB) has been implicated as a potential risk factor for chronic disease. Since children spend most of their awake time in schools, this study aimed to identify individual- and school-level correlates of sedentary time using a multilevel approach, and to determine if these correlates have a similar effect in normal weight (NW) and overweight/obese (O/O) children.

METHODS: Sample comprised 686 Portuguese children aged 9-10 years from 23 schools that took part in the ISCOLE project. Actigraph GT3X + accelerometers were used 24 hours/day for 7 days to assess sedentary time (daily minutes <100 counts/min); BMI was computed and WHO cut-points were used to classify subjects as NW or O/O. Sex, BMI, number of siblings, family income, computer use on school days, and sleep time on school days were used as individual-level correlates. At the school level, school size (number of students), percentage of students involved in sports or physical activity (PA) clubs, school promotion of active transportation, and students' access to equipment outside school hours were used.

All multilevel modelling analysis was done in SPSS, WINPEPI, and HLM. RESULTS: School-level correlates explain ≈ 6.0% of the total variance in sedentary time. Results (β ± SE) showed that boys (-30.85 ± 5.23), children with more siblings (-8.56 ± 2.71) and those who sleep more (-17.78 ± 3.06) were less sedentary, while children with higher family income were more sedentary (4.32 ± 1.68). At the school level, no variable was significantly correlated with sedentary time. Among weight groups, variables related to sedentary time in NW were sex, sleep time and family income, while in O/O sex, number of siblings and sleep time were significant correlates. No school-level predictors were significantly associated in either of the weight groups.
CONCLUSION: Notwithstanding the relevance of the school environment in the reduction of children's sedentary time, individual and family characteristics played a more relevant role than the school context in this study.

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Correlates of sleep irregularity in schizophrenia.
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Circadian rhythm disruption, manifested as circadian misalignment, difficulty initiating sleep, and sleep–wake irregularity, is often left unrecognized in patients with schizophrenia. Studies have shown multiple adverse consequences of sleep irregularity, but limited data is available on schizophrenia. This is a secondary analysis of a case–control study of 66 schizophrenia patients with delayed sleep–wake phase (with or without meeting criteria for the disorder) and normal sleep–wake phase (mean age = 44.08 years; 45.45% males). Potential correlates included sleep quality, daytime sleepiness, social rhythms, chronotype, psychiatric symptoms, psychosocial functioning, metabolic index, cognitive function, and sociodemographic, lifestyle and pharmacological factors. Square successive difference (SSD) scores, derived from 1-week sleep
diary and actigraphy, were indexes of sleep irregularity. Multilevel modeling analysis, with SSD scores as level-1 measures and the hypothesized correlates as level-2 measures, was performed. Statistical significance was Bonferroni-adjusted. Higher SSD scores of sleep diary and actigraphy variables were significantly associated with positive and depressive symptoms, poor sleep quality, daytime sleepiness, irregular social rhythm, evening chronotype, delayed sleep-wake phase disorder, later caffeine use and dinner time, greater cigarette use, and lower dosages of hypnotics and antipsychotics. Our findings highlight the implications of sleep irregularity in schizophrenia and the need for a multimodal intervention.

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Correlations between objective and subjective sleep and circadian markers in remitted patients with bipolar disorder.

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Bipolar disorder (BD) is a chronic psychiatric condition characterized by recurrences of depressive and (hypo)manic episodes. Patients in remission report a wide range of sleep and circadian disturbances that correlate with several outcomes measures such as functioning or physical health. The most appropriate way to measure these abnormalities in clinical practice requires
further investigation since the external validity of self-reports, as compared to more physiological measures (such as polysomnography or actigraphy), has been questioned. Despite the fact that questionnaires are inexpensive, fast and easy to use, they need to be validated against objective measures. This study aims to validate three sleep and circadian questionnaires, namely the Pittsburgh Sleep Quality Index (PSQI), the Composite Scale of Morningness (CSM) and the Circadian Type Inventory (CTI) – against actigraphy in BD patients in remission. Twenty-six carefully assessed BD patients in remission completed the PSQI, the CTI and the CSM, and wore an actigraph (AW7, Camnitech) for 21 consecutive days. Phase preference assessed by the CSM strongly correlated with actigraphic phase markers (M10 onset $\rho = -0.69$ and L5 onset $\rho = -0.63$). Sleep duration and sleep latency assessed by the PSQI and by actigraphy were also highly correlated ($\rho = -0.76$; $\rho = 0.50$). Moderate correlation coefficients were observed between questionnaires and actigraphy for markers that explored the stability of rhythms, sleep quality, sleep latency and sleep disturbances ($|\rho| > 0.40$) although these were not significant after correcting for multiple testing. No correlation was observed between markers for the amplitude of rhythms. While the external validity of the CTI clearly requires further investigation, this study supported the external validity of the CSM and the PSQI for phase preference, sleep duration and latency. We conclude that the CSM and the PSQI could be useful in routine practice and research when actigraphy is not easily available.

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Correlations of sleep disturbance with the immune system in type 2 diabetes mellitus.

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AIMS: The circadian rhythm and immune system are thought to be associated with the pathological state of diabetes. The aim of this study was to examine the correlation of circadian rhythm disturbance including sleep disturbance with the immune state in patients with type 2 diabetes compared to healthy controls.

METHODS: Nineteen patients with type 2 diabetes (11 males and 8 females; aged 46–85 years) and 19 healthy controls (7 males and 12 males; aged 45–85 years) were recruited, and the presence of circadian rhythm disturbance including sleep disturbance was examined using an actigraph. Immunological parameters were also measured.

RESULTS: Sleep and circadian rhythm disturbances were more frequently noted in diabetic patients than in healthy controls. Higher fasting plasma glucose and hemoglobin A1c levels were correlated with stronger sleep and circadian rhythm disturbances. The levels of B lymphocytes, helper T lymphocytes, natural killer cells, natural killer activity, and several cytokines were increased in diabetic patients compared to healthy controls. Correlations were shown among sleep disturbance (circadian rhythm disturbance), immunological measures, and diabetic indices.

CONCLUSION: The exacerbation of diabetes was related to the level of sleep disturbance, circadian rhythm disturbance, and activation of the immune system.

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The cortisol awakening response (CAR) in toddlers: Nap-dependent effects on the diurnal secretory pattern.

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INTRODUCTION: Cortisol levels in adults show a sharp decrease from mid-morning to mid-afternoon. Most toddlers take afternoon naps, which is associated with a less mature diurnal pattern characterized by a midday plateau in cortisol secretion. Napping in preschoolers produces a robust cortisol awakening response (CAR), which may account for such maturational differences. This experimental study extends prior work by examining whether the presence and timing of the nap-dependent CAR influences the diurnal cortisol pattern in toddlers.

METHODS: Toddlers (n = 28; 13 females; 30-36 months) followed a strict biphasic sleep schedule (≥ 12.5h time in bed; ≥ 90 min nap) for ≥ 3 days before each of four randomly ordered, in-home cortisol assessments. For each assessment, saliva samples were obtained at morning awakening, ~09:30, pre-nap, 0, 15, 30, 45, 90, and 135 min post-nap awakening (verified with actigraphy), and ~19:30. On one day, children napped at their scheduled time, and parents collected saliva samples. On another day, children missed their nap, and parents
collected saliva samples at matched times. On two other days, children napped 4h (morning) and 7h (afternoon) after awakening in the morning, during which time researchers collected pre- and post-nap saliva samples. Saliva was assayed for cortisol (μg/dl).

RESULTS: Three-level multilevel models were used to estimate the CAR and diurnal cortisol patterns in all four conditions. Compared to the no-nap condition (no observed CAR; b = -0.78, p = 0.65), we found a pronounced cortisol rise following the morning nap (b = 11.00, p < 0.001) and both afternoon naps whether samples were collected by parents (b = 5.19, p < 0.01) or experimenters (b = 4.97, p < 0.01). Napping in the morning resulted in the most robust post-nap cortisol rise (b = 10.21, p < 0.001). Diurnal patterns were analyzed using piecewise growth modeling that estimated linear coefficients for five separate periods throughout the day (corresponding to morning decline, noon decline, post-nap rise, post-nap decline, and evening decline). We observed a significant post-nap rise in cortisol values on the parent-collected afternoon nap (b = 3.41, p < 0.01) and the experimenter-collected morning nap (b = 7.50, p < 0.01) days as compared to the no-nap day (b = -0.17, p = 0.82). No other differences in diurnal profiles were observed between the parent-collected nap and no-nap conditions; however, toddlers had a steeper evening decline on the day of the morning nap compared to the parent-collected afternoon nap (b = 0.30, p < 0.05) and no-nap conditions (b = 0.27, p < 0.05).

DISCUSSION: These well-controlled findings suggest that the presence and timing of daytime naps influence the pattern of diurnal cortisol secretion in toddlers. They also provide support for the hypothesis that napping is the primary state driving the immature midday plateau in cortisol secretion, which becomes more adult-like across childhood. Prior studies of the diurnal cortisol
pattern have employed a cubic model, and therefore, have not detected all possible variations due to napping. Our experimental data have important methodological implications for researchers examining associations between the slope of the diurnal cortisol pattern and developmental outcomes, as well as those utilizing afternoon cortisol reactivity protocols in napping children.

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The cortisol awakening response in relation to objective and subjective measures of waking in the morning.

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Studies of the salivary cortisol awakening response (CAR) may be confounded by delays between waking in the morning and obtaining the 'waking' salivary sample. We used wrist actigraphy to provide objective information about waking time, and studied the influence of delays in taking the waking sample on the CAR. Eighty-three men and women (mean age 61.30 years) who were referred to hospital with suspected coronary artery disease were studied. Saliva samples were obtained on waking and 15 and 30 min later. The mean interval between waking defined by actigraphy and reported waking time was 6.12+/-(S.D.) 14.8 min, with 55.4% having no delay. The waking saliva sample was obtained an average 5.78+/−15.0 min after self-reported waking, and 12.24+/−20.3 min after objective waking. The
waking cortisol value was significantly higher in participants who had a delay between waking and sampling >15 min (mean 14.46±/−6.34 nmol/l) than in those with zero (mean 10.45±/−6.41 nmol/l) or 1-15 min delays (mean 11.51±/−5.99 nmol/l, p=0.043). Cortisol did not increase between 15 and 30 min after waking in those who delayed >15 min. There were no differences in CAR between participants with zero and 1-15 min delays from objectively defined waking to reported sample times. A small proportion (14.7%) of participants who did not delay saliva sampling showed no increase in cortisol over the 30 min after waking. These CAR nonresponders did not differ from the remainder on sleep patterns, waking time, clinical or medication characteristics, but were more likely to be of higher socioeconomic status (p=0.009). We conclude that long delays between waking and obtaining 'waking' cortisol samples will lead to misleading CAR results, but that delays up to 15 min may not be problematic. A small minority of individuals do not show a positive CAR despite not delaying saliva sampling after waking.

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Crew fatigue during simulated, long duration B-1B bomber missions.

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Crew fatigue associated with successive and unaugmented 36 h missions was evaluated in B-1B simulators. Data were obtained from 32 operationally qualified crewmembers. All crew-members completed three consecutive, long duration missions, each preceded by 33 to 35 h of crew rest. Oral temperature,
Salivary melatonin and cortisol, as well as actigraph and subjective measures, were collected during all missions. Temperature and melatonin data indicate that crews maintained their local home base circadian cycles. Elevated cortisol and subjective fatigue during the first mission indicate that it was the most difficult of the three. Furthermore, quality and duration of sleep were lowest during the first mission. These findings emphasize the need for realistic training in long duration fatigue management to improve the safety and effectiveness of the first and subsequent missions.

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Critical slowing down as an early warning of transitions in episodes of bipolar disorder: A simulation study based on a computational model of circadian activity rhythms.

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Bipolar disorder is characterized by repeated episodes of mania and depression, and can be understood as pathological complex system behaviour involving cognitive, affective and psychomotor disturbance. Accurate prediction of episode transitions in the long-term pattern of mood changes in bipolar disorder could improve the management of the disorder by providing an objective early warning of
relapse. In particular, circadian activity changes measured via actigraphy may contain clinically relevant signals of imminent systemic dysregulation. In this study, we propose a mathematical index to investigate the correlation between apparently irregular circadian activity rhythms and critical transitions in episodes of bipolar disorder. Not only does the proposed index illuminate the effects of pharmacological and psychological therapies in control over the state, but it also provides a framework to understand the dynamic (or state-dependent) control strategies. Modelling analyses using our new approach suggest that key clinical goals are minimizing side effects of mood stabilizers as well as increasing the efficiency of other therapeutic strategies.

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OBJECTIVE: To cross-sectionally and prospectively investigate the association between irregular sleep patterns, a potential marker for circadian disruption, and metabolic abnormalities.
RESEARCH DESIGN AND METHODS: In the Multi-Ethnic Study of Atherosclerosis, participants completed 7-day actigraphy at exam 5 (2010-2013) and were prospectively followed throughout exam 6 (2016 to 2017). Sleep regularity was quantified by the 7-day SD of actigraphy-assessed sleep duration and sleep onset timing. Metabolic abnormalities were defined by 1) the National Cholesterol Education Program Adult Treatment Panel III criteria and 2) a data-driven clustering of metabolic factors.

RESULTS: In the exam 5 cross-sectional analysis adjusted for sociodemographic and lifestyle factors (n = 2,003), every 1-h increase in the sleep duration SD was associated with 27% (95% CI 1.10, 1.47) higher odds of metabolic syndrome, and every 1-h increase in the sleep timing SD was associated with 23% (95% CI 1.06, 1.42) higher odds. The associations remained significant with additional adjustment for sleep-related factors including sleep duration. In the prospective analysis (n = 970), the corresponding fully adjusted odds ratio (OR) was 1.27 (95% CI 0.97, 1.65) for sleep duration and 1.36 (1.03, 1.80) for sleep timing. Compared with the cluster of few metabolic changes, every 1-h increase in sleep variability was associated with almost doubled odds for the cluster characterized by incidence of multiple metabolic abnormalities (OR 1.97 [95% CI 1.18, 3.30] for sleep duration and OR 2.10 [95% CI 1.25, 3.53] for sleep timing).

CONCLUSIONS: Increased variability in sleep duration and timing was associated with higher prevalence and incidence of metabolic abnormalities even after consideration of sleep duration and other lifestyle factors.

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Cumulative Childhood Lead Levels in Relation to Sleep During Adolescence.


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STUDY OBJECTIVES: Lead exposure has been linked to adverse cognitive outcomes among children, and sleep disturbances could potentially mediate these relationships. As a first step, whether childhood lead levels are linked to sleep disturbances must be ascertained. Prior studies of lead and sleep are scarce and rely on parent-reported sleep data.

METHODS: The study population included 395 participants from the Early Life Exposure in Mexico to Environmental Toxicants project, a group of sequentially enrolled birth cohorts from Mexico City. Blood lead levels measured from ages 1 to 4 years were used to calculate a cumulative measure of early childhood lead levels. Average sleep duration, sleep fragmentation, and movement index were assessed once between the ages of 9 and 18 years with wrist actigraphs worn for a
continuous 7-day interval. Linear regression models were fit with average sleep
duration, fragmentation, or movement as the outcome and cumulative lead levels
divided into quartiles as the exposure, adjusted for age, sex, and maternal
education.
RESULTS: Mean (standard deviation) age at follow-up was 13.8 (1.9) years, and 48%
of participants were boys. Median (interquartile range) cumulative childhood lead
level was 13.7 (10.8, 18.0) μg/dL. Patients in the highest quartile of the
cumulative childhood lead group had on average 23 minutes less sleep than those
in the first quartile in adolescence (95% confidence interval [7, 39]; P, trend = .02). Higher cumulative lead level was associated with higher sleep fragmentation
in younger adolescents (younger than 14 years) only (P, interaction = .02).
CONCLUSIONS: Shorter sleep duration may represent an as-yet unrecognized adverse
consequence of lead exposure in youth.

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Daily Actigraphy Profiles Distinguish Depressive and Interepisode States in Bipolar Disorder.

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Disruptions in activity are core features of mood states in bipolar disorder (BD). This study sought to identify activity patterns that discriminate between mood states in BD. Locomotor activity was collected using actigraphy for six weeks in participants with inter-episode BD type I (n=37) or participants with no lifetime mood disorders (n=39). The 24-hour activity pattern of each participant-day was characterized and within-person differences in activity patterns were examined across mood states. Results show that among participants with BD, depressive days are distinguished from other mood states by an overall lower activity level, and a pattern of later activity onset, a midday elevation of activity, and low evening activity. No distinct within-person activity patterns were found for hypomanic/manic days. Since activity can be monitored non-invasively for extended time periods, activity pattern identification may be leveraged to detect mood states in BD, thereby providing more immediate delivery of care.

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PMID: 27642544

Daily activity patterns of 2316 men and women from five countries differing in socioeconomic development.


Author information:
Daily rhythmicity in the locomotor activity of laboratory animals has been studied in great detail for many decades, but the daily pattern of locomotor activity has not received as much attention in humans. We collected waist-worn accelerometer data from more than 2000 individuals from five countries differing in socioeconomic development and conducted a detailed analysis of human locomotor activity. Body mass index (BMI) was computed from height and weight. Individual activity records lasting 7 days were subjected to cosinor analysis to determine the parameters of the daily activity rhythm: mesor (mean level), amplitude (half the range of excursion), acrophase (time of the peak) and robustness (rhythm strength). The activity records of all individual participants exhibited statistically significant 24-h rhythmicity, with activity increasing noticeably a few hours after sunrise and dropping off around the time of sunset, with a peak at 1:42 pm on average. The acrophase of the daily rhythm was comparable in men and women in each country but varied by as much as 3 h from country to country. Quantification of the socioeconomic stages of the five countries yielded suggestive evidence that more developed countries have more obese residents, who are less active, and who are active later in the day than residents from less developed countries. These results provide a detailed characterization of the daily activity pattern of individual human beings and reveal similarities and differences among people from five countries differing in socioeconomic development.

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Daily illumination exposure and melatonin: influence of ophthalmic dysfunction and sleep duration.


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BACKGROUND: Ocular pathology lessens light's efficacy to maintain optimal circadian entrainment. We examined whether ophthalmic dysfunction explains unique variance in melatonin excretion of older adults over and above the variance explained by daily illumination, medical, and sociodemographic factors. We also examined whether ophthalmic dysfunction influences relationships between ambient illumination and melatonin.

METHODS: Thirty older adults (mean age = 69 years; Blacks = 42% and Whites = 58%) of both genders participated in the study. Demographic and health data were collected at baseline. Participants underwent eye exams at SUNY Downstate Medical Center, wore an actigraph to monitor illumination and sleep, and collected urine specimens to estimate aMT6s concentrations.

RESULTS: Hierarchical regression analysis showed that illumination factors explained 29% of the variance in aMT6s mesor. The proportion of variance explained by ophthalmic factors, sleep duration, and race was 10%, 2%, and 2%, respectively. Illumination factors explained 19% of the variance in aMT6s acrophase. The proportion of variance explained by ophthalmic factors, sleep duration, and race was 11%; 17%; and 2%, respectively. Controlling for sleep duration and race reduced the correlations between illumination and melatonin, whereas controlling for ophthalmic factors did not.
CONCLUSION: Ophthalmic exams showed that elevated intraocular pressure and large cup-to-disk ratios were independently associated with earlier melatonin timing. Lower illumination exposure also had independent associations with earlier melatonin timing. Conceivably, ophthalmic and illumination factors might have an additive effect on the timing of melatonin excretion, which in turn might predispose individuals to experience early morning awakenings.

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PMID: 16321164


Daily impaired detachment and short-term effects of impaired sleep quality on next-day commuting near-accidents – an ambulatory diary study.

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This study investigated the short-term effects of daily recovery, that is, impaired psychological detachment from work and various actigraphical indicators of sleep quality, on near-accidents when commuting to work the next morning. Furthermore, the mediating effect of actigraphically assessed sleep quality on the relationship between impaired psychological detachment from work and near-accidents when commuting to work was analysed. Fifty-six full-time employees of a Swiss assurance company participated in the one-week study. Multilevel analyses revealed that impaired detachment was highly related to a decrease in sleep duration. Furthermore, impaired daily recovery processes, such as impaired psychological detachment from work and disturbed sleep quality, were
related to commuting near-accidents. Impaired sleep quality mediated the effect of impaired psychological detachment from work on these near-accidents. Our results show that occupational safety interventions should address both impaired psychological detachment from work and sleep quality in order to prevent near accidents when commuting to work. Practitioner Summary: Commuting accidents occur frequently and have detrimental effects on employees, organisations and society. This study shows that daily lack of recovery, that is, impaired psychological detachment and impaired sleep quality, is related to near-accidents when commuting to work the next morning. Primary prevention of commuting accidents should therefore address daily lack of recovery.

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Daily interpersonal stress, sleep duration, and gene regulation during late adolescence.


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BACKGROUND: Psychological stress and poor sleep are associated with a wide range of negative health outcomes, which are thought to be mediated in part by alterations in immune processes. However, the molecular bases of links among stress, sleep, and immune processes are not completely understood, particularly during adolescence when sensitivity to stress and problems with sleep tend to increase. In the current study, we investigated whether various stressors (daily stress, major life events, perceived stress), sleep indices (duration, efficiency), and their interactions (e.g., moderating effects) are associated with expression of genes bearing response elements for transcription factors that regulate inflammatory and anti-viral processes.

METHOD: Eighty-seven late adolescents completed daily checklists of their social experiences across a 15-day period and reported on their major life events during the previous year. They also completed actigraphy-based assessments of sleep quality and duration during 8 consecutive nights. An average of 5.5 months later, participants reported on their global perceptions of stress during the previous month and provided blood samples for genome-wide expression profiling of mRNA from peripheral blood mononuclear cells (PBMCs).

RESULTS: Higher levels of daily interpersonal stress and shorter sleep duration were associated with upregulation of inflammation-related genes bearing response elements for proinflammatory transcription factor nuclear factor kappa B (NF-κB). Shorter sleep duration was also linked to downregulation of antiviral-related genes bearing response elements for interferon response factors (IRFs). Lastly, there was a significant interaction between daily stress and shorter sleep duration, such that the association between daily stress and
inflammation-related gene expression was exacerbated in the context of shorter sleep duration. Results were independent of sex, ethnicity, parent education, body mass index, and smoking and alcohol history.

CONCLUSION: Everyday interpersonal stress and shortened sleep can be consequential for upstream NF-κB signaling pathways relevant to inflammatory processes during late adolescence. Notably, the occurrence of both may lead to even greater activation of NF-κB signaling.

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Daily nighttime melatonin reduces blood pressure in male patients with essential hypertension.

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Patients with essential hypertension have disturbed autonomic cardiovascular regulation and circadian pacemaker function. Recently, the biological clock was shown to be involved in autonomic cardiovascular regulation. Our objective was to determine whether enhancement of the functioning of the biological clock by repeated nighttime melatonin intake might reduce ambulatory blood pressure in patients with essential hypertension. We conducted a randomized, double-blind, placebo-controlled, crossover trial in 16 men with untreated essential hypertension to investigate the influence of acute (single) and repeated (daily for 3 weeks) oral melatonin (2.5 mg) intake 1 hour before sleep on 24-hour ambulatory blood pressure and actigraphic estimates of sleep quality.
Repeated melatonin intake reduced systolic and diastolic blood pressure during sleep by 6 and 4 mm Hg, respectively. The treatment did not affect heart rate. The day-night amplitudes of the rhythms in systolic and diastolic blood pressures were increased by 15% and 25%, respectively. A single dose of melatonin had no effect on blood pressure. Repeated (but not acute) melatonin also improved sleep. Improvements in blood pressure and sleep were statistically unrelated. In patients with essential hypertension, repeated bedtime melatonin intake significantly reduced nocturnal blood pressure. Future studies in larger patient group should be performed to define the characteristics of the patients who would benefit most from melatonin intake. The present study suggests that support of circadian pacemaker function may provide a new strategy in the treatment of essential hypertension.

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This study assessed daily rest–activity patterns in euthymic, medication-naive bipolar phenotype individuals. The Mood Disorder Questionnaire was used to identify 19 bipolar phenotype individuals and 21 controls. Participants wore an Actiwatch-L for 2 weeks to assess their sleep behaviour and circadian rest–activity rhythmicity. Bipolar phenotype individuals had increased
movement during sleep, as assessed by the fragmentation index, greater activity levels during their least active 5 h (2 am-7 am), and lower circadian relative amplitude compared to controls. Higher activity levels during sleep affecting circadian amplitude in young adults with the bipolar phenotype may be associated with vulnerability for developing mood disorder.

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Daily rhythm of salivary IL-1ß, cortisol and melatonin in day and night workers.

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Shiftwork-induced sleep deprivation and circadian disruption probably leads to an increase in the production of cytokines and dysregulation of innate immune system, respectively. This project aims evaluating changes in salivary IL-1 beta, cortisol, and melatonin in night workers. Method. Two day and three night healthy workers participated in this study. Sleep was evaluated by actimetry and activity protocols. Saliva was collected at waking and bedtime the last workday and the following two days-off and was analyzed by ELISA. Results. Neither sleep duration nor efficiency showed any association with salivary IL-1beta. IL-1beta levels were higher at waking than at bedtime during working days for all workers, but only one day and one night-worker maintained this pattern and hormone rhythms during days off. For this night worker, melatonin levels were shifted
to daytime.
A second one presented clear alterations in IL-1beta and hormone rhythms on
days-off. Conclusions. Our preliminary results suggest that night work can
disturb the variation pattern of salivary IL-1beta. No association of this
variation with sleep was observed. It seems that disruption in hormone rhythms
interfere with salivary IL-1beta production. IL-1beta production pattern seems
to be maintained when rhythms are present, in spite of a shift in melatonin
secretion.

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Dawn-dusk simulation light therapy of disturbed circadian rest-activity cycles in
demented elderly.

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We investigated whether low intensity dawn-dusk simulation (DDS), a
'naturalistic' form of light therapy designed to embed sleep in its accustomed
phase, could improve the disturbed circadian rest-activity cycle, nocturnal sleep
and/or cognitive functions in dementia. A protocol of 3 weeks each of
baseline, treatment and follow-up was completed by 13 patients (85yr
old+/−5yr, MMSE 14+/−5; n=9 DDS versus n=4 'placebo' dim red light) who wore an
activity/lux monitor throughout. There were no significant changes in clinical or
cognitive status, nor modification of circadian stability or amplitude characteristics of
the rest-activity cycle. However, two aspects of sleep responded to DDS but not
to dim red light. The main sleep episode was 1:14h earlier during treatment (p=0.03) compared with before and after DDS. With respect to actimetry-determined sleep variables, the DDS group tended to have shortened 'sleep latency', longer 'sleep duration', more nocturnal immobility and less nocturnal activity than the dim red group (p<0.1). In parallel, nighttime light exposure tended to be reduced (p=0.07). These promising findings—after only 3 weeks of light treatment in elderly patients with advanced dementia—suggest that the circadian timing system remains functionally responsive even to low intensity DDS light. Increasing zeitgeber strength is an important strategy for improving sleep quality and timing in dementia, and DDS light therapy may provide one of the appropriate means to do so.

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The day after: correlates of patient-reported outcomes with actigraphy-assessed sleep in cancer patients at home (inCASA project).


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Subjective sleep assessment in cancer patients poorly correlates with actigraphy parameters that usually encompass multiple nights. We aimed to determine the objective actigraphy measures that best correlated with subjective sleep ratings on a night-by-night basis in cancer patients. Thirty-one cancer patients daily self-rated sleep disturbances using the single dedicated item of the MD Anderson Symptom Inventory (0–10 scale) with 18 other items, and continuously wore a wrist actigraph for 30 days. Objective sleep parameters were computed from the actigraphy nighttime series, and correlated with subjective sleep disturbances reported on the following day, using repeated measures correlations. Multilevel Poisson regression analysis was performed to identify the objective and subjective parameters that affected subjective sleep rating. Poor subjective sleep score was correlated with poor sleep efficiency ($r_{rm} = -0.13$, $p = 0.002$) and large number of wake episodes ($r_{rm} = 0.12$, $p = 0.005$) on the rated night. Multilevel analysis demonstrated that the expected sleep disturbance score was affected by the joint contribution of the wake episodes ($\exp(\beta) = 1.01$, 95% confidence interval = 1.00 to 1.02, $p = 0.016$), fatigue ($\exp(\beta) = 1.35$, 95% confidence interval = 1.15 to 1.55, $p < 0.001$) and drowsiness ($\exp(\beta) = ...
= 1.70, 95%
confidence interval = 1.19 to 2.62, p = 0.018), self-rated the following evening,
and sleep disturbance experienced one night before (exp(β) = 1.77, 95%
confidence interval = 1.41 to 2.22, p < 0.001). The night-by-night approach within a
multidimensional home tele-monitoring framework mainly identified the objective
number of wake episodes computed from actigraphy records as the main determinant
of the severity of sleep complaint in cancer patients on chemotherapy. This
quantitative information remotely obtained in real time from cancer patients
provides a novel framework for streamlining and evaluating interventions toward sleep improvement in cancer patients.

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Day and night shift schedules are associated with lower sleep quality in Evening-types.

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Eveningness has been suggested as a facilitating factor in adaptation to shift work, with several studies reporting evening chronotypes (E-types) as better sleepers when on night shifts. Conversely, eveningness has been
associated with more sleep complaints during day shifts. However, sleep during day shifts has received limited attention in previous studies assessing chronotypes in shift workers. Environmental light exposure has also been reported to differ between chronotypes in day workers. Activity is also known to provide temporal input to the circadian clock. Therefore, the aim of this study was to compare objective sleep, light exposure and activity levels between chronotypes, both during the night and day shifts. Thirty-nine patrol police patrol officers working on a fast rotating shift schedule (mean age ± SD: 28.9 ± 3.2 yrs; 28 males) participated in this study. All subjects completed the Morningness-Eveningness Questionnaire (MEQ). Sleep and activity were monitored with actigraphy (Actiwatch-L; Mini-Mitter/Respironics, Bend, OR) for four consecutive night shifts and four consecutive day shifts (night work schedule: 00:00 h-07:00 h; day work schedule: 07:00 h-15:00 h). Sleep and activity parameters were calculated with Actiware software. MEQ scores ranged from 26 to 56; no subject was categorized as Morning-type. E-types (n = 13) showed significantly lower sleep efficiency, longer snooze time and spent more time awake after sleep onset than Intermediate-types (I-types, n = 26) for both the night and day shifts. E-types also exhibited shorter and more numerous sleep bouts. Furthermore, when napping was taken into account, E-types had shorter total sleep duration than I-types during the day shifts. E-types were more active during the first hours of their night shift when compared to I-types. Also, all participants spent more time active and had higher amount of activity per minute during day shifts when compared to night shifts. No difference was found regarding light exposure between chronotypes. In conclusion, sleep parameters revealed poorer sleep quality in E-types for both the night and day shifts. These differences could not be explained by sleep opportunity, light exposure or activity levels.
This study challenges the notion that E-types adapt better to night shifts. Further studies must verify whether E-types exhibit lower sleep quality than Morning-types.

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Day length associates with activity level in children living at 60 degrees north.
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The associations between day length and activity, rest-activity rhythm, and psychiatric symptoms were studied. Sixty-six healthy children participated in the study during one year. They were monitored for 72 consecutive hours with belt-worn activity monitors (actigraphs) to obtain objective data on their activity levels during the day and night. In addition, the parents filled out the Child Behavior Checklists. It was found, that the mean total and day and night time activity levels were increased and the relative circadian amplitude blunted with the longer day length. It was concluded that day length was associated with activity level and rest-activity rhythm and this association may reflect the seasonal changes in these parameters.

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Day–Night Activity in Hospitalized Children after Major Surgery: An Analysis of
2271 Hospital Days.

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OBJECTIVES: To characterize the day–night activity patterns of children after
major surgery and describe differences in children's activity patterns between
the pediatric intensive care unit (PICU) and inpatient floor setting.

STUDY DESIGN: In this prospective observational study, we characterized the
daytime activity ratio estimate (DARE; ratio between mean daytime activity
[08:00–20:00] and mean 24-hour activity [00:00–24:00]) for children admitted to
the hospital after major surgery. The study sample included 221
infants and children ages 1 day to 17 years admitted to the PICU at a tertiary, academic children's hospital. Subjects were monitored with continuous accelerometry from postoperative day 1 until hospital discharge. The National Health and Nutrition Examination Survey accelerometry data were utilized for normative data to compare DARE in a community sample of US children to hospitalized children. RESULTS: The mean DARE over 2271 hospital days was 57.8%, with a significant difference between the average DARE during PICU days and inpatient floor days (56% vs 61%, P < .0001). The average subject DARE ranged from 43% to 73%. In a covariate-adjusted mixed effects model, PICU location, lower age, orthopedic or urologic surgery, and intubation time were associated with decreased DARE. Hospitalized children had significantly lower DARE than the National Health and Nutrition Examination Survey subjects in all age groups studied, with the largest difference in the youngest PICU group analyzed (6–9 years; 59% vs 75%, P < .0001). A subset analysis of children older than 2 years (n = 144) showed that DARE was <50% on 15% of hospital days.

CONCLUSIONS: Children hospitalized after major surgery experience disruptions in day–night activity patterns during their hospital stay that may reflect disturbances in circadian rhythm.

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Daytime bright light exposure, metabolism, and individual differences in wake and sleep energy expenditure during circadian entrainment and misalignment.

Daytime light exposure has been reported to impact or have no influence on energy metabolism in humans. Further, whether inter-individual differences in wake, sleep, 24 h energy expenditure, and RQ during circadian entrainment and circadian misalignment are stable across repeated 24 h assessments is largely unknown. We present data from two studies: Study 1 of 15 participants (7 females) exposed to three light exposure conditions: continuous typical room ~100 lx warm white light, continuous ~750 lx warm white light, and alternating hourly ~750 lx warm white and blue-enriched white light on three separate days in a randomized order; and Study 2 of 14 participants (8 females) during circadian misalignment induced by a simulated night shift protocol. Participants were healthy, free of medical disorders, medications, and illicit drugs. Participants maintained a consistent 8
h per night sleep schedule for one week as an outpatient prior to the study verified by wrist actigraphy, sleep diaries, and call-ins to a time stamped recorder. Participants consumed an outpatient energy balance research diet for three days prior to the study. The inpatient protocol for both studies consisted of an initial sleep disorder screening night. For study 1, this was followed by three standard days with 16 h scheduled wakefulness and 8 h scheduled nighttime sleep. For Study 2, it was followed by 16 h scheduled wake and 8 h scheduled sleep at habitual bedtime followed by three night shifts with 8 h scheduled daytime sleep. Energy expenditure was measured using whole-room indirect calorimetry. Constant posture bedrest conditions were maintained to control for energy expenditure associated with activity and the baseline energy balance diet was continued with the same exact meals across days to control for thermic effects of food. No significant impact of light exposure was observed on metabolic outcomes in response to daytime light exposure. Inter-individual variability in energy expenditure was systematic and ranged from substantial to almost perfect consistency during both nighttime sleep and circadian misalignment. Findings show robust and stable trait-like individual differences in whole body 24 h, waking, and sleep energy expenditure, 24 h respiratory quotient—an index of a fat and carbohydrate oxidation—during repeated assessments under entrained conditions, and also in 24 h and sleep energy expenditure during repeated days of circadian misalignment.

PMCID: PMC5986103
PMID: 29876528

Daytime light exposure in daily life and depressive symptoms in bipolar disorder:
A cross-sectional analysis in the APPLE cohort.

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OBJECTIVES: Controlled artificial daylight exposure, such as light therapy, is effective in bipolar depression, but the association between uncontrolled daytime light and depressive symptoms in bipolar disorder (BD) is unclear. This study investigated the association between daytime light exposure under real-life situations and depressive symptom in patients with BD.

METHODS: This cross-sectional study enrolled 181 outpatients with BD. The average daytime light intensity and the total duration of light intensity of ≥1000 lux were recorded over 7 consecutive days using an actigraph that measured ambient light. Depressive symptoms were assessed using Montgomery-Åsberg Depression Rating Scale, and scores of ≥8 points were treated as depressed state.

RESULTS: Ninety-seven (53.6%) subjects were depressed state. At higher average daytime light intensity tertiles, the proportion of depressed state was significantly lower (P for trend, 0.003). In multivariable analysis adjusted for age, employment status, age at onset of BD, Young Mania Rating Scale score, bedtime, and physical activity, the highest tertile group in average
light intensity suggested a significantly lower odds ratio (OR) for depressed state than the lowest tertile group (OR, 0.33; 95% confidence interval [CI], 0.14–0.75; \( P = 0.009 \)). Similarly, the longest tertile group in light intensity \( \geq 1000 \text{ lux} \) duration was significantly associated with lower OR for depressed state than lowest tertile group (OR, 0.42; 95% CI, 0.18–0.93; \( P = 0.033 \)).

CONCLUSIONS: The findings suggest that greater daytime light exposure in daily life is associated with decreased depressive symptoms in BD.

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Daytime sleeping, sleep disturbance, and circadian rhythms in the nursing home.

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OBJECTIVE: This study reports the frequency of abnormal daytime sleeping and identifies factors related to daytime sleeping, nighttime sleep disturbance, and circadian rhythm abnormalities among nursing home residents. METHODS: The authors conducted secondary analysis of data collected under usual care conditions within a nonpharmacologic sleep intervention trial. All residents from four Los Angeles nursing homes were screened for daytime sleeping (asleep=\( \geq 15\% \) of observations, 9:00 am–5:00 pm). Consenting residents with daytime sleeping had two nights of wrist actigraphy to assess nighttime sleep disturbance (asleep<80%, 10:00 pm–6:00 am). Residents with nighttime
sleep disturbance completed an additional 72-hour wrist actigraphy recording to assess circadian activity rhythms and light exposure.

RESULTS: Sixty-nine percent of 492 observed residents had daytime sleeping, of whom 60% also had disturbed nighttime sleep. Sleep disturbance and daytime sleeping were rarely documented in medical records. Residents spent one-third of the day in their rooms, typically in bed, and were seldom outdoors or exposed to bright light. More time in bed and less social activity were significant predictors of daytime sleepiness. Ninety-seven percent of residents assessed had abnormal circadian rhythms. More daytime sleeping and less nighttime sleep were associated with weaker circadian activity rhythms. Later circadian rhythm acrophase (peak) was associated with more bright light exposure.

CONCLUSION: Daytime sleepiness, nighttime sleep disturbance, and abnormal circadian rhythms were common in nursing home residents. Modifiable factors (e.g., time in bed) are associated with sleep/wake abnormalities. Mental health specialists should consider the complexity of factors causing sleep problems in nursing home residents.

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Decline in long-term circadian rest-activity cycle organization in a patient with dementia.

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Continuous measurement of the circadian rest-activity cycle for 598
days in a demented patient with probable Alzheimer's disease revealed slow progressive changes in temporal organization until death. Circadian and sleep analysis of the actigraphic data provided objective documentation of the gradual insertion of wakefulness into rest and rest into wake periods. Pacing, a nonphotic zeitgeber strengthening, led to improved synchronization of the rest-activity cycle.

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Decrease in daytime sleeping is associated with improvement in cognition after hospital discharge in older adults.

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OBJECTIVES: To examine the relationship between changes in objectively assessed sleep and global cognitive functioning from inpatient postacute rehabilitation to 6-month follow-up.

DESIGN: Secondary analysis of two prospective, longitudinal studies.

SETTING: Inpatient rehabilitation units at a Veterans Affairs Medical Center.

PARTICIPANTS: Older adults (mean age 73.8 ± 9.4) undergoing inpatient rehabilitation (n = 192).

MEASUREMENTS: All participants completed 7 nights and days of ambulatory sleep monitoring using wrist actigraphy (yielding an estimate of nighttime wakefulness and daytime sleep) and the Mini-Mental State Examination (MMSE) during a postacute inpatient rehabilitation stay and 6 months after discharge. The 5-item
Geriatric Depression Scale, Geriatric Pain Measure, and Cumulative Illness Rating Scale for Geriatrics were completed during inpatient rehabilitation.

RESULTS: Growth curve modeling (controlling for baseline age, education, sex, body mass index, depression, pain, and comorbidity burden) revealed that individuals whose amount of daytime sleep decreased from inpatient postacute rehabilitation to 6-month follow-up also experienced improvements in MMSE score ($\beta = -0.01$, t(80 = -3.22, P = .002)). Change in nighttime wakefulness was not a significant predictor of change in MMSE score.

CONCLUSION: Older adults whose daytime sleeping decreased after hospital discharge also experienced improvements in cognitive functioning at 6 month follow-up. As such, daytime sleep may represent a promising candidate for targeted interventions aimed at promoting cognitive recovery after hospital discharge.

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Decrease in scale invariance of activity fluctuations with aging and in patients with suprasellar tumors.


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Motor activity in healthy young humans displays intrinsic fluctuations that are scale-invariant over a wide range of time scales (from minutes to hours). Human postmortem and animal lesion studies showed that the intact function of the suprachiasmatic nucleus (SCN) is required to maintain such scale-invariant patterns. We therefore hypothesized that scale invariance is degraded in patients treated for suprasellar tumors that compress the SCN. To test the hypothesis, we investigated 68 patients with nonfunctioning pituitary macroadenoma and 22 patients with craniopharyngioma, as well as 72 age-matched healthy controls (age range 21.0-70.6 years). Spontaneous wrist locomotor activity was measured for 7 days with actigraphy, and detrended fluctuation analysis was applied to assess correlations over a range of time scales from minutes to 24 h. For all the subjects, complex scale-invariant correlations were only present for time scales smaller than 1.5 h, and became more random at time scales 1.5-10 h. Patients with suprasellar tumors showed a larger decrease in correlations at 1.5-10 h as compared to healthy controls. Within healthy subject, gender and age >33 year were associated with attenuated scale invariance. Conversely, activity patterns at time scales between 10 and 24 h were significantly more regular than all other
time scales, and this was mostly associated with age. In conclusion, scale invariance is degraded in healthy subjects at the ages of >33 year as characterized by attenuation of correlations at time scales 1.5-10 h. In addition, scale invariance was more degraded in patients with suprasellar tumors as compared to healthy subjects.

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Decrease in urinary albumin excretion associated with the normalization of nocturnal blood pressure in hypertensive subjects.

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Previous results have indicated that valsartan administration at bedtime as opposed to on wakening improves the diurnal/nocturnal ratio of blood pressure without loss in efficacy and therapeutic coverage. We hypothesized that increasing this ratio could reduce microalbuminuria. We conducted a prospective, randomized, open-label, blinded endpoint trial on 200 previously untreated nonproteinuric patients with grade 1 to 2 essential hypertension, assigned to receive valsartan (160 mg/d) as a monotherapy either on awakening or at bedtime. Blood pressure was measured by ambulatory monitoring for 48 consecutive hours before and after 3 months of treatment. Physical activity was simultaneously monitored every minute by wrist actigraphy to accurately calculate the diurnal and nocturnal means of blood pressure on a per-subject basis. The significant blood pressure reduction after 3 months of therapy was similar for
both treatment times. The diurnal/nocturnal blood pressure ratio was unchanged after valsartan on awakening, but significantly increased from 7.5 to 12.2 (P<0.001) when valsartan was administered at bedtime. Urinary albumin excretion was significantly reduced by 41% after bedtime treatment. This reduction was independent of the 24-hour blood pressure decrease but highly correlated with the decrease in nocturnal blood pressure and mainly with the increase in diurnal/nocturnal ratio (P<0.001). Bedtime valsartan administration improves the diurnal/nocturnal blood pressure ratio to a more dipper profile. This normalization of the circadian blood pressure pattern is associated with a significant decrease in urinary albumin excretion and plasma fibrinogen, and could thus reduce the increased cardiovascular risk in nondipper hypertensive patients.

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Decreased need for sleep as an endophenotype of bipolar disorder: an actigraphy study.


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Reports of subjective sleep impairments have been replicated in adults with bipolar disorder (BD), young BD patients, and even children of parents with BD. Furthermore, circadian rhythm alterations are a core feature of BD. Despite the impairment in circadian rhythms and altered sleep included in various heuristic developmental models of BD, thus far, biomarkers have not been sufficiently objectively validated. Thus, here, we assessed the rest-activity circadian rhythmicity and sleep macrostructure using actigraphy in a sample of unaffected child and adolescent offspring of bipolar parents (BO; n = 43; 21 females; 11.0 ± 3.2 years) and controls (n = 42; 17 females; 11.1 ± 3.4 years) comparable in sex (p = .4) and age (p = .7). All participants wore a MotionWatch 8 (Camntech, Cambridge, UK) actigraph on their nondominant wrist for ≥ 14 days and completed sleep diaries. Psychopathology was assessed by the Kiddie Schedule for Affective Disorders and Schizophrenia and by subjective scales. The main areas of interest were rest-activity circadian rhythmicity, chronotype and sleep macrostructure. Subgroup analyses (child and adolescent subgroups) were conducted to identify physiological differences in sleep between these age groups. The BO and controls did not differ in the presence of current mood (p = .5) and anxiety (p = .6) disorders. The BO had shorter sleep time on free days (p = .007; effect size, Cohen’s d = 0.56), lower sleep efficiency on free days (p = .01; d = 0.47), lower prolongation of time in bed on free days (p = .046; d = 0.41), and lower social jet lag (p = .04; d = 0.5) than the controls. A longer sleep time on school days (p < .001; d = 0.21), lower prolongation of sleep time between school and free days (p = .008; d = 0.74), and larger difference in sleep onset latency.
between school days and free days ($p = .009; d = 0.52$) were observed in the adolescent BO than in the controls. The child BO had poorer sleep quality on free days than the controls ($p = .02; d = 0.96$). In all cases, the results remained significant after controlling for subthreshold mood and anxiety symptoms. The BO had less variable rest-activity rhythm than controls ($p = .04; d = 0.32$). No other significant differences between the BO and controls were observed in the rest-activity circadian rhythmicity and chronotype. The results showed decreased physiological catch-up sleep on free days in the BO, which may indicate a decreased need for sleep in this population. Thus, the decreased need for sleep observed in the unaffected BO may represent an endophenotype of BD.

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Delay discounting and response disinhibition moderate associations between actigraphically measured sleep parameters and body mass index.

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Previous research suggests that the sleep–obesity association varies significantly across individuals. This study examined the associations between actigraphically measured sleep parameters and body mass index and hypothesized that the associations would be stronger in individuals with greater delay discounting, the devaluation of future rewards and response disinhibition and the difficulty in withholding previously rewarded responses. Seventy-eight college students carried a wrist-worn actigraph and completed diaries reporting bedtime, wake time and covariates including physical activity, alcohol and
caffeine consumption, daytime nap duration and perceived stress for 7 days and completed the delay discounting and go/no-go response disinhibition tasks. Their height and weight were measured. Only bedtime variability was significantly associated with body mass index in the main effect model controlling for all covariates (B = 0.03, P = 0.001). Delay discounting moderated associations of bedtime (B = 0.03, P < 0.001), sleep duration variability (B = 0.05, P = 0.002), bedtime variability (B = 0.03, P = 0.002) and wake time variability (B = 0.02, P < 0.001) with body mass index; these associations were significant only when the delay discounting rate was high. Response disinhibition moderated the association between bedtime variability and body mass index in a similar pattern (B = 0.01, P = 0.004). The findings suggest that, using actigraphy measures of sleep, circadian desynchrony rather than sleep duration is a risk factor for higher body mass index. The findings support the hypothesis that delay discounting and response disinhibition moderate the associations between sleep and body mass index. Delay discounting and response disinhibition might characterize individuals who are vulnerable to the influence of circadian desynchrony on weight.

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Delayed circadian phase is linked to glutamatergic functions in young people with affective disorders: a proton magnetic resonance spectroscopy study.

BACKGROUND: While the association between affective disorders and sleep and circadian disturbance is well established, little is known about the neurobiology underpinning these relationships. In this study, we sought to determine the relationship between a marker of circadian rhythm and neuronal integrity (N-Acetyl Aspartate, NAA), oxidative stress (glutathione, GSH) and neuronal-glial dysfunction (Glutamate + Glutamine, Glx).

METHODS: Fifty-three young adults (age range 15-33 years, mean = 21.8, sd = 4.3) with emerging affective disorders were recruited from a specialized tertiary referral service. Participants underwent clinical assessment and actigraphy monitoring, from which sleep midpoint was calculated as a marker of circadian
rhythm. Proton magnetic resonance spectroscopy was performed in the anterior cingulate cortex (ACC). The metabolites NAA, GSH and Glx were obtained, and expressed as a ratio to Creatine.

RESULTS: Neither NAA or GSH were associated with sleep midpoint. However, higher levels of ACC Glx were associated with later sleep midpoints (rho = 0.35, p = 0.013). This relationship appeared to be independent of age and depression severity.

CONCLUSIONS: This study is the first to demonstrate that delayed circadian phase is related to altered glutamatergic processes. It is aligned with animal research linking circadian rhythms with glutamatergic neurotransmission as well as clinical studies showing changes in glutamate with sleep interventions. Further studies may seek to examine the role of glutamate modulators for circadian misalignment.

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Delayed circadian rhythm in adults with attention-deficit/hyperactivity disorder and chronic sleep-onset insomnia.

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BACKGROUND: Previous studies suggest circadian rhythm disturbances in children with attention-deficit/hyperactivity disorder (ADHD) and sleep-onset insomnia (SOI). We investigate here sleep and rhythms in activity and melatonin in adults
with ADHD.

METHODS: Sleep logs and actigraphy data were collected during 1 week in 40 adults with ADHD, of whom 31 reported SOI. Salivary melatonin levels were assessed during 1 night. Sleep measures, circadian activity variables, and dim light melatonin onset were compared between groups of ADHD adults with and without SOI and with matched healthy control subjects.

RESULTS: Compared with control subjects, both groups of ADHD adults had longer sleep-onset latency and lower sleep efficiency. Adults with ADHD and SOI showed a delayed start and end of their sleep period and a delayed melatonin onset compared with adults with ADHD without SOI (p = .006; p = .023; p = .02) and compared with healthy control subjects (p = .014; p = .019; p = .000). Adults with ADHD and SOI also showed an attenuated 24-hour amplitude in their rest-activity pattern, in contrast to those without SOI, who showed a higher day-to-day stability.

CONCLUSIONS: These findings demonstrate diurnal rhythm deviations during everyday life in the majority of adults with ADHD that have SOI and suggest that potential benefits of rhythm-improving measures should be evaluated.

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Delayed Onset of Sleep in Adolescents With PAX6 Haploinsufficiency.


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OBJECTIVE: PAX6 haploinsufficiency (+/-) can occur due to mutations involving only PAX6 in patients with isolated aniridia or as contiguous gene deletions in patients with Wilms tumor, aniridia, genitourinary anomalies, and range of developmental and intellectual disabilities syndrome. Given the role of PAX6 in pineal development and circadian regulation, adolescents with PAX6+/- may experience sleep-wake disturbances. The purpose of this observational study was to explore sleep-related phenotypes in adolescents with PAX6+/-.

METHODS: This study compared sleep phenotypes of nine subjects with PAX6+/- (aged 10–19 years) with previously published data on healthy adolescents (n = 25, aged 10–18 years). Subjects completed the Cleveland Adolescent Sleepiness Questionnaire (CASQ), Patient Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance (v. 1.0; 8a), and PROMIS Sleep-Related Impairment (v. 1.0; 8b) Questionnaires and wore actigraphs for seven nights to record sleep patterns.

RESULTS: Total CASQ, PROMIS sleep-related impairment, and PROMIS sleep disturbance scores were not statistically different between the groups (ps > .15). Actigraph data for lights off to sleep-onset time were found to be significantly higher in subjects with PAX6+/- versus the healthy comparison group.
(adjusted mean [95% confidence interval]: 20.1 min [8.1, 49.8] vs. 6.2 min [3.7, 10.4], respectively, p = .04).

CONCLUSION: Both adolescents with PAX6+/- and the healthy comparison group on average slept less than 8 hr/night, and overall sleep deprivation in adolescents may have masked differences between groups. This study used rare genetic disorders with biological vulnerability to sleep problems as a genotype-phenotype model. Knowledge of sleep-related phenotypes will assist in designing studies to manage sleep-related symptoms in adolescents.

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Delayed sleep phase: An important circadian subtype of sleep disturbance in bipolar disorders.

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BACKGROUND: Theoretical models of Bipolar Disorder (BD) highlight that sleep disturbances may be a marker of underlying circadian dysregulation. However, few studies of sleep in BD have reported on the most prevalent circadian sleep abnormality, namely Delayed Sleep Phase (DSP).

METHODS: A cross-sectional study of 404 adults with BD who met published clinical criteria for insomnia, hypersomnia or DSP, and who had previously participated in a study of sleep in BD using a comprehensive structured interview assessment.

RESULTS: About 10% of BD cases with a sleep problem met criteria for a DSP profile. The DSP group was younger and had a higher mean Body Mass Index (BMI) than the other groups. Also, DSP cases were significantly more likely to be prescribed mood stabilizers and antidepressant than insomnia cases. An exploratory analysis of selected symptom item ratings indicated that DSP was significantly more likely to be associated with impaired energy and activity levels.

LIMITATIONS: The cross-sectional design precludes examination of longitudinal changes. DSP is identified by sleep profile, not by diagnostic criteria or objective sleep records such as actigraphy. The study uses data from a previous study to identify and examine the DSP group.

CONCLUSIONS: The DSP group identified in this study can be differentiated from hypersomnia and insomnia groups on the basis of clinical and demographic features. The association of DSP with younger age, higher BMI and impaired energy and activity also suggest that this clinical profile may be a good proxy for underlying circadian dysregulation.

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Delayed sleep phase in young people with unipolar or bipolar affective disorders.

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BACKGROUND: Circadian disturbances may play a key role in the pathogenesis of some forms of mood disorders. Despite marked changes in circadian rhythms during the normal course of adolescence and young adulthood, less is known about changes in the 24-h sleep-wake cycle in young persons with mood disorders.

METHODS: Seventy-five young participants with mood disorders (unipolar: n=46, 20.1 ± 4.7 years old; bipolar I or II: n=29, 23.2 ± 4.3) and 20 healthy participants (24.8 ± 2.5 years old) underwent actigraphy monitoring during a depressive phase over seven consecutive days and nights. Sleep phase delay was defined as mean sleep onset ≥ 1:30 am and/or sleep offset ≥ 10:00 am.

RESULTS: A delayed sleep phase was found in 62% of participants with bipolar disorders when depressed, compared with 30% of those with unipolar depression (χ(2)=6.0, p=0.014) and 10% of control participants (χ(2)=11.2, p<0.001). Sleep offset times were significantly later in subjects with mood disorders compared to the control group, and later in those with bipolar as compared with unipolar disorders (all p ≤ 0.043).

LIMITATIONS: This study was cross-sectional and the depressed groups were somewhat younger compared to the healthy controls. Longitudinal studies are
required to determine the predictive significance of these findings.

CONCLUSIONS: Young patients with mood disorders, especially those with bipolar disorders, are particularly likely to have a delayed sleep phase. Therapies focused on advancing sleep phase may be of specific benefit to these young persons.

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Delayed sleep timing and circadian rhythms in pregnancy and transdiagnostic symptoms associated with postpartum depression.

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Later sleep timing, circadian preference, and circadian rhythm timing predict worse outcomes across multiple domains, including mood disorders, substance use, impulse control, and cognitive function. Disturbed sleep is common among pregnant and postpartum women. We examined whether sleep timing during third trimester of pregnancy predicted postpartum symptoms of mania, depression, and obsessive-compulsive disorder (OCD). Fifty-one women with a previous, but not active, episode of unipolar or bipolar depression had symptoms evaluated and sleep recorded with wrist actigraphy at 33 weeks of gestation and 2, 6, and 16 weeks postpartum. Circadian phase was measured in a subset of women using salivary dim light melatonin onset (DLMO). We divided the sample into "early sleep" and "late sleep" groups using average sleep onset time at 33 weeks of gestation, defined by the median-split time of 11:27 p.m. The "late sleep" group reported significantly more manic and depressive symptoms at postpartum week 2. Longer phase angle between DLMO and sleep onset at 33 weeks was associated with more manic symptoms at postpartum week 2 and more obsessive-compulsive symptoms at week 6. Delayed sleep timing in this sample of at-risk women was associated with more symptoms of mania, depression, and OCD in the postpartum period. Sleep timing may be a modifiable risk factor for postpartum depression.

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PMID: 32066689


Delayed sleep timing and symptoms in adults with attention-deficit/
Patients with attention-deficit/hyperactivity disorder (ADHD) often exhibit disrupted sleep and circadian rhythms. Determination of whether sleep disturbance and/or circadian disruption are differentially associated with symptom severity is necessary to guide development of future treatment strategies. Therefore, we measured sleep and ADHD symptoms in participants aged 19–65 who met the DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision) criteria for ADHD and insomnia without psychiatric comorbidities by monitoring actigraphy and daily sleep logs for 2 wks, as well as the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), the ADHD Rating Scale (ADHD-RS), and a clinic-designed sleep behavior questionnaire. Principal components analysis identified correlated circadian- and sleep-related variables in all participants with ADHD who completed the study (n = 24). The identified components were entered into a backwards stepwise linear regression analysis, which indicated that delayed sleep timing and increased sleepiness (ESS) (but not sleep duration or sleep efficiency) significantly predicted greater severity of both hyperactive-impulsive and inattentive ADHD symptoms (p < .05 for partial regression coefficients). In addition, combined subtypes had the most impaired age-adjusted sleep quality (PSQI scores; p < .05 compared with healthy controls; n = 13), and 91.7% of them reported going to bed late due to being "not tired/too keyed up to sleep" compared with 57.2% and 50% of inattentive and symptom-controlled participants, respectively (p < .05). In
conclusion, the results of this study suggest that ADHD symptom severity correlates with delayed sleep timing and daytime sleepiness, suggesting that treatment interventions aimed at advancing circadian phase may improve daytime sleepiness. In addition, ADHD adults with combined hyperactive-impulsive and inattentive symptoms have decreased sleep quality as well as the delayed sleep timing of predominately inattentive subtypes.

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Delayed sleep-wake phase disorder in a clinical population: gender and sub-population differences.

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Objective/Background: Delayed sleep-wake phase disorder (DSWPD) is defined by a delay in the major sleep episode relative to desired or required sleep and wake times. The objectives of this study were to evaluate DSWPD in our population and to compare it with similar clinical data, to analyse gender differences, and to identify possible subpopulations based on circadian timing and alignment.

Patients/Methods: 162 consecutive DSWPD patients from a sleep clinic with a median age of 35.5 (24.0) years, 85 (52.5%) males were studied. Patient data were obtained from a clinical interview composed of socio-demographic, life events, daily habits, consumptions, and comorbidities data; and from diaries, actimetry, melatonin and PSG T1. The Dim Light Melatonin Onset (DLMO) was used to
Results: In our DSWPD cohort, there were gender differences for different age groups (p=0.028). Men were more likely to be single and women more likely to be married (p=0.034). In students, school failure was higher for women (p<0.001); for workers, absenteeism was higher in women (p=0.001). In the circadian aligned (compared to misaligned group), DLMO was later (p<0.001), sleep onset time (p=0.046) was later, total sleep time (p=0.035), and number of sleep cycles (p=0.018) were lower, as measured using PSG T1.

Conclusions: In this clinical population, DSWPD is more prevalent in young men and in middle age women, although with no overall significant differences between genders. There are two different phenotypes of DSWPD: circadian misaligned and circadian aligned. Depression is prevalent in both groups. Better definition, classification and diagnostic criteria for DSWPD are still needed, and targeted therapeutical intervention should be evaluated.

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Delta-9-tetrahydrocannabinol for nighttime agitation in severe dementia.

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RATIONALE: Nighttime agitation occurs frequently in patients with dementia and represents the number one burden on caregivers today. Current treatment options
are few and limited due to substantial side effects.

OBJECTIVES: The aim of the study was to measure the effect of the cannabinoid dronabinol on nocturnal motor activity.

METHODS: In an open-label pilot study, six consecutive patients in the late stages of dementia and suffering from circadian and behavioral disturbances—five patients with Alzheimer's disease and one patient with vascular dementia—were treated with 2.5 mg dronabinol daily for 2 weeks. Motor activity was measured objectively using actigraphy.

RESULTS: Compared to baseline, dronabinol led to a reduction in nocturnal motor activity (P=0.028). These findings were corroborated by improvements in Neuropsychiatric Inventory total score (P=0.027) as well as in subscores for agitation, aberrant motor, and nighttime behaviors (P<0.05). No side effects were observed.

CONCLUSIONS: The study suggests that dronabinol was able to reduce nocturnal motor activity and agitation in severely demented patients. Thus, it appears that dronabinol may be a safe new treatment option for behavioral and circadian disturbances in dementia.

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Depressive symptoms and actigraphy-measured circadian disruption predict head and neck cancer survival.


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OBJECTIVE: Depressive symptoms have demonstrated prognostic significance among head and neck cancer patients. Depression is associated with circadian disruption, which is prognostic in multiple other cancer types. We hypothesized that depressive symptoms would be associated with circadian disruption in head and neck cancer, that each would be related to poorer 2-year overall survival, and that relationships would be mediated by tumor response to treatment.

METHODS: Patients (N = 55) reported on cognitive/affective and somatic depressive symptoms (PHQ-9) and wore an actigraph for 6 days to continuously record rest and activity cycles prior to chemoradiation. Records review documented treatment response and 2-year survival. Spearman correlations tested depressive symptoms and circadian disruption relationships. Cox proportional hazard models tested the predictive capability of depressive symptoms and circadian disruption, separately, on survival.

RESULTS: Depressive symptoms were significantly associated with circadian disruption, and both were significantly associated with shorter survival (somatic: hazard ratio [HR] = 1.325, 95% confidence interval [CI] = 1.089-1.611, \(P = .005\); rest/activity rhythm: HR = 0.073, 95% CI = 0.009-0.563, \(P = .012\); nighttime restfulness: HR = 0.910, 95% CI = 0.848-0.977, \(P = .009\)). Tumor response to treatment appeared to partly mediate the nighttime restfulness-survival relationship.

CONCLUSIONS: This study replicates and extends prior work with new evidence linking a subjective measure of depression and an objective measure of circadian disruption—2 known prognostic indicators—to shortened overall survival among head and neck cancer patients. Continued examination should elucidate mechanisms by
which depressive symptomatology and circadian disruption translate to head and neck cancer progression and mortality.

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Depressive symptoms and circadian activity rhythm disturbances in community-dwelling older women.


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OBJECTIVES: Aging is associated with changes in circadian rhythms. Current evidence supports a role for circadian rhythms in the pathophysiology of depression. However, little is known about the relationship between depressive symptoms and circadian activity rhythms in older adults. We examined this association in community-dwelling older women.

METHODS: We performed a cross-sectional analysis of 3,020 women (mean age: 83.55 ± 3.79 years) enrolled in the Study of Osteoporotic Fractures. Depressive symptoms were assessed with the Geriatric Depression Scale categorizing participants as "normal" (0–2; referent group, N = 1,961), "some depressive symptoms" (3–5, N = 704), or "depressed" (≥6, N = 355). Circadian activity rhythm variables were measured using wrist actigraphy.

RESULTS: In age-adjusted and Study of Osteoporotic Fractures site-adjusted models, greater levels of depressive symptoms were associated with decreased amplitude (height; df = 3,014, t = -11.31, p for linear trend <0.001), pseudo F-statistic (robustness; df = 3,014, t = -8.07, p for linear trend <0.001), and mesor (mean modeled activity; df = 3014, t = -10.36, p for linear trend <0.001) of circadian activity rhythms. Greater levels of depressive symptoms
were also associated with increased odds of being in the lowest quartile for amplitude
\((\text{df} = 1, \chi^2(2) = 9240, p \text{ for linear trend}<0.001)\), pseudo F-statistic
\((\text{df} = 1, \chi^2(2) = 49.73, p \text{ for linear trend}<0.001)\), and mesor \((\text{df} = 1, \chi^2(2) = 81.12, p \text{ for linear trend}<0.001)\). These associations remained significant in multivariate models. Post-hoc analyses comparing mean amplitude, mesor, and pseudo F-statistic values pair-wise between depression-level groups revealed significant differences between women with "some depressive symptoms" and the "normal" group.

CONCLUSION: These data suggest a graded association between greater levels of depressive symptoms and more desynchronization of circadian activity rhythms in community-dwelling older women. This association was observed even for women endorsing subthreshold levels of depressive symptoms.

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Deriving the reference value from the circadian motor active patterns in the "non-dementia" population, compared to the "dementia" population: What is the amount of physical activity conducive to the good circadian rhythm.

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BACKGROUND: The circadian rhythm in older adults is commonly known to change with a decrease in physical activity. However, the association between circadian rhythm metrics and physical activity remains unclear. The objective of this study was to examine circadian activity patterns in older people with and without dementia and to determine the amount of physical activity conducive to a good circadian measurement.

METHOD: Circadian parameters were collected from 117 older community-dwelling people (66 subjects without dementia and 52 subjects with dementia); the parameters were measured continuously using actigraphy for 7 days. A receiver operating characteristic (ROC) curve was applied to determine reference values for the circadian rhythm parameters, consisting of interdaily stability (IS), intradaily variability (IV), and relative amplitude (RA), in older subjects.

RESULTS: The ROC curve revealed reference values of 0.55 for IS, 1.10 for IV, and 0.82 for RA. In addition, as a result of the ROC curve in the moderate-to-vigorous physical Activity (MVPA) conducive to the reference value of the Non-parametric Circadian Rhythm Analysis per day, the optimal reference values were 51 minutes for IV and 55 minutes for RA. However, the IS had no classification accuracy.

CONCLUSIONS: Our results demonstrated the reference values derived from the circadian parameters of older Japanese population with or without dementia. Also, we determined the MVPA conducive to a good circadian rest-active pattern. This reference value for physical activity conducive to a good circadian rhythm might be useful for developing a new index for health promotion in the older community-dwelling population.

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Desynchronization of daily rest–activity rhythm in the days following light propofol anesthesia for colonoscopy.

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Anesthesia and surgery are associated with fatigue and sleep disorders, suggestive of disturbance of the circadian rest–activity rhythm. Previous studies on circadian rhythm disturbance were focused on patients undergoing general anesthesia associated with surgery. This does not permit one to draw valid conclusions about the effects of general anesthesia per se on circadian rhythms. Our study was set up to determine the impact of a hypnotic dose of propofol on the circadian rest–activity rhythm in humans under real-life conditions. Seventeen healthy subjects scheduled to receive light propofol anesthesia for ambulatory colonoscopy were investigated. Their rest–activity rhythms were assessed using actigraphic monitoring. Diurnal rest was increased, whereas nocturnal sleep was unchanged in the days following anesthesia. Nonparametric analyses showed a decrease in the strength of coupling of the rhythm to stable environmental zeitgebers and increase of fragmentation of the rhythm after anesthesia. Light general anesthesia itself impairs synchronization of the circadian rest–activity rhythm to local time in patients by acting directly on the circadian clock.

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Detecting the effect of Alzheimer's disease on everyday motion behavior.


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BACKGROUND: Early detection of behavioral changes in Alzheimer's disease (AD) would help the design and implementation of specific interventions. OBJECTIVE: The target of our investigation was to establish a correlation between diagnosis and unconstrained motion behavior in subjects without major clinical behavior impairments.

METHOD: We studied everyday motion behavior in 23 dyads with one partner suffering from AD dementia and one cognitively healthy partner in the subjects' home, employing ankle-mounted three-axes accelerometric sensors. We determined frequency features obtained from the signal envelopes computed by an envelope detector for the carrier band 0.5 Hz to 5 Hz. Based on these features, we employed quadratic discriminant analysis for building models discriminating between AD patients and healthy controls.

RESULTS: After leave-one-out cross-validation, the classification accuracy of motion features reached 91% and was superior to the classification accuracy based on the Cohen-Mansfield Agitation Inventory (CMAI). Motion features were significantly correlated with MMSE and CMAI scores.

CONCLUSION: Our findings suggest that changes of everyday behavior are detectable in accelerometric behavior protocols even in the absence of major clinical behavioral impairments in AD.

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PMID: 24077435 [Indexed for MEDLINE]
Determinants of sleep behavior in adolescents: A pilot study.

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PURPOSE: To identify determinants of sleep behavior in adolescents of middle to high socioeconomic status.

METHODS: Eighteen students (9 boys, 9 girls) with a mean age of 14.9±1.5 years were interviewed using a standardized script inspired by the theory of planned behavior. Interviews were audio-recorded and anonymously transcribed verbatim. In addition, participants completed a survey assessing demographic and health characteristics and their sleep duration was measured using actigraphy.

RESULTS: Adolescents listed a few positive benefits of healthy sleep and described a large number of immediate negative consequences caused by sleep deprivation. Strong positive/negative emotions were barriers to healthy sleep. The use of electronic devices at bedtime and sports participation were described as both barriers to and facilitators of healthy sleep. Participants indicated their intention to sleep more and to use relaxing activities at bedtime. Some
intended to advance their bedtime, but none intended to stop using electronic devices at bedtime. Most participants stated that it would be easy to turn off phones but difficult to turn off movies at bedtime, and many believed that their parents and peers were against engaging in risky sleep behavior. CONCLUSIONS: Interventions that seek to alter adolescents' ability to regulate affect and address their beliefs regarding the use of electronic devices at bedtime, combined with information regarding the long-term impact of sleep health, may improve the effectiveness of sleep promotion programs for adolescents.

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Development and evaluation of a sleep education program for older adults with dementia living in adult family homes.

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OBJECTIVES: To investigate the feasibility of implementing a Sleep Education Program (SEP) for improving sleep in adult family home (AFH) residents with dementia, and the relative efficacy of SEP compared with usual care control in a pilot randomized controlled trial. PARTICIPANTS: Thirty-seven AFH staff-caregivers and 47 residents with comorbid dementia and sleep disturbances. INTERVENTION: SEP consisted of four training sessions with staff-caregivers to
develop and implement individualized resident behavioral sleep plans. MEASUREMENTS: Treatment fidelity to the SEP was assessed following the National Institutes of Health (NIH) Behavior Change Consortium model utilizing trainer observations and staff-caregiver reports. Resident sleep was assessed by wrist actigraphy at baseline, 1-month posttreatment, and 6-month follow-up. Caregiver reports of resident daytime sleepiness, depression, and disruptive behaviors were also collected.

RESULTS: Each key area of treatment fidelity (SEP delivery, receipt, enactment) was identified, measured, and yielded significant outcomes. Staff-caregivers learned how to identify sleep scheduling, daily activity, and environmental factors that could contribute to nocturnal disturbances and developed and implemented strategies for modifying these factors. SEP decreased the frequency and disturbance level of target resident nocturnal behaviors and improved actigraphically measured sleep percent and total sleep time over the 6-month follow-up period compared with the control condition.

CONCLUSION: Results suggest behavioral interventions to improve sleep are feasible to implement in adult family homes and merit further investigation as a promising intervention for use with AFH residents with dementia.

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PMID: 22367233 [Indexed for MEDLINE]
Actigraphy has proven to be a useful tool in the assessment of circadian rhythms, and more recently in the automatic staging of sleep and wake states. Whilst accuracy of commercial systems appears good over 24 hour periods, the sensitivity of detecting wake during time in bed is poor. One possible explanation for these poor results is the technical limitations of currently available commercial actigraphs. In particular, raw data is generally not available to the user. Instead, activity counts for each epoch (typically between 10-60 secs) are calculated using various algorithms, from which sleep state is identified. Consequently morphologically different movements observed during sleep and wake states may not be detected as such. In this paper, the development of a continuous multisite, accelerometry system (CMAS) is described. Initial results, comparing data collected using a commercial actigraph (Actiwatch-Mini Motionlogger), and the continuous multisite accelerometry system are presented. The CMAS is able to differentiate brief movement "twitches" from postural changes.

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Development of circadian rhythmicity of temperature in full-term normal infants.

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Twelve full-term infants (7 girls and 5 boys) with normal neurological, behavioral and somatic development were followed at regular intervals during the
first 5 months of life to appreciate the development of circadian
rectal temperature rhythmicity. Activity and temperature (oral at birth, rectal thereafter) were monitored for a minimum of 60 hours on seven separate occasions: at birth, 3 weeks, 6 weeks, 8 weeks, 10 weeks, 16 weeks and 20 weeks of age.
Activity was measured using an actigraph worn on the infant's wrist, and rectal temperature was measured using a rectal probe attached to a portable microprocessor (Vitalog TM). Data points were collected every 2 minutes. No fewer than ten infants were monitored at each session, and no infant missed more than one session. Missing recordings were due to equipment malfunctions, probe expulsions and minor health problems. Six infants out of 12 were successfully monitored at each of the first four sessions, from birth to 8 weeks of age inclusively, and two subjects were successfully monitored at all seven sessions. Periodic regression analysis was performed by least squares curve fit with secondary analysis of variance. Analysis of covariance was performed on repeated measures. There was no evidence of rectal temperature circadian rhythmicity at 3 weeks. Two infants demonstrated a circadian rhythmicity at 6 weeks, and all infants had a circadian rhythmicity at 10 weeks post-natal age. At the time of the first observance of circadian rhythmicity of rectal temperature, the mean delta in temperature from peak to trough was 0.6 +/- 0.3 degrees C. This delta was greater at the 16th week, with a mean value of 1.2 +/- 0.3 degrees C. The trough was seen during the first part of the long nocturnal inactivity period. Circadian rhythmicity of rectal temperature was always observed in the studied subjects before the establishment of a consolidated, long daytime wake period.

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The development of infants’ circadian rest–activity rhythm and mothers’ rhythm.

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In order to know when and how infants obtain their circadian sleep–wake rhythm, infants’ developing circadian rest–activity rhythm and mothers’ circadian rhythm in the postpartum period were examined using actigraph monitoring. The subjects were 11 primipara and their infants. Actigraphic recordings for the infants and their mothers were made over 3–5 continuous days during the 3rd, 6th, 9th and 12th weeks after birth. A 24-h peak on a mean autocorrelogram of the infants’ movements was detected at the 3rd week. The infants’ circadian rest–activity rhythm already existed in the 3rd week. The amplitude of this 24-h peak gradually increased from the 6th to 12th week. This may be useful as an index of the development of infants’ circadian rest–activity rhythm. An 11-h peak was also observed at the 3rd week. This 11-h peak was thought to be a semi-circadian rhythm. Regarding the mothers, the amplitude of the 24-h peak on the mean autocorrelogram at the 3rd week was the smallest of all other weeks, and it became larger from the 3rd to 12th week. This meant that the mothers' circadian rhythm at the 3rd week was influenced by their interrupted sleep at night to take care of their infants. The mother–infant synchronization is probably the 1st factor in the entrainment of infants' circadian sleep–wake rhythm. In this study, we also propose a novel method for compensating for missing data in autocorrelogram analysis.

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OBJECTIVES: To assess differences relating to circadian preference in objectively measured sleep patterns from childhood to adolescence over a 9-year period. We hypothesized there is developmental continuity in sleep timing and duration according to circadian preference.

STUDY DESIGN: Young participants (N = 111, 65% girls) from a community-based
birth cohort underwent sleep actigraphy at mean ages 8.1 (SD = 0.3), 12.3 (SD = 0.5), and 16.9 (SD = 0.1) years. A short version of Morningness–Eveningness Questionnaire was administered in late adolescence. At each follow-up, sleep midpoint, duration, wake after sleep onset, sleep efficiency, and weekend catch-up sleep were compared between those reporting morning, intermediate, and evening preferences in late adolescence.

RESULTS: Mixed model analyses indicated that sleep timing was significantly earlier among morning types compared with evening types at all ages (P values < .04). The mean differences in sleep midpoint between morning and evening types increased from a mean of 19 minutes (age 8), 36 minutes (age 12), to 89 minutes (age 17). The largest change occurred from age 12 to 17 years. Sleep duration, wake after sleep onset, sleep efficiency, and catch-up sleep did not differ according to circadian preference.

CONCLUSIONS: This study found significant continuity in sleep timing from childhood to adolescence over 9 years, indicating that late circadian preference reported in late adolescence begins to manifest in middle childhood. Further studies are needed to establish whether sleep timing has its origins at an even earlier age.

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Development of sleep/wake, activity and temperature rhythms in newborns maintained in a neonatal intensive care unit and the impact of feeding schedules.

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Biological rhythms in infants are described as evolving from an ultradian to a circadian pattern along the first months of life. Recently, the use of actigraphy and thermistors with memory has contributed to the understanding of temporal relations of different variables along development. The aim of this study was to describe and compare the development of the rhythmic pattern of wrist temperature, activity/rest cycle, sleep/wake and feeding behavior in term and preterm newborns maintained in a neonatal intensive care unit (NICU).

METHODS: Nineteen healthy preterm and seven fullterm newborns had the following variables monitored continuously while they were in the NICU: activity recorded by actigraphy, wrist temperature recorded with a thermistor and observed sleep and feeding behavior recorded by the NICU staff with diaries. Subjects were divided in 3 groups according to their gestational age at birth and rhythmic parameters were compared.

RESULTS: A dominant daily rhythm was observed for wrist temperature since the first two weeks of life and no age relation was demonstrated. Otherwise, a daily pattern in activity/rest cycle was observed for most preterm newborns since 35 weeks of postconceptional age and was more robust in term babies. Feeding and sleep/wake data showed an almost exclusive 3h rhythm, probably related to a masking effect of feeding schedules.

CONCLUSIONS: We found that wrist temperature develops a daily pattern as soon as previously reported for rectal temperature, and with acrophase profile similar to adults. Moreover, we were able to find a daily rhythm in activity/rest cycle earlier than previously reported in literature. We also suggest that
sleep/wake rhythm and feeding behavior follow independent developmental courses, being more suitable to masking effects.

Development of sleep-wake rhythms during the first year of age.


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Circadian rhythms refer to biological rhythms that have an endogenous period length of approximately 24 hr. However, not much is known about the
variance in the development of the sleep-wake rhythm. The study objectives were (a) to describe the normative variation in the development of a sleep-wake rhythm in infancy, (b) to assess whether slower development is related to sleep quality and (c) to evaluate factors that are related to the slower development of a sleep-wake rhythm. The study is based on a representative birth cohort.

Questionnaires at the ages of 3 (n = 1,427) and 8 months (n = 1,302) and actigraph measurement at 8 months (n = 372) were available. Infants with significant developmental delays (n = 11) were excluded. The results are based on statistical testing and multivariate modelling. We found that the average percentage of daytime sleep was 36.3% (standard deviation [SD], 8.5%) at 3 months and 25.6% (SD, 6.6%) at 8 months. At both time-points, infants with slower sleep-wake rhythm development slept more hours per day, had a later sleep-wake rhythm, more difficulties in settling to sleep and longer sleep-onset latency; they also spent a longer time awake during the night. According to actigraph registrations, we found that the infants with slow development of a sleep-wake rhythm slept less and had a later start and end to night-time sleep than the other infants. Infants' sleep-wake rhythm development is highly variable and is related to parent-reported and objectively measured sleep quality and quantity. Interventions to improve the sleep-wake rhythm might improve sleep quality in these infants.

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Development of the individualised Comparative Effectiveness of Models Optimizing Patient Safety and Resident Education (iCOMPARE) trial: a protocol summary of a national cluster-randomised trial of resident duty hour policies in internal medicine.

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INTRODUCTION: Medical trainees' duty hours have received attention globally; restrictions in Europe, New Zealand and some Canadian provinces are much lower
than the 80 hours per week enforced in USA. In USA, resident duty hours have been implemented without evidence simultaneously reflecting competing concerns about patient safety and physician education. The objective is to prospectively evaluate the implications of alternative resident duty hour rules for patient safety, trainee education and intern sleep and alertness. METHODS AND ANALYSIS: 63 US internal medicine training programmes were randomly assigned 1:1 to the 2011 Accreditation Council for Graduate Medical Education resident duty hour rules or to rules more flexible in intern shift length and number of hours off between shifts for academic year 2015-2016. The primary outcome is calculated for each programme as the difference in 30-day mortality rate among Medicare beneficiaries with any of several prespecified principal diagnoses in the intervention year minus 30-day mortality in the preintervention year among Medicare beneficiaries with any of several prespecified principal diagnoses. Additional safety outcomes include readmission rates, prolonged length of stay and costs. Measures derived from trainees' and faculty responses to surveys and from time-motion studies of interns compare the educational experiences of residents. Measures derived from wrist actigraphy, subjective ratings and psychomotor vigilance testing compare the sleep and alertness of interns. Differences between duty hour groups in outcomes will be assessed by intention-to-treat analyses. ETHICS AND DISSEMINATION: The University of Pennsylvania Institutional Review Board (IRB) approved the protocol and served as the IRB of record for 40 programmes that agreed to sign an Institutional Affiliation Agreement. Twenty-three programmes opted for a local review process. TRIAL REGISTRATION NUMBER: NCT02274818; Pre-results.

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Devices for Ambulatory Monitoring of Sleep-Associated Disorders in Children with Neurological Diseases.

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Good sleep quality is essential for a child's wellbeing. Early sleep problems have been linked to the later development of emotional and behavioral disorders and can negatively impact the quality of life of the child and his or her family. Sleep-associated conditions are frequent in the pediatric population, and even more so in children with neurological problems. Monitoring devices can help to better characterize sleep efficiency and sleep quality. They can also be helpful to better characterize paroxysmal nocturnal events and differentiate between nocturnal seizures, parasomnias, and obstructive sleep apnea, each of which has a different management. Overnight ambulatory detection devices allow for a tolerable, low cost, objective assessment of sleep quality in the
patient's
natural environment. They can also be used as a notification system to allow for
rapid recognition and prompt intervention of events like seizures. Optimal
monitoring devices will be patient- and diagnosis-specific, but may include a
combination of modalities such as ambulatory electroencephalograms, actigraphy,
and pulse oximetry. We will summarize the current literature on
ambulatory sleep
devices for detecting sleep disorders in children with neurological
diseases.

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laboratory works
with device donations from several companies, including Empatica,
SmartWatch, and
Epitel, among others. He is part of several pending patent application
regarding
epilepsy diagnosis, seizure detection, and seizure prediction. He
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as a consultant for Zogenix, Engage, Upsher Smith, Amzell, Eisai,
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Lundbeck. He has received speaker honorariums from national societies including
the American Academy of Neurology, American Epilepsy Society and American
Clinical Neurophysiology Society, and for grand rounds at various academic centers. He performs long-term video electroencephalogram and Intensive Care Unit (ICU) monitoring, electroencephalograms, and other electrophysiological studies at Boston Children’s Hospital and affiliated hospitals, and bills for these procedures. He evaluates pediatric neurology patients and bills for clinical care. His wife, Karen Stannard, is a pediatric neurologist and she performs long-term video electroencephalogram and ICU monitoring, electroencephalograms, and other electrophysiological studies, and bills for these procedures. She evaluates pediatric neurology patients and bills for clinical care. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.


Diabetes management mediates the association between sleep duration and glycemic control in youth with type 1 diabetes mellitus.

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OBJECTIVE/BACKGROUND: The purpose of this study was to examine the associations of diabetes management and sleep duration with glycemic control in youth with type 1 diabetes mellitus.

PATIENTS/METHODS: 111 participants (mean age = 13.59 ± 2.11 years,
52.3% male, 50.5% non-white) wore actigraphy (average duration = 5.5 nights) and completed self-reported daily sleep diaries (average duration = 5.3 nights). Parents and participants each completed the Diabetes Management Scale (DMS) as part of a neurobehavioral evaluation. Glycated hemoglobin (HbA1c) and daily frequency of self-monitored blood glucose (SMBG) were collected from patient medical records.

RESULTS: Youth with T1DM slept below the recommended amount of sleep for this age group (M = 7.45, SD = 0.74), which is approximately 9 h for school aged youth. They were in poor glycemic control with an average HbA1c of 9.11% (SD = 1.95) and their SMBG frequency was 4.9 (SD = 2.71). Average sleep duration from actigraphy was significantly correlated with average SMBG frequency and inversely related to HbA1c, indicating that less sleep was associated with worse management and glycemic control. When entered into a mediation model, diabetes management (SMBG frequency) completely mediated the relationship between sleep duration and glycemic control (HbA1c). Different sleep parameters of sleep quality, time to sleep, and sleep consistency also significantly correlated with HbA1c, SMBG, and parent and child-reports of various aspects of diabetes management. In particular, later bedtimes and a greater social jetlag predicted worse glycemic control.

CONCLUSIONS: In a sample of sleep deprived and poorly controlled youth with T1DM, diabetes management was an intermediary factor between sleep duration and glycemic control. Additional analyses of data supported circadian influences on glycemic control. These results highlight the importance of addressing sleep duration, quality, and consistency as part of routine diabetes management in this population.

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Sleep and wakefulness are fundamental behavioral and neurobiological states that characterize all higher animals, including human beings. This article presents an overview of the current state of our knowledge concerning the function of sleep and sleep-wake rhythms, the neurobiology of circadian rhythms, how wakefulness and sleep are studied, and the clinical assessment and diagnosis of sleep and circadian rhythm disorders. Major theories of the function of sleep and sleep-wake rhythms are reviewed, including ecological or environmental advantage, physical restoration, optimizing waking function, learning and integration of experience, and survival. The author then reviews what is known about the neurobiology of endogenous circadian rhythms and how they are affected by environmental time cues. How sleep is studied using polysomnography (PSG) is explained, and the PSG characteristics of the three major neurobehavioral states, wakefulness, rapid eye movement (REM) sleep, and non-rapid eye movement (NREM) sleep, are described. Systems of classifying sleep disorders are reviewed, including those of the DSM-IV-TR, the International Classification of Sleep Disorders, and the ICD-10. Methods of assessing sleep complaints are then described, including taking an accurate history from the patient and bed partner, use of sleep history questionnaires and sleep-wake diaries, use of actigraphy, and use of PSG.
STUDY OBJECTIVES: To report the diagnostic and treatment challenges of sighted non-24-hour sleep-wake disorder (N24SWD).

METHODS: We report a series of seven sighted patients with N24SWD clinically evaluated by history and sleep diaries, and when available wrist actigraphy and salivary melatonin levels, and treated with timed melatonin and bright light therapy.

RESULTS: Most patients had a history of a delayed sleep-wake pattern prior to developing N24SWD. The typical sleep-wake pattern of N24SWD was seen in the sleep diaries (and in actigraphy when available) in all patients with a daily delay in midpoint of sleep ranging 0.8 to 1.8 hours. Salivary dim light melatonin onset (DLMO) was evaluated in four patients but was missed in one. The estimated phase angle from DLMO to sleep onset ranged from 5.25 to 9 hours. All six patients who attempted timed melatonin and bright light therapy were able to entrain their sleep-wake schedules. Entrainment occurred at a late circadian phase, possibly related to the late timing of melatonin administration, though the patients often preferred late sleep times. Most did not continue treatment and
continued to have
a non-24-hour sleep-wake pattern.

CONCLUSIONS: N24SWD is a chronic debilitating disorder that is often overlooked in sighted people and can be challenging to diagnose and treat. Tools to assess circadian pattern and timing can be effectively applied to aid the diagnosis. The progressive delay of the circadian rhythm poses a challenge for determining the most effective timing for melatonin and bright light therapies. Furthermore, once the circadian sleep-wake rhythm is entrained, long-term effectiveness is limited because of the behavioral and environmental structure that is required to maintain stable entrainment.

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Dietary intake following experimentally restricted sleep in adolescents.

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Comment in

STUDY OBJECTIVE: To examine the relationship between sleep and dietary intake in adolescents using an experimental sleep restriction protocol.
DESIGN: Randomized crossover sleep restriction-extension paradigm.
SETTING: Sleep obtained and monitored at home, diet measured during an office visit.
PARTICIPANTS: Forty-one typically developing adolescents age 14-16 years.
INTERVENTIONS: The 3-week protocol consisting of a baseline week designed to stabilize the circadian rhythm, followed randomly by 5 consecutive nights of sleep restriction (6.5 hours in bed Monday–Friday) versus healthy sleep duration (10 hours in bed), a 2-night washout period, and a 5-night crossover period.

MEASUREMENTS: Sleep was monitored via actigraphy and teens completed validated 24-hour diet recall interviews following each experimental condition.

RESULTS: Paired-sample t-tests examined differences between conditions for consumption of key macronutrients and choices from dietary categories. Compared with the healthy sleep condition, sleep-restricted adolescents' diets were characterized by higher glycemic index and glycemic load and a trend toward more calories and carbohydrates, with no differences in fat or protein consumption. Exploratory analyses revealed the consumption of significantly more desserts and sweets during sleep restriction than healthy sleep.

CONCLUSIONS: Chronic sleep restriction during adolescence appears to cause increased consumption of foods with a high glycemic index, particularly desserts/sweets. The chronic sleep restriction common in adolescence may cause changes in dietary behaviors that increase risk of obesity and associated morbidity.
The current study was conducted to provide normative data on actigraphic dichotomy index (I < 0) (the percentage of in bed activity counts that are less than the median of out of bed counts) in healthy population and to assess whether the I < 0 could be an effective index in discriminating the circadian motor activity of cancer patients from healthy controls. In this retrospective study, we recovered 408 actigraphic records from two databases: healthy controls (n = 182; 79 males; mean age 38.7 ± 12.6) and patients with metastatic colorectal cancer (n = 226; 149 males; mean age 58.4 ± 11.4). Beside the usual actigraphic sleep parameters (time in bed, sleep onset latency, total sleep time, wake after sleep onset, sleep efficiency, number of awakenings, and mean motor activity), we also computed the dichotomy index and number of actigraphic wake parameters, namely, diurnal motor activity, diurnal total sleep time, number of sleep episodes, and the mean duration of the longest diurnal sleep episode. Using the Youden index, we calculated the cut off value that performed the best for I < 0 and actigraphic wake parameters. Finally, we created Receiver Operator Characteristic curves to test the efficacy of each actigraphic parameter to discriminate cancer patient from healthy controls. Mean I < 0 was 99.5% (SD, 0.48%) in the healthy group, as compared to 96.6% (SD, 3.6%) in the cancer group (p < 0.0001). Important age-related effects appeared unlikely after performing both the main analysis with age as a covariate, and a subset analysis in 104 subjects matched for age and sex. In the main analysis, all actigraphic parameters, except total sleep time, significantly differentiated the two groups of participants. However, the I < 0 was the one that clearly performed best. Here, we provide the first large dataset on I < 0 in healthy subjects,
we confirm
the relevance of this circadian index for discriminating advanced
stage
colorectal cancer patients from healthy subjects, and we lay the
grounds for
further investigations of this circadian index in patients with other
chronic
diseases.

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405. Chronobiol Int. 2016;33(8):1009-17. doi:
Jun 15.

Differences in circadian phase and weekday/weekend sleep patterns in a
sample of
middle-aged morning types and evening types.

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Factors contributing to sleep timing and sleep restriction in daily
life include
chronotype and less flexibility in times available for sleep on
scheduled days
versus free days. There is some evidence that these two factors
interact, with
morning types and evening types reporting similar sleep need, but
evening types
being more likely to accumulate a sleep debt during the week and to
have greater
sleep extension on weekend nights. The aim of the present study was to
evaluate
the independent contributions of circadian phase and weekend-to-
weekday
variability to sleep timing in daily life. The study included 14
morning types
and 14 evening types recruited from a community-based sample of New
Zealand
adults (mean age 41.1 ± 4.7 years). On days 1-15, the participants
followed their
usual routines in their own homes and daily sleep start, midpoint and
end times
were determined by actigraphy and sleep diaries. Days 16–17 involved a 17 h modified constant routine protocol in the laboratory (17:00 to 10:00, <20 lux) with half-hourly saliva samples assayed for melatonin. Mixed model ANCOVAs for repeated measures were used to investigate the independent relationships between sleep start and end times (separate models) and age (30–39 years versus 40–49 years), circadian phase [time of the dim light melatonin onset (DLMO)] and weekday/weekend schedules (Sunday–Thursday nights versus Friday–Saturday nights).

As expected on weekdays, evening types had later sleep start times (mean = 23:47 versus 22:37, p < .0001) and end times (mean = 07:14 versus 05:56, p < .0001) than morning types. Similarly on weekend days, evening types had later sleep start times (mean = 00:14 versus 23:07, p = .0032) and end times (mean = 08:56 versus 07:04, p < .0001) than morning types. Evening types also had later DLMO (22:06 versus 20:46, p = .0002) than morning types (mean difference = 80.4 min, SE = 18.6 min). The ANCOVA models found that later sleep start times were associated with later DLMO (p = .0172) and weekend–to–weekday sleep timing variability (p < .0001), after controlling for age, while later sleep end times were associated with later DLMO (p = .0038), younger age (p = .0190) and weekend days (p < .0001). Sleep end times showed stronger association with DLMO (for every 30 min delay in DLMO, estimated mean sleep end time occurred 14.0 min later versus 10.19 min later for sleep start times). Sleep end times also showed greater delays on weekends versus weekdays (estimated mean delay for sleep end time = 84 min, for sleep start time = 28 min). Comparing morning types and evening types, the estimated contributions of the DLMO to the mean observed differences in sleep timing were on weekdays, 39% for sleep start times and 49% for sleep end times; and on weekends, 41% for sleep start times and 34% of sleep.
end times. We conclude that differences in sleep timing between
morning types and
evening types were much greater than would be predicted on the basis
of the
independent contribution of the difference in DLMO on both weekdays
and weekend
days. The timing of sleep in daily life involves complex interactions
between
physiological and psychosocial factors, which may be moderated by age
in adults
aged 30–49 years.

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Nov 20.

Differences in circadian rhythmicity in CLOCK 3111T/C genetic variants
in
moderate obese women as assessed by thermometry, actimetry and body
position.

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INTRODUCTION: Genetics is behind our circadian machinery. CLOCK
(Circadian
Locomotor Output Cycles Kaput) 3111T/C single-nucleotide polymorphism
(SNP) has
been previously related to obesity and weight loss. However, phenotypic
association and functionality of CLOCK 3111 locus is still unknown. The aim of
this study was to determine, in free-living conditions, if the presence of CLOCK
3111C in overweight women could be related to (a) circadian disorders, and (b)
changes in sleep quality, to improve understanding of the previously demonstrated
associations with obesity and reduced weight loss of the C carriers.

METHODS: Wrist temperature, actimetry and position (TAP) and TAP
variables were measured as markers of circadian functionality during 8 consecutive days. A rest-activity and food diary was also completed, whereas sleep quality was determined by domiciliary polysomnography. We recruited 85 women who were overweight with body mass index (BMI) of 28.59±4.30 kg m\(^{-2}\) and age 43±12 years. From this sample, we found that 43 women were carrying the minor allele (C) for CLOCK 3111T/C SNP and 42 women were TT carriers (major allele carriers). Both groups of patients were matched for number, age, obesity parameters and energy intake.

RESULTS: Compared with TT subjects, who showed more robust circadian rhythm profiles, patients with the C allele displayed significant circadian abnormalities: lower amplitude and greater fragmentation of the rhythm, a less stable circadian pattern and a significantly weakened circadian function, as assessed by the circadian function index (CFI). C subjects were also less active, started their activities later in the morning and were sleepier during the day, showing a delayed acrophase that characterizes 'evening-type' subjects.

CONCLUSION: C genetic variants in CLOCK 3111T/C display a less robust circadian rhythm than TT and a delayed acrophase that characterizes 'evening-type' subjects. We support the notion that identifying CLOCK genotypes in patients may assist the therapist in characterization of the roots of the metabolic problem.

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Differences in sleep, light, and circadian phase in offshore 18:00–06:00 h and 19:00–07:00 h shift workers.
Complaints concerning sleep are high among those who work night shifts; this is in part due to the disturbed relationship between circadian phase and the timing of the sleep-wake cycle. Shift schedule, light exposure, and age are all known to affect adaptation to the night shift. This study investigated circadian phase, sleep, and light exposure in subjects working 18:00–06:00 h and 19:00–07:00 h schedules during summer (May–August). Ten men, aged 46+/−10 yrs (mean+/−SD), worked the 19:00–07:00 h shift schedule for two or three weeks offshore (58 degrees N). Seven men, mean age 41+/−12 yrs, worked the 18:00–06:00 h shift schedule for two weeks offshore (61 degrees N). Circadian phase was assessed by calculating the peak (acrophase) of the 6-sulphatoxymelatonin rhythm measured by radioimmunoassay of sequential urine samples collected for 72 h at the end of the night shift. Objective sleep and light exposure were assessed by actigraphy and subjective sleep diaries. Subjects working 18:00–06:00 h had a 6-sulphatoxymelatonin acrophase of 11.7+/−0.77 h (mean+/−SEM, decimal hours), whereas it was significantly later, 14.6+/−0.55 h (p=0.01), for adapted subjects working 19:00–07:00 h. Two subjects did not adapt to the 19:00–07:00 h night shift (6-sulphatoxymelatonin acrophases being 4.3+/−0.22 and 5.3+/−0.29 h).

Actigraphy analysis of sleep duration showed significant differences (p=0.03), with a mean sleep duration for those working 19:00–07:00 h of 5.71+/−0.31 h compared to those working 18:00–06:00 h whose mean sleep duration was 6.64+/−0.33 h. There was a trend to higher morning light exposure (p=0.07) in the 19:00–07:00 h group. Circadian phase was later (delayed on average by 3 h) and objective
sleep was shorter with the 19:00–07:00 h than the 18:00–06:00 h shift schedule. In these offshore conditions in summer, the earlier shift start and end time appears to favor daytime sleep.

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Differences in workday sleep fragmentation, rest-activity cycle, sleep quality, and activity level among nurses working different shifts.

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Schedule changes associated with rotating shifts can interfere with the circadian rhythms of nurses and thereby affect their sleep duration, sleep quality, work efficiency, and work performance. The objectives of this study was to investigate differences in workday sleep fragmentation, rest-activity cycle, sleep quality, and activity level among nurses working different shifts. After filling out a basic information questionnaire and completing the Pittsburgh Sleep Quality Index (PSQI) questionnaire, participants were asked to wear an actigraph and keep sleep records for seven consecutive days. Data pertaining to wake after sleep onset (WASO), 24-hour autocorrelation coefficient (r24), and daytime activity mean was collected in order to investigate workday sleep fragmentation, rest-activity cycle, and daytime activity level. We obtained complete questionnaires
and data from 191 nurses. Day- and evening-shift nurses had more regular workday rest-activity cycles than did night-shift nurses (F = 51.26, p < .001). After controlling for r24 coefficients, we determined that nurses who experienced greater workday sleep fragmentation had higher PSQI scores (β = .18, p = .008). After controlling for WASO times, we determined that nurses who had more regular rest-activity cycles on workdays had lower PSQI scores (β = -.16, p = .036). After controlling for shift type and WASO times, we determined that nurses with higher PSQI scores displayed lower activity levels (β = -.21, p = .015) and those with higher r24 coefficients displayed higher activity levels (β = .18, p = .040) on workdays. We then examined the causal path relationships. Among the shifts, only the day-shift nurses had a higher r24 (β = -.59, p < .001) than did the night-shift nurses; WASO exerted a significant impact on PSQI scores (β = .20, p = .002); r24 had a significant and negative influence on PSQI scores (β = -.38, p < .001), and PSQI scores significantly and negatively influenced workday activity levels (β = -.20, p = .006). This study determined that day- and evening-shift nurses enjoyed more regular and consistent rest-activity cycles than did night-shift nurses; nurses with greater workday sleep fragmentation and/or more irregular rest-activity cycles experienced poorer sleep quality; and nurses suffering from poorer sleep quality displayed lower daytime activity levels on workdays.

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Different manifestations of circadian rhythms in senile dementia of Alzheimer's type and multi-infarct dementia.
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Using an actigraph and a long-term body temperature (BT) monitoring system, we simultaneously monitored rest-activity (R-A) and BT rhythms in patients with senile dementia of Alzheimer's type (SDAT; n = 20) or multi-infarct dementia (MID; n = 21) for 5-7 consecutive days. The SDAT group exhibited a well-organized BT rhythm with significantly higher amplitude compared with the MID group. The SDAT group also showed significant positive correlation between the total daily activity as well as percentage of nighttime activity and the degree of dementia, while no such tendency was observed in the MID group. The different properties of the biological rhythm disorders among the SDAT and MID groups possibly underlie their sleep and behavioral disorders.

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Differential effects of environmental enrichment on behavior and learning of male and female Ts65Dn mice, a model for Down syndrome.

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We have assessed the effects of enriched environment (EE) upon behavioral and
cognitive performances of partially trisomic Ts65Dn (TS) mice and their control (CO) littermates. Enriched environment was applied to pups for 7 weeks after weaning. Circadian spontaneous activity (actimetry), exploratory behavior (hole board), activity in the open field and spatial memory (Morris Water Maze, repeated acquisition and cued paradigms) were analyzed in 86 female and 75 male mice, starting 15 days after completing enrichment. For each gender, mice were distributed in non-enriched and enriched control and trisomic groups. Enriched environment reduced in trisomic females and enhanced in trisomic males' circadian activity. Exploratory behavior was increased by enrichment in all groups, regardless of gender or presence of trisomy. In the Morris Water Maze, a significant improvement of the spatial memory was observed in enriched-control females, but not in enriched-control male mice, as assessed by distances traveled. Performances in the four groups of control animals were also consistently and significantly better than those of matching trisomic mice. In the acquisition trials, enrichment improved performance in trisomic female animals, but deteriorated in trisomic male mice. In all groups, changes in escape latencies and distances induced by enrichment were accounted for by changes in the total time spent in the periphery of the pool, indicating changes in learning strategy. Working memory was the function more affected by enrichment. It is concluded that enriched environment induces behavioral and learning changes in trisomic mice, although gender plays a significant modulatory role.

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Differential effects of morning and evening dosing of nisoldipine ER
on circadian blood pressure and heart rate.

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The time of administration of once-daily antihypertensive agents may have a significant impact on blood pressure control during awake and sleep periods. Using 24-h ambulatory monitoring, we compared the effects of morning and evening dosing of the long-acting dihydropyridine calcium channel blocker, nisoldipine extended-release (ER), on circadian blood pressure (BP) and heart rate in patients with mild-to-moderate hypertension. After completing a 3-week placebo run-in period, 85 patients were randomized to morning versus evening nisoldipine ER treatment at a fixed 20-mg dose. Patients were treated for 4 weeks, followed by crossover to the alternate dosing regimen for 4 additional weeks. Twenty-four-hour ambulatory monitoring was performed at baseline and at 4 and 8 weeks after randomization. Awake and sleep times were determined by electronic activity recorders (Actigraphy). Similar least-squares (+/-SE) mean changes from baseline in 24-h BP (systolic BP/diastolic BP: -11.9/-7.4 +/- 0.6/0.5 mm Hg) and heart rate (1.0/1.7 +/- 0.4/0.4 beats/min) occurred with morning and evening administration, respectively. A significantly greater effect on awake diastolic BP (systolic BP/diastolic BP: -12.6/-8.1 +/- 0.7/0.4 v -11.3/-6.4 +/- 0.7/0.4 mm Hg; P = .16/.01) was observed with morning dosing compared with evening dosing. In addition, small increases in sleep and early morning heart rate were seen with evening compared with morning administration of nisoldipine (sleep, 3.1 +/- 0.4 v 0.4 +/- 0.4 beats/min; P < .001; early morning, 3.5 +/- 0.7 v 0.5 +/- 0.7 beats/min; P = .002). These
differential effects on awake BP and sleep heart rate were also observed in patients who had normal (dippers) and elevated (nondippers) BP values during sleep. Appropriate evaluation of the efficacy and safety of long-acting antihypertensive agents is essential when evening administration is being considered. In the present study, the timing of nisoldipine ER administration had no effect on mean changes in BP and heart rate over a 24-h period. However, nisoldipine ER had some differential effects during sleep and awake periods with morning relative to evening dosing.

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The dim light melatonin onset following fixed and free sleep schedules.

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The time at which the dim light melatonin onset (DLMO) occurs can be used to ensure the correct timing of light and/or melatonin administration in order to produce desired circadian phase shifts. Sometimes however, measuring the DLMO is not feasible. Here we determined if the DLMO was best estimated from fixed sleep times (based on habitual sleep times) or free (ad libitum) sleep times. Young healthy sleepers on fixed (n=60) or free (n=60) sleep schedules slept at home for 6 days. Sleep times were recorded with sleep logs verified with wrist actigraphy. Half-hourly saliva samples were then collected during a dim light phase assessment and were later assayed to determine the DLMO. We found that the DLMO
was more highly correlated with sleep times in the free sleepers than in the
fixed sleepers (DLMO versus wake time, r=0.70 and r=0.44, both
P<0.05). The
regression equation between wake time and the DLMO in the free
sleepers predicted
the DLMO in an independent sample of free sleepers (n=23) to within
1.5 h of the
actual DLMO in 96% of cases. These results indicate that the DLMO can be readily
estimated in people whose sleep times are minimally affected by work, class and
family commitments. Further work is necessary to determine if the DLMO can be
accurately estimated in people with greater work and family responsibilities that
affect their sleep times, perhaps by using weekend wake times, and if
this method
will apply to the elderly and patients with circadian rhythm disorders.

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Dim light, sleep tight, and wake up bright – Sleep optimization in athletes by
means of light regulation.

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Despite an elevated recovery need, research indicates that athletes often exhibit relatively poor sleep. Timing and consolidation of sleep is driven by the circadian system, which requires periodic light-dark exposure for stable entrainment to the 24-hour day, but is often disturbed due to underexposure to light in the morning (e.g. low-level indoor lighting) and overexposure to light in the evening (e.g. environmental and screen-light). This study examined whether combining fixed sleep schedules with light regulation leads to more consolidated sleep. Morning light exposure was increased using light-emitting goggles, whereas evening light exposure was reduced using amber-lens glasses. Using a within-subject crossover design, twenty-six athletes (14 female, 12 male) were randomly assigned to start the intervention with the light-regulation-week or the no light-regulation-week. Sleep was monitored by means of sleep diaries and actigraphy. Due to low protocol adherence regarding the fixed sleep-wake schedules, two datasets were constructed; one including athletes who kept a strict sleep-wake schedule (N = 8), and one that also included athletes with a more lenient sleep-wake schedule (N = 25). In case of a lenient sleep-wake schedule, light regulation improved self-reported sleep onset latency ($\Delta$ SOL = 8 min). This effect was stronger ($\Delta$ SOL = 17 min) and complemented by enhanced subjective sleep quality in case of a strict sleep-wake schedule. None of the actigraphy-based estimates differed significantly between conditions. To conclude, light regulation may be considered a potentially effective strategy to improve subjective sleep, but less obtrusive methods should be explored to
increase protocol compliance.

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Direct comparison of two widely used activity recorders.

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Wrist actigraphy is increasingly used to track circadian rest-activity cycles and to identify states of wakefulness and sleep, yet the measurement characteristics of activity recorders have never been compared. Two widely used recorders are compared here: the MotionLogger from Ambulatory Monitoring, Inc (AM) and the Gaehwiler (G). They were worn together on the same wrist for periods averaging 41.5 hours by five members of a research team. Activity counts were stored every half-minute. Pairwise comparisons between recorders of each type showed both types to be reliable. Each also validly detected circadian rest/activity cycles. Both types suffered, however, from insensitivity. For the lower 75% of activity levels, the variance of data from the G was indeed so small as to be essentially uninformative. Since these levels include over 95% of all nocturnal data, the G must be less sensitive than the AM to small nocturnal movements, including those signifying arousal. An additional difference is that data from the AM but not the G were distributed in biphasic fashion. Biphasic activity levels are consistent with the common assumption that activity/wakefulness and rest/sleep are distinct neurobehavioral states. As the use of actigraphy increases, the important differences found here between two leading instruments point to an urgent need
for standards by which activity recorders can be compared. Aspects of instrument
design that could be quantitatively rated are reliability, validity, ruggedness
and artifact rejection.

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The discrepancy between actigraphic and sleep diary measures of sleep in
adolescents.

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OBJECTIVE: To explore the discrepancy between sleep diary and
actigraphic measures of sleep in adolescents and to ascertain whether these
discrepancies may vary according to characteristics of the participant.
METHODS: Participants were 385 adolescents aged 13-18 years (X=15.6,
standard deviation [SD]=0.95; 60% male) from eight high schools in South
Australia. Adolescents completed the School Sleep Habits Survey and Pediatric
Daytime Sleepiness Scale during class time, followed by an 8-day sleep diary
and wrist actigraphy. The Flinders Fatigue Scale was completed on the final day
of the study. Parents completed a sleep, medical, education, and family
history survey.
RESULTS: Actigraphic estimates of wake after sleep onset (WASO) were
substantially greater than sleep diary estimates (74 min actigraphy vs. 7 min
sleep diary) and actigraphic estimates of total sleep time were substantially less than
sleep diary and parent report (6h 51min actigraphy vs. 8h 16min sleep diary vs. 8h 51 parent report). Actigraphy displayed no significant relationship with daytime functioning and weak relationships with concomitantly recorded sleep diary variables. Sex and puberty-related differences in actigraphic scoring were found, with more WASO and less sleep scored in boys compared to girls and more WASO scored amongst pubertally-mature boys than boys of less advanced pubertal development.

CONCLUSIONS: There may be differences in the sleep of adolescents that result in less actigraphic total sleep scored than perceived, particularly in boys, possibly because of increased sleep motor activity in adolescents that actigraphic algorithms score as wake. This is a significant concern that requires further examination with polysomnography.

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Disparities in sleep characteristics by race/ethnicity in a population-based sample: Chicago Area Sleep Study.

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BACKGROUND: Prior studies report less favorable sleep characteristics among non-Whites as compared with non-Hispanic Whites. However, few population-based studies have used objective measures of sleep duration, especially in more than two racial/ethnic groups. We tested whether objectively estimated sleep duration and self-reported sleep quality varied by race and whether differences were at least partially explained by the variability in clinical, psychological, and behavioral covariates.

METHODS: Adults aged 35–64 years who self-identified as White, Black, Asian, or Hispanic were randomly sampled from Chicago, IL, and the surrounding suburbs. Our analytic sample included adults who had an apnea-hypopnea index <15 after one night of screening and who completed seven nights of wrist actigraphy for determination of sleep duration, sleep percentage, minutes of wake after sleep onset, and sleep fragmentation (n = 495). Daytime sleepiness was estimated using the Epworth Sleepiness Scale (ESS), and sleep quality was estimated from the Pittsburgh Sleep Quality Index (PSQI).

RESULTS: Following statistical adjustment for age, gender, education, work schedule (ie, day vs. night shift), smoking status, depressive symptoms, body mass index (BMI), hypertension, and diabetes, sleep duration (minutes) was significantly (all p < 0.01) shorter in Black (mean = 399.5), Hispanic (mean = 411.7), and Asian (mean = 409.6) participants than in White participants (mean = 447.4). All remaining sleep characteristics were significantly less favorable among Black participants as compared with White participants. Asian participants also reported significantly more daytime sleepiness than did White participants.

CONCLUSIONS: Differences in sleep characteristics by race/ethnicity
are apparent
in a sample of adults with a low probability of sleep apnea and following
adjustment for known confounders.

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Disrupted daily activity/rest cycles in relation to daily cortisol rhythms of
home-dwelling patients with early Alzheimer's dementia.

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Disturbed sleep cycles are the principal cause of institutionalization in
dementia, and therefore represent a major clinical problem. They may arise from
dysfunction within the circadian clock of the hypothalamus that times and
consolidates wakefulness, or from neuropathology in output pathways and/or target
sites of the clock specifically controlling sleep and wakefulness. To determine
the relationship of disturbed activity cycles to other circadian clock-controlled
rhythms, cross-sectional and longitudinal actigraphy and serial sampling of
saliva were used to compare the impact of early Alzheimer's dementia on
activity/rest and cortisol rhythms in home-dwelling subjects. Mildly demented
subjects had daily activity rhythms comparable to those of healthy age-matched
subjects. Moderately demented subjects exhibited a range of disturbances of the
activity/rest cycle, with reduced stability, increased fragmentation and loss of
amplitude. Within the moderately demented group, however, the degree of circadian
disruption was not correlated with the individual severity of
dementia. All groups of subjects, mild, moderate with normal activity cycles and moderate with abnormal activity cycles, exhibited robust daily profiles of salivary cortisol, with highest levels in the morning (08:00 h) and an evening nadir (20:00-24:00 h). Salivary cortisol levels tended to be higher in the moderately demented subjects in the afternoon, but this effect was not specific to those with abnormal activity/rest patterns. The actimetric data confirm that deterioration of activity/rest cycles is a common and progressive feature in home-dwelling Alzheimer's patients, occurring early in the disease but after the measurable onset of dementia. The maintenance of highly rhythmic daily cortisol profiles in association with disturbed activity profiles, both on an individual and on a group basis, demonstrates that loss of circadian control to activity/rest cycles is not a consequence of global circadian disruption in early dementia. Rather, pathology may develop in discrete elements of the circadian clockwork and/or its output systems that control activity/rest, sleep and wakefulness. Further characterization of this pathology will facilitate more effective management of sleep patterns in home-dwelling demented patients.

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Disrupted Diurnal Oscillation of Gut-Derived Short Chain Fatty Acids in Shift Workers Drinking Alcohol: Possible Mechanism for Loss of Resiliency of Intestinal Barrier in Disrupted Circadian Host.

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Microbiota derived short chain fatty acids (SCFAs) are produced by fermentation of non-digestible fiber, and are a key component in intestinal barrier homeostasis. Since the microbiome has diurnal fluctuations, we hypothesized that SCFAs in humans have a diurnal rhythm and their rhythmicity would be impacted by the host central circadian misalignment (night shift work) which would make intestinal barrier more susceptible to disruption by alcohol. To test this hypothesis, we studied three groups of subjects: patients with alcohol use disorder, but no liver disease (AD), healthy day workers (DW), and night workers (NW). All subjects were studied at baseline and then in DW and NW subjects after moderate daily alcohol (0.5 g/kg) for seven days. Gut derived plasma SCFAs showed a significant circadian oscillation by cosinor analysis in DW; however, SCFA in the AD and NW subjects lost 24 hour rhythmicity. Decrease in SCFA correlated with increased colonic permeability. Both chronic and moderate alcohol consumption for one week caused circadian disruption based on wrist actigraphy and urinary melatonin. Our study shows that: (1) gut derived plasma SCFAs have a diurnal rhythm in humans that is impacted by the central clock of the host; (2) moderate alcohol suppresses SCFAs which was associated with increased colonic permeability; and (3) less invasive urinary 6-SM correlated and rest-activity
actigraphy correlated with plasma melatonin. Future studies are needed to examine
the role circadian misalignment on gut derived SCFAs as possible mechanism for
loss of intestinal barrier resiliency to injurious agents like alcohol.

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Disrupted sleep and circadian patterns in frontotemporal dementia.
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BACKGROUND: A study of the pattern of Sleep/Wake disturbance in frontotemporal dementia (FTD).
METHODS: Sleep diaries and prolonged actigraphy were used to record the activity, sleep and wake of 13 patients with a clinical diagnosis of FTD. These were compared with diaries and actigraphy from normal age/sex matched controls and also to a population with probable Alzheimer's disease (AD).
RESULTS: There was significant sleep/wake disturbance in FTD. This occurred throughout the course of the illness and the nature of the sleep disturbance was different to patients with AD. FTD subjects showed increased nocturnal activity and decreased morning activity compared with controls, suggesting possible phase delay. Sleep diary data confirmed decreased sleep efficiency and decreased total sleep in all FTD patients.
CONCLUSIONS: We describe significant sleep disturbance in non-institutionalized patients with FTD and suggest that early sleep disturbance may help differentiate between FTD and AD.
Disruption in daily eating–fasting and activity–rest cycles in Indian adolescents attending school.

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A lifestyle with erratic eating patterns and habits predisposes youngsters to obesity. Through a two-phase feasibility study among Indian students living in the Delhi area, we longitudinally examined the following: (1) the daily eating–fasting cycles of students (N = 34) in school and college using smartphones as they transition from high school (aged 13–15 years; nIX = 13) to higher secondary school (HSSS; 16–18 years; nXII = 9) to their first year (FY) of college (18–19 years; nFC = 12); and (2) daily activity–rest cycles and light–dark exposure of 31 higher secondary school students (HSSS) using actigraphy. In phase 1, students' food data were analyzed for temporal details of eating events and observable differences in diet composition, such as an energy-dense diet (fast food (FF)), as confounding factors of circadian health. Overall, the mean eating duration in high school, higher secondary and FY college students ranged from 14.1 to 16.2 h. HSSS exhibited the shortest night fasting. Although FY college students exhibited the highest fast food percentage (FF%), a positive correlation between body mass index (BMI) and FF% was observed only among HSSS. Furthermore, the body weight of HSSS was significantly higher,
indicating that FF, untimely eating and reduced night fasting were important
obesity-associated factors in adolescents. Reduced night fasting duration was
also related to shorter sleep in HSSS. Therefore, food data were supplemented
with wrist actigraphy, i.e., activity-rest data, in HSSS. Actigraphy externally
validated the increased obesogenic consequences of deregulated eating rhythms in
HSSS. CamNtech motion watches were used to assess the relationship between
disturbed activity cycles of HSSS and other circadian clock-related rhythms, such
as sleep. Less than 50% of Indian HSSS slept 6 hours or more per night. Seven of
31 students remained awake throughout the night, during which they had more than
20% of their daily light exposure. Three nonparametric circadian rhythm analysis
(NPCRA) variables revealed circadian disruption of activity in HSSS. The present
study suggests that inappropriate timing and quality of food and sleep
disturbances are important determinants of circadian disruptions in
adolescents attending school.

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interests exist

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Disruption of sleep, sleep-wake activity rhythm, and nocturnal melatonin
production in breast cancer patients undergoing adjuvant chemotherapy:
prospective cohort study.

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OBJECTIVE: This prospective cohort study captured the patterns of sleep, sleep-wake activity rhythm, and first-morning urinary melatonin in breast cancer patients undergoing adjuvant chemotherapy.

METHODS: Breast cancer patients undergoing adjuvant chemotherapy wore wrist actigraphy for 168 h and collected first-morning void urine samples before treatment, during the first, and at the last cycle of chemotherapy. We converted actigraphy data into sleep duration, sleep efficiency, nighttime total wake time, percent rhythm, F-statistic, amplitude, mesor, and acrophase. We then assessed urinary 6-sulfatoxymelatonin (aMT6s) levels.

RESULTS: This cohort contained 180 participants. Compared with the baseline, sleep efficiency during the first and last cycle decreased by 10.16% [95% confidence interval (95% CI): 5.85%, 14.47%] and 5.01% (95% CI: 0.50%, 9.53%), respectively. Similarly, percent rhythm decreased by 27.20% (95% CI: 19.95%, 34.45%) during the first cycle and 21.20% (95% CI: 13.52, 28.89) during the last cycle. Taking the baseline as the reference, aMT6s levels during the first and last cycle decreased by 11.27% (95% CI: 0.37%, 22.16%) and 14.74% (95% CI: 2.34,
27.11), respectively.
CONCLUSION: The first administration of adjuvant chemotherapy is associated with sleep disturbance and sleep-wake activity rhythm disruption among breast cancer patients, while the disturbance and disruption during the last cycle are less severe; nevertheless, repeated administration of chemotherapy results in progressive impairment of nocturnal melatonin production.

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Disruptions in sleep-wake cycles in community-dwelling cancer patients receiving palliative care and their correlates.

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Significant disruptions in sleep-wake cycles have been found in advanced cancer patients in prior research. However, much remains to be known about specific sleep-wake cycle variables that are impaired in patients with a significantly altered performance status. More studies are also needed to explore the extent to which disrupted sleep-wake cycles are related to physical and psychological symptoms, time to death, maladaptive sleep behaviors, quality of life and 24-h light exposure. This study conducted in palliative cancer patients was aimed at
characterizing patients' sleep-wake cycles using various circadian parameters (i.e. amplitude, acrophase, mesor, up-mesor, down-mesor, rhythmicity coefficient). It also aimed to compare rest-activity rhythm variables of participants with a performance status of 2 vs. 3 on the Eastern Cooperative Oncology Group scale (ECOG) and to evaluate the relationships of sleep-wake cycle parameters with several possible correlates. The sample was composed of 55 community-dwelling cancer patients receiving palliative care with an ECOG of 2 or 3. Circadian parameters were assessed using an actigraphic device for seven consecutive 24-h periods. A light recording and a daily pain diary were completed for the same period. A battery of self-report scales was also administered. A dampened circadian rhythm, a low mean activity level, an early mean time of peak activity during the day, a late starting time of activity during the morning and an early time of decline of activity during the evening were observed. In addition, a less rhythmic sleep-wake cycle was associated with a shorter time to death (from the first home visit) and with a lower 24-h light exposure.

Sleep-wake cycles are markedly disrupted in palliative cancer patients, especially, near the end of life. Effective non-pharmacological interventions are needed to improve patients' circadian rhythms, including perhaps bright light therapy.

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Dissonance Between Parent-Selected Bedtimes and Young Children's Circadian Physiology Influences Nighttime Settling Difficulties.

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Nighttime settling difficulties (i.e., bedtime resistance, sleep-onset delay) occur in about 25% of young children and are associated with attentional, behavioral, and emotional problems. We examined whether the timing of internal (endogenous) circadian melatonin phase (i.e., dim light melatonin onset; DLMO) and its relationship with parent-selected bedtimes were related to nighttime settling behaviors. Fourteen regularly napping preschoolers (8 females; 30–36 months) participated in a 6-day protocol (parent-report of nighttime settling, actigraphic assessment of sleep onset latency, evening salivary DLMO). Average DLMO clock time was 07:40 p.m. ± 00:48 minutes, occurring 29 minutes ± 32 minutes prior to bedtime (lights-out). Children with later DLMOs had longer sleep-onset latencies (r = .62) and poorer success in falling asleep (r = -.59). Children whose bedtimes were closer to their DLMO had longer sleep-onset latencies (r = .72) and increased bedtime resistance (r = -.54). We conclude that dissonance between parent-selected bedtimes and children's circadian physiology may contribute to the development of nighttime settling difficulties in early childhood.

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Distal–proximal skin temperature gradient prior to sleep onset in infants for clinical use.

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BACKGROUND: The objective of this study was to explore the possibility of using distal–proximal skin temperature gradient (DPG) to predict sleep-onset latency of night-time sleep for infants at home.

METHODS: Foot (for distal) and abdominal (for proximal) skin temperature during sleep onset in healthy infants, aged 4–9 months, was continuously recorded using a temperature logger at home. Sleep-onset latency during each study night was defined as the interval from lights-off to sleep onset, determined on actigraphy. Association of DPG profile after lights-off with sleep-onset latency on the study nights was evaluated.

RESULTS: Data for 43 nights from 28 infants were available for analysis. With regard to low DPG (≤−2.5°C) at lights-off, >60% of infants fell asleep within 30 min if DPG was increased to ≥−2.5°C within 15 min after lights-off. If DPG remained at ≤−2.5°C at 15 min after lights-off, however, only 20% of infants fell asleep within 30 min. In addition, if infants were still awake at 15 min after lights-off and the DPG at that time was ≤−2.5°C, they were not likely to quickly fall asleep (predictive value was 0.875).

CONCLUSIONS: Increase in DPG by 15 min after lights-off is a key determinant for sleep-onset latency.

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Distress and quality of life in an ethnically diverse sample awaiting breast cancer surgery.

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Poor breast cancer-related quality of life is associated with flattened cortisol rhythms and inflammation in breast cancer survivors and women with advanced disease. We explored the associations of cancer-specific distress (Impact of Events Scale), mood (Profile of Mood States), activity/sleep (wake after sleep onset, 24-hour autocorrelation coefficient) and cortisol (diurnal slope) circadian rhythms, and inflammation (interleukin-6) with quality of life (Functional Assessment of Cancer Therapy-Breast) among patients awaiting breast cancer surgery (N = 57). Models were adjusted for differences in age and cancer stage. Distress and mood disturbance were significantly correlated with lower quality of life. Ethnic differences in the relationship between distress and mood disturbance with global quality of life and subscales of quality of life were observed. Actigraphic measures showed that in comparison with non-Hispanic patients, African Americans had significantly poorer activity/sleep (wake after sleep onset, 24-hour autocorrelation coefficient). Circadian disruption and inflammation were not associated with quality of life. Physiological dysregulation and associated comorbidities may take time to develop over the
Disturbances in melatonin and core body temperature circadian rhythms after minimal invasive surgery.

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BACKGROUND: Sleep disturbances, fatigue and reduced general well-being frequently occur after minimal invasive surgery. The circadian rhythms of melatonin and core body temperature are central to the regulation of normal sleep. The aim of this study was to assess changes in these circadian rhythms after laparoscopic cholecystectomy.

METHODS: Twelve women were studied before and after laparoscopic cholecystectomy. The major urinary melatonin metabolite, 6-sulphatoxymelatonin (aMT6s), and the core body temperature were measured for 1 day before and 1 day after surgery. The basal and maximum secretion of aMT6s were determined, as well as the timing and amplitude of aMT6s and the temperature rhythm. The patients' rest-activity and calculated sleep parameters were assessed by actigraphy.

RESULTS: A significant delay in the timing of aMT6s rhythm was observed after surgery [median (range) peak time of aMT6s: after surgery, 05:49 h (02:57-08:23 h); before surgery, 04:32 h (02:18-06:49 h); P< or = 0.05]. The amplitude of the aMT6s rhythm was also significantly decreased after surgery [after surgery, 7.1 ng aMT6s/mg creatinine (1-15.9 ng); before surgery, 13.2 ng aMT6s/mg creatinine]
(2.9–22.7 ng); P< or = 0.005]. There was almost a 12-h phase delay of the core body temperature rhythm after surgery [peak time: before surgery, 17:39 h (15:17–22:06 h); after surgery, 05:14 h (03:24–21:43 h); P< or = 0.01].

CONCLUSIONS: Following laparoscopic cholecystectomy, there was a delay in the timing of the aMT6s rhythm and a decreased evening decline in the temperature rhythm.

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Disturbances in melatonin secretion and circadian sleep-wake regulation in Parkinson disease.

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OBJECTIVE: Using salivary dim light melatonin onset (DLMO) and actigraphy, our study sought to determine if Parkinson disease (PD) patients demonstrate circadian disturbance compared to healthy controls. Additionally, our study investigated if circadian disturbances represent a disease-related process or may be attributed to dopaminergic therapy.

METHODS: Twenty-nine patients with PD were divided into unmedicated and medicated groups and were compared to 27 healthy controls. All participants underwent neurologic assessment and 14 days of actigraphy to establish habitual sleep-onset time (HSO). DLMO time and area under the melatonin curve (AUC) were calculated from salivary melatonin sampling. The phase angle of entrainment was calculated by subtracting DLMO from HSO. Overnight polysomnography (PSG) was performed to determine sleep architecture.

RESULTS: DLMO and HSO were not different across the groups. However, the phase angle of entrainment was more than twice as long in the medicated PD group compared to the unmedicated PD group (U = 35.5; P = .002) and was more than 50% longer than controls (U = 130.0; P = .021). The medicated PD group showed more than double the melatonin AUC compared to the unmedicated group (U = 31; P = 0.001) and controls (U = 87; P = .001). There was no difference in these measures comparing unmedicated PD and controls.

CONCLUSIONS: In PD dopaminergic treatment profoundly increases the secretion of melatonin. Our study reported no difference in circadian phase and HSO between groups. However, PD patients treated with dopaminergic therapy unexpectedly showed a delayed sleep onset relative to DLMO, suggesting dopaminergic therapy in PD results in an uncoupling of circadian and sleep regulation.
Disturbances in the circadian pattern of activity and sleep after laparoscopic versus open abdominal surgery.

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BACKGROUND: Studies on the circadian variation in bodily functions and sleep are important for understanding the pathophysiological processes in the postoperative period. We aimed to investigate changes in the circadian variation in activity after minimally invasive surgery (laparoscopic cholecystectomy, LC) and major abdominal surgery (MAS) and if these changes correlated with postoperative subjective recovery measures.

METHODS: We examined 76 and 44 patients undergoing LC and MAS, respectively, for 4 days before and after surgery. Subjective recovery parameters were assessed by visual analogue scale (sleep quality, general well-being and pain) and fatigue was measured by a ten-point fatigue scale. The activity levels of the patients were monitored by actigraphy (a wrist-worn device measuring patient activity).

Measures of circadian activity level [interday stability (IS), intraday variability (IV) and the amplitude (AMP)] were derived after nonparametric analysis of activity data.

RESULTS: IS was significantly reduced both after MAS (0.72 before surgery and 0.58 after surgery, p < 0.0001) and after LC (0.76 before surgery and 0.66 after...
surgery, p < 0.0001). The IS dropped significantly more following MAS surgery compared with following LC surgery (p < 0.001). The fragmentation of the rhythm IV increased and the amplitude dropped significantly after both LC and MAS surgery. Subjective recovery parameters were worse after MAS when compared with LC, and correlated significantly to the circadian activity parameters (IS, IV and AMP).

CONCLUSION: Severely disturbed circadian activity parameters was found after both LC and MAS with worse changes after MAS. Measures of circadian activity pattern analyses correlated significantly with postoperative subjective recovery parameters.

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Disturbed circadian motor activity patterns in postcardiotomy delirium.

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AIMS: More than 20% of patients of 65 years or older may develop a delirium after cardiac surgery. Patients with delirium frequently show a disturbed 24-hr motor activity pattern, but objective and quantitative data are scarce. Our aim was to quantify motor activity patterns in elderly patients with or without a postcardiotomy delirium after elective cardiac surgery.

METHODS: Wrist-actigraphy was used to quantify 24-hr motor activity patterns for a 5-day period following cardiac surgery in 79 patients of 65 years or older.

Clinical state was monitored daily by means of the Confusion
Assessment Method-Intensive Care Unit and the Delirium Rating Scale-Revised 98. RESULTS: The activity Amplitude, and the daytime Activity/minute and Restlessness index were significantly higher and the daytime number of Immobility minutes significantly lower for the patients without delirium or with short delirium episodes, as compared to patients with a sustained delirium (>3 days). CONCLUSIONS: Actigraphy proves to be a valuable instrument for evaluating motor activity patterns in relation to clinical state in patients with a postcardiotomy delirium.

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Diurnal changes in core body temperature, day/night locomotor activity patterns, and actigraphy-generated behavioral sleep in aged canines with varying levels of cognitive dysfunction.

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Core body temperature (CBT) rhythm, locomotor activity, and actigraphy-sleep were evaluated in geriatric dogs with cognitive dysfunction. Dogs (n=33; 9-16 yrs) performed a spatial working memory task and divided into three memory groups: Low, Moderate, and High, with subsequent evaluation of learning and attention. Rectal CBT was recorded 6 times over a 17.5 h period and Actiwatch® activity monitoring system for 5 days while housed indoors with 12 h light/dark schedule. Rhythm of daily activity data was evaluated using the traditional cosinor analysis and generation of non-parametric measures of interdaily
stability, intradaily variability, and relative amplitude. CBT differed with time (F (5, 130)=11.36, p<0.001), and was the highest at 19:00C. CBT at 19:00 was positively related (p<0.01) to memory (r(31)=0.50) and 3-domain cognitive performance index (memory, learning, attention; r(31)=0.39). Total daytime or night-time activity did not differ between memory groups, but hourly counts at 8:00 were positively related (p<0.05) to memory (r(31)=0.52), learning (r(31)=0.36), and 3-domain cognitive performance index (r(31)=0.53). There were no significant differences between age or memory groups for any circadian rhythm measures. Daytime naps were inversely related to memory accuracy (r(31)=-0.39; p<0.05) and BT at 15:00 (r(30)=-0.51; p<0.01). Lower peak BT and increased napping may predict some aspects of cognitive performance of working memory, learning, and/or attention processes in these geriatric dogs, but minimal diurnal rhythm disruption of locomotor activity is observed when these cognitive processes decline.

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PMID: 31236491


Diurnal fatigue patterns, sleep timing, and mental health outcomes among healthy postpartum women.

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Postpartum women have frequently interrupted sleep, report high levels
of fatigue, and may experience circadian rhythm disruptions. They are also susceptible to mood impairments, anxiety, and stress. The current study explored associations between maternal postpartum daily fatigue patterns, which should vary according to circadian influences and mental health. Seventy-one primiparous, healthy mothers completed multiple daily self-reports of fatigue during postpartum Weeks 2 and 12 and were categorized at each week as having either a rhythmic or random fatigue pattern during the daytime. Wrist actigraphy data were used to calculate sleep midpoints. Surveys assessed chronotype, mood, anxiety, and stress. At postpartum Week 2, there were no differences in mental health measures between fatigue groups. At postpartum Week 12, higher overall fatigue levels were associated with increased anxiety, stress, and mood disruption. However, overall fatigue levels did not differ between fatigue groups. Women with a rhythmic fatigue pattern reported significantly less stress and more vigor than women with a random fatigue pattern. An earlier sleep midpoint was associated with a rhythmic fatigue pattern during postpartum Week 12. These data suggest that, despite similar average daily fatigue levels, having a rhythmic daily pattern of fatigue may be advantageous for mental health outcomes among postpartum women.

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Diurnal variation in vascular function: role of sleep.

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Although vascular function is lower in the morning than afternoon, previous studies have not assessed the influence of prior sleep on this diurnal variation. The authors employed a semiconstant routine protocol to study the contribution of prior nocturnal sleep to the previously observed impairment in vascular function in the morning. Brachial artery vascular function was assessed using the flow-mediated dilation technique (FMD) in 9 healthy, physically active males (mean ± SD: 27 ± 9 yrs of age), at 08:00 and 16:00 h following, respectively, 3.29 ± .37 and 3.24 ± .57 h prior sleep estimated using actimetry. Heart rate and systolic and diastolic blood pressures were also measured. The data of the experimental sleep condition were compared with the data of the "normal" diurnal sleep condition, in which FMD measurements were obtained from 21 healthy individuals who slept only during the night, as usual, before the morning test session. The morning-afternoon difference in FMD was 1 ± 4% in the experimental sleep condition compared with 3 ± 4% in the normal sleep condition (p = .04). This difference was explained by FMD being 3 ± 3% lower in afternoon following the prior experimental sleep (p = .01). These data suggest that FMD is more dependent on the influence of supine sleep than the endogenous circadian timekeeper, in agreement with our previous finding that diurnal variation in FMD is influenced by exercise. These findings also raise the possibility of a lower homeostatic "set point" for vascular function following a period of sleep and in the absence of perturbing hemodynamic fluctuation.

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Do differences in compositional time use explain ethnic variation in the prevalence of obesity in children? Analyses using 24-hour accelerometry.

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BACKGROUND/OBJECTIVES: Whether variation in sleep and physical activity explain marked ethnic and socioeconomic disparities in childhood obesity is unclear. As time spent in one behaviour influences time spent in other behaviours across the 24-hour day, compositional analyses are essential. The aims of this study were to determine how ethnicity and socioeconomic status influence compositional time use in children, and whether differences in compositional time use explain variation in body mass index (BMI) z-score and obesity prevalence across ethnic groups.

METHODS: In all, 690 children (58% European, 20% Māori, 13% Pacific, 9% Asian; 66% low-medium deprivation and 34% high deprivation) aged 6-10 years wore an ActiGraph accelerometer 24-hours a day for 5 days yielding data on sedentary time, sleep, light physical activity (LPA) and moderate-to-vigorous physical activity (MVPA). Height and weight were measured using standard techniques and BMI z-scores calculated. Twenty-four hour movement data were transformed into isometric log-ratio co-ordinates for multivariable regression analysis
and effect sizes were back-transformed. RESULTS: European children spent more time asleep (predicted difference in minutes, 95% CI: 16.1, 7.4–24.9) and in MVPA (6.6 min, 2.4–10.4), and less time sedentary (-10.2 min, -19.8 to -0.6) and in LPA (-12.2 min, -21.0 to -3.5) than non-European children. Overall, 10% more sleep was associated with a larger difference in BMI z-score (adjusted difference, 95% CI: -0.13, -0.25 to -0.01) than 10% more MVPA (-0.06, -0.09 to -0.03). Compositional time use explained 35% of the increased risk of obesity in Pacific compared with European children after adjustment for age, sex, deprivation and diet, but only 9% in Māori and 24% in Asian children. CONCLUSIONS: Ethnic differences in compositional time use explain a relatively small proportion of the ethnic differences in obesity prevalence that exist in children.

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Do night and around-the-clock firefighters' shift schedules induce deviation in tau from 24 hours of systolic and diastolic blood pressure circadian rhythms?

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Systolic (S) and diastolic (D) blood pressures (BP) [SBP and DBP] are circadian rhythmic with period (τ) in healthy persons assumed to be maintained at 24.0h. We tested this assumption in a sample of 30 healthy career (mean >12 yrs) 30-to-46 yr-old male Caucasian French firefighters (FFs) categorized into three groups according to work schedule and duties: Group A - 12 FFs working 12h day, 12h night, and occasionally 24h shifts and whose primary duties are firefighting plus paramedical and road rescue services; Group B - 9 FFs working mostly 12h day and 12h night shifts and whose duties are answering incoming emergency calls and coordinating service vehicle dispatch from fire stations with Group A personnel; Group C - 9 day shift (09:00-17:00h) FFs charged with administrative tasks. SBP and DBP, both in winter and in summer studies of the same FFs, were sampled by ambulatory BP monitoring every 1h between 06:00-23:00h and every 2h between 23:01-05:59h, respectively, their approximate off-duty wake and sleep spans, for 7 consecutive days. Activity (wrist actigraphy) was also sampled at 1-min intervals. Prominent τ of each variable was derived by a power spectrum program written for unequal-interval time series data, and between-group differences in incidence of τ≠24h of FFs were assessed by chi square test. Circadian rhythm disruption (τ≠24h) of either the SBP or DBP rhythm occurred almost exclusively in night and 24h shift FFs of Group A and B, but almost never in day shift FFs of Group C, and it was not associated with altered τ from 24.0h of the circadian activity rhythm. In summer, occurrence of τ≠24 for FFs of Group A and B differed
from that for FFs of Group C in SBP (p=0.042) and DBP (p=0.015); no such differences were found in winter (p>0.10). Overall, manifestation of prominent \( \tau \neq 24h \) of SBP or DBP time series was greater in summer than winter, 27.6\% versus 16.7\%, when workload of Group B FFs, i.e. number of incoming emergency telephone calls, and of Group A FFs, i.e. number of dispatches for provision of emergency services, was, respectively, two and fourfold greater and number of 12h night shifts worked by Group B FFs and number of 24h shifts worked by Group A FFs was, respectively, 92\% and 25\% greater. FFs of the three groups exhibited no winter-summer difference in \( \tau \neq 24h \) of SBP or SDP; however, \( \tau \neq 24h \) of DBP in Group B FFs was more frequent in summer than winter (p=0.046). Sleep/wake cycle disruption, sleep deprivation, emotional and physical stress, artificial light-at-night, and altered nutrient timings are hypothesized causes of \( \tau \neq 24h \) for BP rhythms of affected Groups A and B FFs, but with unknown future health effects.

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Do sleep deprivation and time of day interact with mild obstructive sleep apnea to worsen performance and neurobehavioral function?

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STUDY OBJECTIVES: Sleep deprivation, time of day (circadian influences), and obstructive sleep apnea (OSA) all reduce performance and neurobehavioral
function. We assessed the interactive effect of sleep deprivation and time of day on performance and neurobehavioral function in subjects with and without mild OSA.

METHODS: This was a cross-over study in which 13 subjects with mild OSA and 16 subjects without OSA had performance and neurobehavioral testing after a normal night's sleep and after a night of supervised sleep deprivation. All subjects were studied in the sleep laboratory of a university teaching hospital. Subjects were administered questionnaires to collect demographic, physical, and medical information; completed actigraphy and sleep diaries to estimate prior sleep debt before testing periods; and were tested on the Neurobehavioral Assessment Battery, a personal computer–based driving simulator (AusEd), and the Oxford Sleep Resistance Test to assess performance and neurobehavioral function.

RESULTS: Sleep deprivation resulted in poorer driving simulator and neurobehavioral performance for most outcome measures. The worst daytime performance was often seen at 3:00 PM. Subjects with mild OSA were less aware of their sleepiness due to sleep deprivation and, in 1 reaction time task, showed greater impairment than did subjects without OSA at certain times of the day after sleep deprivation.

CONCLUSIONS: The results suggest that subjects with mild OSA are not primarily different than subjects without OSA in their response to sleep deprivation or time-of-day influences. Consistent with previous literature, there were clear effects of sleep deprivation and time of day in all subjects. The finding that perception of daytime sleepiness after sleep deprivation was blunted in subjects with OSA compared with subjects without OSA, despite similar performance decrements, warrants further study.

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Background: Preschool children can spend up to 12 h a day in sedentary time and few meet current recommendations for screen time. Little is known about ecological correlates that could be targeted to decrease specific versus total sedentary behaviour. This study examined whether the correlates of screen time and sedentary time differ in preschool boys and girls.

Methods: Parents participating in the HAPPY Study in 2008/09 in Melbourne, Australia reported their child's usual screen time and potential individual, social and physical environment correlates. Children wore ActiGraph GT1M accelerometers for eight days to objectively assess sedentary time (<100 counts.min⁻¹). Multivariable linear regression analyses were performed, stratified by sex and controlling for child age, preschool/childcare attendance and clustering by centre of recruitment. Correlates significantly associated with screen time or sedentary time in individual models (p < 0.05) were included in
RESULTS: Children were sedentary for 301.1 (SD 34.1) minutes/day and spent 108.5 (SD 69.6) minutes/day in screen time. There were no sex differences in screen or sedentary time. In the final models, sleep duration was inversely associated with girls' sedentary time and boys' screen time. The only other consistent correlates for boys and girls were parental self-efficacy to limit screen time and screen time rules, which were inversely associated with screen time for both sexes. Parents reporting that they get bored watching their child play was inversely associated and maternal television viewing was positively associated with boys' screen time. Paternal age was positively associated with boys' sedentary time. Maternal ethnicity was inversely associated and paternal education, child preferences for sedentary behaviour, and parental concerns about child's physical activity and sedentary behaviour were positively associated with girls' screen time.

CONCLUSIONS: The modifiable correlates of total sedentary and screen time identified in this study could be targeted in interventions to reduce these behaviours. With correlates differing for screen and sedentary time, and between boys and girls, interventions may also benefit from including behaviour- and sex-specific strategies.

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Does activity matter: an exploratory study among mothers with preterm infants?

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The purpose of this study was to describe the daytime activity levels and their association with sleep, fatigue, depressive symptoms, and quality of life. Wrist actigraphy and questionnaires were used to examine 51 mothers with a preterm infant during their second week postpartum. Circadian activity rhythms (CAR) were less synchronized in these mothers; they experienced sleep disturbances, fatigue, depressive symptoms, and poor health-related quality of life (H-QOL). Compared to high-activity mothers, mothers with low activity levels slept less during nighttime but napped more during daytime, and reported more postpartum depressive symptoms. Further research is needed to examine the effect of low activity level and sleep loss on postpartum depression, and to develop interventions for improving rest/activity patterns for new mothers.

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Does socioeconomic status impact physical activity and sleep among children with cancer?

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BACKGROUND: Compared with healthy children, pediatric oncology patients have impaired sleep and engage in less physical activity (PA). Socioeconomic status (SES) may be one determinant of PA and sleep among pediatric oncology patients.

PROCEDURE: Between November 12, 2009 and March 27, 2013, 50 pediatric oncology patients between the ages of 8 and 18 years were recruited from an urban children's hospital. PA and sleep were assessed by actigraphy and diaries over 7 days. Fatigue was assessed using the Fatigue Scale. SES was defined by primary payer status of insurance (state or private) and by Median Household Income (MHI) obtained from 2010 U.S. Census block data for residences. MHI was compared to Connecticut state median income ($67,000). Multivariate regression models examined the relationship between SES and PA, sleep and fatigue.

RESULTS: PA and sleep efficiency were strongly correlated ($r = 0.31, P = 0.03$). Children with state insurance had higher average PA ($P = 0.004$) than children on private insurance. There were no significant differences in PA or sleep efficiency by block MHI. The 7-day fatigue score was lower among the participants aged 8–12 years in the group with MHI less than $67,000$ ($P = 0.03$), although there was no significant difference among participants aged 13–18 years in the group. There was no difference in mean fatigue scores by insurance status.

CONCLUSIONS: Participants on state insurance had higher PA than those with private insurance. Although block MHI did not influence PA or sleep efficiency among children with cancer, participants aged 8–12 years in a lower MHI block had less fatigue. Future research is needed to further understand how SES influences PA.

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Does the circadian clock drift when pilots fly multiple transpacific flights with 1- to 2-day layovers?

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On trips with multiple transmeridian flights, pilots experience successive non-24 h day/night cycles with circadian and sleep disruption. One study across a 9-day sequence of transpacific flights (no in-flight sleep, 1-day layovers between flights) reported an average period in the core body temperature rhythm of 24.6 h (circadian drift). Consequently, pilots were sometimes flying through the circadian performance nadir and had to readapt to home base time at the end of the trip. The present study examined circadian drift in trip patterns with longer flights and in-flight sleep. Thirty-nine B747-400 pilots (19 captains, 20 first officers, mean age = 55.5 years) were monitored on 9- to 13-day trips with multiple return flights between East Coast USA and Japan (in 4-pilot crews) and between Japan and Hawaii (in 3-pilot crews), with 1-day layovers between each flight. Measures included total in-flight sleep (actigraphy, log books) and top of descent (TOD) measures of sleepiness (Karolinska Sleepiness Scale), fatigue (Samn-Perelli Crew Status Check) and psychomotor vigilance task (PVT) performance. Circadian rhythms of individual pilots were not monitored. To detect
circadian drift, mixed-model analysis of variance examined whether for a given flight, total in-flight sleep and TOD measures varied according to when the flight occurred in the trip sequence. In addition, sleep propensity curves for pre-trip and post-trip days were examined (Chi-square periodogram analyses). Limited data suggest that total in-flight sleep of relief crew at landing may have decreased across successive East Coast USA-Japan (flights 1, 3, 5 or 7; median arrival 03:45 Eastern Daylight Time (EDT)). However, PVT response speed at TOD was faster on East Coast USA-Japan flights later in the trip. On these flights, circadian drift would result in flights later in the trip landing closer to the evening wake maintenance zone, when sleep is difficult and PVT response speeds are fastest. On Japan-East Coast USA flights (flights 2, 4, 6 or 8; median arrival time 14:52 EDT), PVT response speeds were slower on flight 8 than on flight 2. Circadian drift would move these arrivals progressively earlier in the SCN pacemaker cycle, where PVT response speeds are slower. Across the five post-trip days, 12 pilots (Group A) immediately resumed their pre-trip sleep pattern of a single nocturnal sleep episode; 9 pilots (Group B) had a daytime nap on most days that moved progressively earlier until it merged with nocturnal sleep and 17 pilots (Group C) had nocturnal sleep and intermittent naps. Chi-square periodogram analyses of the sleep propensity curves for each group across baseline and post-trip days suggest full adaptation to EDT from post-trip day 1 (dominant period = 24 h). However, in Groups B and C, the patterns of split sleep post-trip compared to pre-trip suggest that this may be misleading. We conclude that the trends in total in-flight sleep and significant changes in PVT performance speed at TOD provide preliminary evidence for circadian drift, as do persistent patterns of split sleep post-trip. However, new measures to track
circadian rhythms in individual pilots are needed to confirm these findings.

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Dose finding of melatonin for chronic idiopathic childhood sleep onset insomnia: an RCT.

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RATIONALE: Pharmacokinetics of melatonin in children might differ from that in adults.
OBJECTIVES: This study aims to establish a dose-response relationship for melatonin in advancing dim light melatonin onset (DLMO), sleep onset (SO), and reducing sleep onset latency (SOL) in children between 6 and 12 years with chronic sleep onset insomnia (CSOI).
METHODS: The method used for this study is the randomized, placebo-controlled double-blind trial. Children with CSOI (n = 72) received either melatonin 0.05, 0.1, and 0.15 mg/kg or placebo during 1 week. Sleep was assessed with log and actigraphy during this week and the week before. Outcomes were the shifts in DLMO, SO, and SOL.
RESULTS: Treatment with melatonin significantly advanced SO and DLMO by approximately 1 h and decreased SOL by 35 min. Within the three melatonin groups, effect size was not different, but the circadian time of administration (TOA) correlated significantly with treatment effect on DLMO (r (s) = -0.33, p = 0.022)
and SO \((r(s) = -0.38, p = 0.004)\), whereas clock TOA was correlated with SO shift \((r = -0.35, p = 0.006)\) and not with DLMO shift.

**CONCLUSIONS:** No dose-response relationship of melatonin with SO, SOL, and DLMO is found within a dosage range of 0.05–0.15 mg/kg. The effect of exogenous melatonin on SO, SOL, and DLMO increases with an earlier circadian TOA. The soporific effects of melatonin enhance the SO shift. This study demonstrates that melatonin for treatment of CSOI in children is effective in a dosage of 0.05 mg/kg given at least 1 to 2 h before DLMO and before desired bedtime.

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A double-blind, randomized, placebo-controlled trial of adjunctive blue-blocking glasses for the treatment of sleep and circadian rhythm in patients with bipolar disorder.


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OBJECTIVES: Recent studies have suggested that evening blue light exposure is associated with sleep and circadian rhythm abnormalities. This study examined the effect of blue-blocking (BB) glasses on sleep and circadian rhythm in patients with bipolar disorder (BD).

METHODS: We used a randomized, placebo-controlled, double-blinded design.
Outpatients with BD and also with insomnia were randomly assigned to wear either orange glasses (BB) or clear ones (placebo) and were instructed to use these from 20:00 hours until bedtime for 2 weeks. The primary outcome metric was the difference in change from baseline to after intervention in sleep quality, as measured by the visual analog scale (VAS).

RESULTS: Forty-three patients were included in this study (BB group, 21; placebo group, 22). The change in sleep quality as per the VAS metric was not significantly different between the two groups (95% confidence interval [CI], -3.34 to 24.72; P = .13). However, the Morningness–Eveningness Questionnaire score had shifted to an advanced rhythm in the BB group and to a delayed rhythm in the placebo group, and the difference in these changes was statistically significant (95% CI, 1.69–7.45; P = .003). The change in the actigraphy sleep parameters and mood symptoms was not significantly different between the two groups.

CONCLUSION: Although concurrent medications may have influenced, our results suggest that BB glasses may be useful as an adjunctive treatment for circadian rhythm issues in patients with BD.

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Double blind study of melatonin effects on the sleep-wake rhythm, cognitive and non-cognitive functions in Alzheimer type dementia.

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Previously, we reported that morning bright light therapy improved
sleep time and cognitive function in Alzheimer type of dementia. We conducted a double blind study to examine the effects of melatonin on the sleep-wake rhythm, cognitive and non-cognitive functions in Alzheimer type of dementia. The subjects were 9 persons given a placebo (PLA), and 11 given melatonin (3 mg) (MLT). The mean age was 79.2 +/- 6.4 (17 females and 3 males). The drugs were given at 20:30 each day for 4 weeks. We checked sleep time and activity by Actigraph through one week before and the 4th week after drug administration. Cognitive and non-cognitive functions were evaluated with the clinical dementia rating scale (CDR), and Mini Mental State Examination (MMSE), and the Alzheimer's Disease Assessment Scale (ADAS). We successfully recorded Actigraph data from 18 patients (PLA8, MLT10). The mean sleep time change ratio and SD of the administration of PLA in the night was -0.2 +/- 13.7%, and MLT was 33.2 +/- 37.6%. The mean activity counts and SD of the administration of PLA in the night was 29.8 +/- 77.0%; in MLT it was -44.9 +/- 21.9%. Melatonin significantly prolonged the sleep time (p=0.017) and decreased activity (p=0.014) in the night (21:00-6:00) in the MLT group, although no significant difference in sleep time or activity in the daytime (6:00-21:00) was recognized between the two groups. In comparison with ADAS cognition score changes, the mean change and SD in the PLA was 0.3 +/- 3.7; in MLT it was -4.3 +/- 3.6 points. In comparison with ADAS non-cognition score, the mean change and SD in the PLA group was -0.8 +/- 1.0, in the MLT group it was -4.1 +/- 2.2 points. There were also significant differences between the PLA and the MLT groups in the comparison with the score improvement of ADAS cognition (p=0.017) and non-cognition (p=0.002), otherwise there was no significant difference in improvement of MMSE between both groups. Melatonin administration had effect to improve sleep time and night activity, but no significant effect to improve daytime naps and
Although melatonin administration might have less strong effect on circadian rhythm than morning bright light therapy we previously reported, cognitive and non-cognitive functions were improved. Melatonin seemed to be useful for care of the Alzheimer type of dementia patients.

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During day and night: Childhood psychotic experiences and objective and subjective sleep problems.

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BACKGROUND: Psychotic experiences comprise auditory and visual perceptive phenomena, such as hearing or seeing things that are not there, in the absence of a psychotic disorder. Psychotic experiences commonly occur in the general pediatric population. Although the majority of psychotic experiences are transient, they are predictive of future psychotic and non-psychotic disorders. They have been associated with sleep problems, but studies with objective sleep measures are lacking. This study assessed whether psychotic experiences were associated with actigraphic sleep measures, symptoms of dyssomnia, nightmares, or other parasomnias.

METHODS: This cross-sectional population-based study comprises 4149 children from the Generation R Study. At age 10 years, psychotic experiences including hallucinatory phenomena were assessed by self-report; dyssomnia and parasomnia symptoms were assessed by mother- and child-report. Additionally, at age 11 years, objective sleep parameters were measured using a tri-axial wrist accelerometer in N = 814 children, who wore the accelerometer for five consecutive school days.

RESULTS: Psychotic experiences were not associated with objective sleep duration, sleep efficiency, arousal, or social jetlag. However, psychotic experiences were associated with self-reported dyssomnia (B = 2.45, 95%CI: 2.13-2.77, p < 0.001) and mother-reported parasomnia, specifically nightmares (ORadjusted = 3.59, 95%CI 2.66-4.83, p < 0.001). Similar results were found when analyses were restricted to hallucinatory phenomena.
CONCLUSIONS: Childhood psychotic experiences were not associated with objective sleep measures. In contrast, psychotic experiences were associated with nightmares, which are a known risk indicator of psychopathology in pre-adolescence. More research is needed to shed light on the potential etiologic or diagnostic role of nightmares in the development of psychotic phenomena.

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[DYNAMIC CIRCADIAN SYSTEM PATIENTS UNDER CHIMIOThERAPY]

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Currently, the circadian timing system of cancer patients can be estimated with wrist actimetry, which provides numerical data on the continuous activity of patients. The method of processing of these data, which we implemented, aims at answering the following questions: is the circadian timing system stable before chemotherapy, is this system extensively modified by chemotherapy, are there structural modifications or a decrease in activity amplitude produced by chemotherapy and how does the circadian activity rhythm recover? Here, we determine a circadian model function using a wavelet transform prior to chemotherapy delivery. Then we measure the correlation between this model function and the evolution of the circadian rhythm of activity over the whole observation span during and after chemotherapy. The application of
this method to
the record of activity rhythms in cancer patients highlights the characteristics
and the recovery pattern of chemotherapy-induced alterations of the circadian
timing system.

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Dysregulated sleep–wake cycles in young people are associated with emerging
stages of major mental disorders.

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AIM: To determine if disturbed sleep–wake cycle patterns in young people with
emerging mental disorder are associated with stages of illness.

METHODS: The sleep–wake cycle was monitored using actigraphy across 4
to 22 days.
Participants (21 healthy controls and 154 persons seeking help for mental health
problems) were aged between 12 and 30 years. Those persons seeking mental health
care were categorized as having mild symptoms (stage 1a), an 'attenuated
syndrome' (stage 1b) or an 'established mental disorder' (stage 2+).

RESULTS: The proportions of individuals with a delayed weekdays sleep schedule
increased progressively across illness stages: 9.5% of controls, 11.1%
of stage 1a, 25.6% of stage 1b, and 50.0% of stage 2+ ($\chi^2$ (3 d.f.) = 18.4, P
A similar pattern was found for weekends ($\chi^2$ (3 d.f.) = 7.6, $P = 0.048$). Compared with controls, stage 1b participants had later sleep onset on weekends ($P = 0.015$), and participants at stages 1b and 2+ had later sleep offset on both weekdays and weekends ($P < 0.020$). Compared with controls, all participants with mental disorders had more wake after sleep onset ($P < 0.029$) and those at stages 1a and 2+ had lower sleep efficiency ($P < 0.040$). Older age, medicated status and later weekdays sleep offset were found to be the three strongest correlates of later versus earlier clinical stages.

CONCLUSIONS: In relation to clinical staging of common mental disorders in young people, the extent of delayed sleep phase is associated with more severe or persistent phases of illness.

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Dysregulation of objectively assessed 24-hour motor activity patterns as a potential marker for bipolar I disorder: results of a community-based family study.


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There has been a growing number of studies that have employed actigraphy to investigate differences in motor activity in mood disorders. In general, these studies have shown that people with bipolar disorders (BPDs) tend to exhibit greater variability and less daytime motor activity than controls. The goal of this study was to examine whether patterns of motor activity differ in euthymic individuals across the full range of mood disorder subtypes (Bipolar I (BPI), Bipolar II (BPII) and major depression (MDD)) compared with unaffected controls in a community-based family study of mood spectrum disorders. Minute-to-minute activity counts derived from actigraphy were collected over a 2-week period for each participant. Prospective assessments of the level, timing and day-to-day variability of physical activity measures were compared across diagnostic groups after controlling for a comprehensive list of potential confounding factors. After adjusting for the effects of age, sex, body mass index (BMI) and medication use, the BPI group had lower median activity intensity levels across the second half of the day and greater variability in the afternoon compared with controls. Those with a history of BPII had increased variability during the night time compared with controls, indicating poorer sleep quality. No differences were found in the average intensity, variability or timing of activity in comparisons between other mood disorder subgroups and controls. Findings confirm evidence
from previous studies that BPI may be a manifestation of a rhythm disturbance that is most prominent during the second half of the day. The present study is the largest study to date that included the full range of mood disorder subgroups in a nonclinical sample that increases the generalizability of our findings to the general community. The manifestations of activity patterns outside of acute episodes add to the accumulating evidence that dysregulation of patterns of activity may constitute a potential biomarker for BPD.

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Early declines in physical function among aging adults with type 2 diabetes.

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AIMS: Type 2 diabetes (T2DM) is associated with reduced physical function and early disability. We hypothesized that changes in physical function occur early and differ by age. Our aims were to determine and compare differences in and predictors of physical function in older and younger adults with T2DM.

METHODS: Eighty adults completed six-minute walk distance (6MWD) tests, wore
wrist actigraphy for 5 days and completed diabetes health and symptom surveys.
Comparative and bivariate analyses were completed to assess differences between age groups determined by serial Box's M-plot analyses.
RESULTS: 6MWD was low (476.9±106.2 m), and negatively associated with female gender, age, neuropathic pain, diabetes duration, BMI, poor sleep quality, and fatigue and positively with habitual activity and education (p<0.05). Covariance matrices changed at age 59. In subjects age <58, 6MWD was predicted by gender, sleep quality, and neuropathic pain (R²=0.593, p<0.001). In those age ≥59, 6MWD was predicted by diabetes duration, education, and habitual activity (R²=0.554, p<0.001). There were no shared predictors of 6MWD between groups.
CONCLUSIONS: T2DM is associated with early declines in physical function; the predictors of which change in midlife. Therapies to maintain or improve physical function should be tailored by age, pain symptoms, and habitual activity levels.

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Early Life Socioeconomic Disparities in Children's Sleep: The Mediating Role of the Current Home Environment.

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Despite identified concurrent socioeconomic disparities in children's sleep, little research has examined pathways explaining such associations. This study examined the quality of the home environment as a direct predictor of sleep and potential mediator of associations between early life socioeconomic status and objective and subjective indicators of sleep in middle childhood. A socioeconomically and ethnically diverse sample of 381 twin children (50% female; 46.6% lower middle class or living at or below the poverty line; 26% Hispanic/Latino) were assessed at 12 months for SES and eight years using gold-standard home environment interviews and actigraphy-measured sleep. Multilevel mediation path models indicated that lower early SES and lower quality concurrent home environments were associated with shorter sleep durations, longer sleep latencies, and greater sleep timing variability. The home environment significantly mediated associations with sleep duration and sleep timing variability. The findings illustrate an important target in the prevention of poor childhood and adolescent sleep.

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Economic adversity and children's sleep problems: multiple indicators and moderation of effects.

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OBJECTIVE: Toward explicating relations between economic adversity and children's
sleep, we examined associations between multiple indicators of socioeconomic
status (SES)/adversity and children's objectively and subjectively derived sleep
parameters; ethnicity was examined as potential moderator.
METHODS: Participants were 276 third- and fourth-grade children and
their families (133 girls; M age = 9.44 years; SD = .71): 66% European
American (EA) and 34% African American (AA). Four SES indicators were used: income-
to-needs ratio, perceived economic well-being, maternal education, and
community poverty. Children wore actigraphs for 7 nights and completed a self-report
measure to assess sleep problems.
RESULTS: Objectively and subjectively assessed sleep parameters were
related to different SES indicators, and overall worse sleep was evident for
children from lower SES homes. Specifically, children from homes with lower income-
to-needs ratios had higher levels of reported sleep/wake problems. Parental perceived
economic well-being was associated with shorter sleep minutes and greater
variability in sleep onset for children. Lower mother's education was associated
with lower sleep efficiency. Children who attended Title 1 schools had shorter
sleep minutes. Ethnicity was a significant moderator of effects in the link
between some SES indicators and children's sleep. AA children's sleep was more
negatively affected by income-to-needs ratio and mother's education than was the
sleep of EA children.
CONCLUSIONS: The results advocate for the importance of specifying
particular SES and sleep variables used because they may affect the ability to detect
associations between sleep and economic adversity.
The Effect of a Common Daily Schedule on Human Circadian Rhythms During the Polar Day in Svalbard: A Field Study.


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All Arctic visitors have to deal with extreme conditions, including a constant high light intensity during the summer season or constant darkness during winter. The light/dark cycle serves as the most potent synchronizing signal for the biological clock, and any Arctic visitor attending those regions during winter or summer would struggle with the absence of those entraining signals. However, the inner clock can be synchronized by other zeitgebers such as physical activity, food intake, or social interactions. Here, we investigated the effect of the polar day on the circadian clock of 10 researchers attending the polar base station in the Svalbard region during the summer season. The data collected in Svalbard was compared with data obtained just before leaving for the expedition (in the Czech Republic 49.8175°N, 15.4730°E). To determine the circadian functions, we monitored activity/rest rhythm with wrist actigraphy followed by sleep diaries, melatonin rhythm in saliva, and clock gene expression (Per1, Bmal1, and Nr1D1) in buccal mucosa samples. Our data shows that the two-week stay in Svalbard delayed melatonin onset but did not affect its rhythmic secretion, and delayed the activity/rest rhythm. Furthermore, the clock gene expression displayed a higher amplitude in Svalbard compared to the amplitude detected in
the Czech Republic. We hypothesize that the common daily schedule at the Svalbard expedition strengthens circadian rhythmicity even in conditions of compromised light/dark cycles. To our knowledge, this is the first study to demonstrate peripheral clock gene expression during a polar expedition.

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Conflict of interest statement: The authors have no competing interests to declare.


Effect of a protected sleep period on hours slept during extended overnight in-hospital duty hours among medical interns: a randomized trial.


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CONTEXT: A 2009 Institute of Medicine report recommended protected sleep periods for medicine trainees on extended overnight shifts, a position reinforced by new Accreditation Council for Graduate Medical Education requirements. OBJECTIVE: To evaluate the feasibility and consequences of protected sleep periods during extended duty. DESIGN, SETTING, AND PARTICIPANTS: Randomized controlled trial conducted at the Philadelphia VA Medical Center medical service and Oncology Unit of the Hospital of the University of Pennsylvania (2009–2010). Of the 106 interns and senior
medical students who consented, 3 were not scheduled on any study rotations.
Among the others, 44 worked at the VA center, 16 at the university hospital, and
43 at both.
INTERVENTION: Twelve 4-week blocks were randomly assigned to either a standard
intern schedule (extended duty overnight shifts of up to 30 hours; equivalent to
1200 overnight intern shifts at each site), or a protected sleep period
(protected time from 12:30 AM to 5:30 AM with handover of work cell phone;
equivalent to 1200 overnight intern shifts at each site). Participants were asked
to wear wrist actigraphs and complete sleep diaries.
MAIN OUTCOME MEASURES: Primary outcome was hours slept during the protected
period on extended duty overnight shifts. Secondary outcome measures included
hours slept during a 24-hour period (noon to noon) by day of call cycle and
Karolinska sleepiness scale.
RESULTS: For 98.3% of on-call nights, cell phones were signed out as designed. At
the VA center, participants with protected sleep had a mean 2.86 hours
(95% CI, 2.57-3.10 hours) of sleep vs 1.98 hours (95% CI, 1.68-2.28 hours)
among those who
did not have protected hours of sleep (P < .001). At the university hospital,
participants with protected sleep had a mean 3.04 hours (95% CI, 2.77-3.45 hours)
of sleep vs 2.04 hours (95% CI, 1.79-2.24) among those who did not
have protected
sleep (P < .001). Participants with protected sleep were significantly
less
likely to have call nights with no sleep: 5.8% (95% CI, 3.0%-8.5%) vs
18.6% (95%
CI, 13.9%-23.2%) at the VA center (P < .001) and 5.9% (95% CI, 3.1%-8.7%) vs
14.2% (95% CI, 9.9%-18.4%) at the university hospital (P = .001).
Participants
felt less sleepy after on-call nights in the intervention group, with Karolinska
sleepiness scale scores of 6.65 (95% CI, 6.35-6.97) vs 7.10 (95% CI, 6.85-7.33; P
= .01) at the VA center and 5.91 (95% CI, 5.64-6.16) vs 6.79 (95% CI, 6.57-7.04;
P < .001) at the university hospital.
CONCLUSIONS: For internal medicine services at 2 hospitals, implementation of a protected sleep period while on call resulted in an increase in overnight sleep duration and improved alertness the next morning.

TRIAL REGISTRATION: clinicaltrials.gov Identifier: NCT00874510.

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Effect of behavioural-educational intervention on sleep for primiparous women and their infants in early postpartum: multisite randomised controlled trial.


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OBJECTIVE: To evaluate the effectiveness of a behavioural-educational sleep intervention delivered in the early postpartum in improving maternal and infant sleep.

DESIGN: Randomised controlled trial.

SETTING: Postpartum units of two university affiliated hospitals.

PARTICIPANTS: 246 primiparous women and their infants randomised while in hospital with an internet based randomisation service to intervention (n=123) or usual care (n=123) groups.

INTERVENTIONS: The behavioural-educational sleep intervention included a 45–60 minute meeting with a nurse to discuss sleep information and strategies to promote maternal and infant sleep, a 20 page booklet with the content discussed, and phone contacts at one, two, and four weeks postpartum to reinforce information, provide support, and problem solve. The usual care group
received calls at weeks one, two, and four to maintain contact without provision of advice.

MAIN OUTCOME MEASURES: Primary outcome was maternal nocturnal (9 pm to 9 am) sleep (minutes) and secondary outcome was longest stretch of infant nocturnal sleep (minutes) measured at six and 12 weeks postpartum by actigraphy. Other outcomes measured at six and 12 weeks were number of maternal and infant night time awakenings by actigraphy, fatigue visual analogue scale, general sleep disturbance scale, and Edinburgh postnatal depression scale. Rates of exclusive breast feeding were measured at 12 weeks postpartum only.

RESULTS: All women who completed any outcome measures at six or 12 weeks were included in analysis. Sleep outcomes were completed at one or both of six and 12 weeks postpartum for 215 of 246 (87%) women (110/123 intervention and 105/123 usual care). Longitudinal mixed effects model analyses indicated no significant differences between the groups on any of the outcomes. The estimated mean difference in maternal nocturnal sleep between the intervention and usual care groups was 5.97 minutes (95% confidence interval −7.55 to 19.5 minutes, P=0.39). No differences in any outcomes were noted based on the specific nurse delivering the intervention or the number of phone contacts received.

CONCLUSION: A behavioural-educational intervention delivered in the early postpartum, in hospital, and in the first weeks at home, was ineffective in improving maternal and infant sleep or other health outcomes in the first months postpartum.

TRIAL REGISTRATION: ISRCT No 13501166.

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The effect of blue-blocking and neutral intraocular lenses on circadian photoentrainment and sleep one year after cataract surgery.


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PURPOSE: To compare the long-term effect on circadian photoentrainment and sleep in patients implanted with neutral and blue-blocking intraocular lenses 1 year after cataract surgery.

METHODS: Randomized, controlled trial involving 67 patients with age-related cataract. Intervention was cataract surgery with implantation of either a neutral or a blue-blocking intraocular lens (IOL). Main outcome was activation of the intrinsically photosensitive retinal ganglion cells (ipRGC) measured by chromatic pupillometry. The circadian rhythm was analysed by 24-hr melatonin profiles and actigraphy; the latter was also used to determine objective sleep quality. The Pittsburgh Sleep Quality Index determined subjective sleep quality.

RESULTS: One year after surgery, peak melatonin concentration was 3.3 pg/ml (95% CI, 2-5.5) corresponding to 50% lower for the participants allocated to blue-blocking IOLs compared with participants allocated to neutral IOLs. Compared with preoperative levels, the ipRGC response had increased by 13.7% (95% confidence interval [CI], 3.2-22.6) 1 year after surgery. Objective sleep quality was also improved as the time of wakefulness after sleep onset had
improved by 5 min (95% CI, 1-10) for the entire population while sleep efficiency had increased by two percentage points (95% CI, 0.42-3.65) although exclusively, for the participants allocated to blue-blocking IOLs.

CONCLUSION: Blue-blocking IOLs increased sleep efficiency but lowered nocturnal melatonin secretion compared with neutral IOLs. Cataract surgery improved the response of ipRGCs and sleep quality. However, the effect of cataract surgery on sleep quality may be unrelated to circadian photoentrainment.

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Effect of bright light therapy on delayed sleep/wake cycle and reaction time of athletes participating in the Rio 2016 Olympic Games.

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This study investigated the effect of using an artificial bright light on the entrainment of the sleep/wake cycle as well as the reaction times of athletes before the Rio 2016 Olympic Games. A total of 22 athletes from the Brazilian
Olympic Swimming Team were evaluated, with the aim of preparing them to compete at a time when they would normally be about to go to bed for the night. During the 8-day acclimatization period, their sleep/wake cycles were assessed by actigraphy, with all the athletes being treated with artificial light therapy for between 30 and 45 min (starting at day 3). In addition, other recommendations to improve sleep hygiene were made to the athletes. In order to assess reaction times, the Psychomotor Vigilance Test was performed before (day 1) and after (day 8) the bright light therapy. As a result of the intervention, the athletes slept later on the third (p = 0.01), seventh (p = 0.01) and eighth (p = 0.01) days after starting bright light therapy. Regarding reaction times, when tested in the morning the athletes showed improved average (p = 0.01) and minimum reaction time (p = 0.03) when comparing day 8 to day 1. When tested in the evening, they showed improved average (p = 0.04), minimum (p = 0.03) and maximum reaction time (p = 0.02) when comparing day 8 to day 1. Light therapy treatment delayed the sleep/wake cycles and improved reaction times of members of the swimming team. The use of bright light therapy was shown to be effective in modulating the sleep/wake cycles of athletes who had to perform in competitions that took place late at night.

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The effect of bright light therapy on sleep and circadian rhythms in renal transplant recipients: a pilot randomized, multicentre wait-list controlled trial.

Burkhalter H(1), Wirz-Justice A, Denhaerynck K, Fehr T, Steiger J,
This study assessed the effect and feasibility of morning bright light therapy (BLT) on sleep, circadian rhythms, subjective feelings, depressive symptomatology and cognition in renal transplant recipients (RTx) diagnosed with sleep-wake disturbances (SWD). This pilot randomized multicentre wait-list controlled trial included 30 home-dwelling RTx randomly assigned 1:1 to either 3 weeks of BLT or a wait-list control group. Morning BLT (10 000 lux) was individually scheduled for 30 min daily for 3 weeks. Wrist actimetry (measuring sleep and circadian rhythms), validated instruments (subjective feelings and cognition) and melatonin assay (circadian timing) were used. Data were analysed via a random-intercept regression model. Of 30 RTx recipients (aged 58 ± 15, transplanted 15 ± 6 years ago), 26 completed the study. While BLT had no significant effect on circadian and sleep measures, sleep timing improved significantly. The intervention group showed a significant get-up time phase advance from baseline to intervention (+24 min) [(standardized estimates (SE): −0.23 (−0.42; −0.03)] and a small (+14 min) but significant bedtime phase advance from intervention to follow-up (SE: −0.25 (−0.41; −0.09). Improvement in subjective feelings and depressive symptomatology was observed but was not statistically significant. Bright light therapy showed preliminary indications of a beneficial effect in RTx with sleep-wake disturbances. (ClinicalTrials.gov number: NCT01256983).
The Effect of Cataract Surgery on Circadian Photoentrainment: A Randomized Trial of Blue-Blocking versus Neutral Intraocular Lenses.


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PURPOSE: Cataract decreases blue light transmission. Because of the selective blue light sensitivity of the retinal ganglion cells governing circadian photoentrainment, cataract may interfere with normal sleep-wake regulation and cause sleep disturbances. The purpose was to investigate the effect of cataract surgery on circadian photoentrainment and to determine any difference between blue-blocking and neutral intraocular lenses (IOLs).

DESIGN: The study was a single-center, investigator-driven, double-masked, block-randomized clinical trial.

PARTICIPANTS: One eye in 76 patients with bilateral age-related
cataract eligible for cataract surgery was included.

METHODS: Intervention was cataract surgery by phacoemulsification. Patients were randomized to receive a blue-blocking or neutral IOL.

MAIN OUTCOME MEASURES: Primary outcome was activation of intrinsic photosensitive ganglion cells using post-illumination pupil response (PIPR) to blue light from 10 to 30 seconds after light exposure as a surrogate measure. Secondary outcomes were circadian rhythm analysis using actigraphy and 24-hour salivary melatonin measurements. Finally, objective and subjective sleep quality were determined by actigraphy and the Pittsburgh Sleep Quality Index.

RESULTS: The blue light PIPR increased 2 days (17%) and 3 weeks (24%) after surgery (P < 0.001). The majority of circadian and sleep-specific actigraphy parameters did not change after surgery. A forward shift of the circadian rhythm by 22 minutes (P = 0.004) for actigraphy and a tendency toward an earlier melatonin onset (P = 0.095) were found. Peak salivary melatonin concentration increased after surgery (P = 0.037). No difference was detected between blue-blocking and neutral IOLs, whereas low preoperative blue light transmission was inversely associated with an increase in PIPR (P = 0.021) and sleep efficiency (P = 0.048).

CONCLUSIONS: Cataract surgery increases photoreception by the photosensitive retinal ganglion cells. Because of inconsistency between the significant findings and the many parameters that were unchanged, we can conclude that cataract surgery does not adversely affect the circadian rhythm or sleep. Longer follow-up time and fellow eye surgery may reveal the significance of the subtle changes observed. We found no difference between blue-blocking and neutral IOLs, and, because of the minor effect of surgery in itself, an effect of IOL type seems highly unlikely.

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The effect of consecutive transmeridian flights on alertness, sleep-wake cycles and sleepiness: A case study.


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Travel across time zones disrupts circadian rhythms causing increased daytime sleepiness, impaired alertness and sleep disturbance. However, the effect of repeated consecutive transmeridian travel on sleep–wake cycles and circadian dynamics is unknown. The aim of this study was to investigate changes in alertness, sleep–wake schedule and sleepiness and predict circadian and sleep dynamics of an individual undergoing demanding transmeridian travel. A 47-year-old healthy male flew 16 international flights over 12 consecutive days. He maintained a sleep–wake schedule based on Sydney, Australia time
The participant completed a sleep diary and wore an Actiwatch before, during and after the flights. Subjective alertness, fatigue and sleepiness were rated 4 hourly (08:00–00:00), if awake during the flights. A validated physiologically based mathematical model of arousal dynamics was used to further explore the dynamics and compare sleep time predictions with observational data and to estimate circadian phase changes. The participant completed 191 h and 159 736 km of flying and traversed a total of 144 time-zones. Total sleep time during the flights decreased (357.5 min actigraphy; 292.4 min diary) compared to baseline (430.8 min actigraphy; 472.1 min diary), predominately due to restricted sleep opportunities. The daily range of alertness, sleepiness and fatigue increased compared to baseline, with heightened fatigue towards the end of the flight schedule. The arousal dynamics model predicted sleep/wake states during and post travel with 88% and 95% agreement with sleep diary data. The circadian phase predicted a delay of only 34 min over the 16 transmeridian flights. Despite repeated changes in transmeridian travel direction and flight duration, the participant was able to maintain a stable sleep schedule aligned with the Sydney night. Modelling revealed only minor circadian misalignment during the flying period. This was likely due to the transitory time spent in the overseas airports that did not allow for resynchronisation to the new time zone. The robustness of the arousal model in the real-world was demonstrated for the first time using unique transmeridian travel.

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The effect of evening bright light in delaying the circadian rhythms
and lengthening the sleep of early morning awakening insomniacs.

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Past studies have predicted that early morning awakening insomnia is associated with advanced or early circadian rhythms. Because bright light stimulation in the evening can delay the phase of circadian rhythms, we tested its effects on nine (4 females, 5 males) early morning awakening insomniacs. Their sleep was evaluated with wrist actigraphy and their temperature and melatonin circadian rhythms were measured in constant routine procedures. In the initial evaluation, the temperature rhythm phase positions of these insomniacs did appear to be earlier than normal. The subjects were then exposed to bright light stimulation (2,500 lux) from 2000 to 2400 hours on two consecutive evenings. Following the evening bright light treatment, temperature rhythm phase markers were delayed 2-4 hours and melatonin phase markers were delayed 1-2 hours. Sleep onset times were not changed but the mean final wake-up time was delayed from 0459 hours to 0611 hours, resulting in a mean increase of total sleep time of > 1 hour. This pilot study suggests that evening bright light stimulation may be an effective nondrug treatment for early morning awakening insomnia.

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Effect of exposure to evening light on sleep initiation in the elderly: a longitudinal analysis for repeated measurements in home settings.
Epidemiologic data have demonstrated associations of sleep-onset insomnia with a variety of diseases, including depression, dementia, diabetes and cardiovascular diseases. Sleep initiation is controlled by the suprachiasmatic nucleus of the hypothalamus and endogenous melatonin, both of which are influenced by environmental light. Exposure to evening light is hypothesized to cause circadian phase delay and melatonin suppression before bedtime, resulting in circadian misalignment and sleep-onset insomnia; however, whether exposure to evening light disturbs sleep initiation in home settings remains unclear. In this longitudinal analysis of 192 elderly individuals (mean age: 69.9 years), we measured evening light exposure and sleep-onset latency for 4 days using a wrist actigraph incorporating a light meter and an accelerometer. Mixed-effect linear regression analysis for repeated measurements was used to evaluate the effect of evening light exposure on subsequent sleep-onset latency. The median intensity of evening light exposure and the median sleep-onset latency were 27.3 lux (interquartile range, 17.9–43.4) and 17 min (interquartile range, 7–33), respectively. Univariate models showed significant associations between sleep-onset latency and age, gender, daytime physical activity, in-bed time, day length and average intensity of evening and nighttime light exposures. In a multivariate model, log-transformed average intensity of evening light exposure was significantly associated with log-transformed sleep-onset latency independent of the former potential confounding factors (regression coefficient, 0.133; 95% CI, 0.020–0.247; p = 0.021). Day length and nighttime light exposure were also significantly associated with log-transformed sleep-onset latency (p =
0.001 and 
p < 0.001, respectively). In conclusion, exposure to evening light in home setting prolongs subsequent sleep-onset latency in the elderly.

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Effect of home-based light treatment on persons with dementia and their caregivers.


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Sleep disorders are problematic for persons with dementia and their family caregivers. This randomized controlled trial with crossover evaluated the effects of an innovative blue–white light therapy on 17 pairs of home-dwelling persons
with dementia and their caregivers. Subjects with dementia received blue–white light and control ('red–yellow' light) for six weeks separated by a four-week washout. Neither actigraphic nor most self-reported sleep measures significantly differed for subjects with dementia. For caregivers, both sleep and role strain improved. No evidence of retinal light toxicity was observed. Six weeks of modest doses of blue–white light appear to improve sleep in caregivers but not in persons with dementia. Greater or prolonged circadian stimulation may be needed to determine if light is an effective treatment for persons with dementia.

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Effect of Home-Call on Otolaryngology Resident Education: A Pilot Study.

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OBJECTIVE: To inform institutional policies regarding call encounters through an evaluation of the effect of home-call on academic experience and fatigue among surgical residents. This study conducted an assessment of the nature of resident call encounters premidnight and postmidnight and a comparative analysis of sleep deprivation and efficiency in residents during home-call and off call.

DESIGN, SETTING, AND PARTICIPANTS: All Otolaryngology–Head and Neck Surgery residents (n = 9) at a single Canadian institution were asked to establish the time and nature of call encounters during home-call. Residents completed the Stanford Sleepiness Scale precall and postcall to measure sleepiness and wore an Actigraph device to measure sleep efficiency to establish fatigue in the setting of home-call as compared with residents off call. Home-call and off call patterns were studied using a random computer-generated selection of days for participants in both study groups. Analysis was conducted from December 1, 2013 to December 30, 2014.

RESULTS: Residents received on average 7 pages per night, of which 78.5% of pages were for nonurgent issues. On average, change in sleep deprivation scores postcall was 3.0 points higher (95% CI: 2.48–3.57, p < 0.0001) in residents who were qualified for a postcall day compared with residents who did not qualify for a postcall day and residents off call according to the Stanford Sleepiness Scale. Postcall sleep deprivation was significantly associated with number of encounters managed after midnight, regardless of management through telephone or in-hospital (p = 0.01). The Actigraph device identified a significant decrease in sleep efficiency in residents who were qualified for a postcall day compared with
residents off call (mean = -31.1; 95% CI: -38.9, -23.4; p < 0.001).

CONCLUSIONS: This is the first study to evaluate surgical residents' home-call experience. We identified a high proportion of nonurgent encounters that residents managed on call and increased postcall fatigue associated with postmidnight telephone encounters. This study highlights the detrimental effects of frequent sleep interruptions because of encounters on call and suggests the need for institutional guidelines to help minimize these interruptions.

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Effect of institutional respite care on the sleep of people with dementia and their primary caregivers.

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OBJECTIVES: To evaluate the sleep-wake patterns of community-dwelling patients with dementia and their primary caregivers before, during, and after 2-week periods of institutional respite care.

DESIGN: Prospective case series.

SETTING: Four community hospital units in East Midlands, United Kingdom.

PARTICIPANTS: Thirty-nine patients meeting Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, criteria for dementia and caregivers completed baseline assessments; 33 of these dyads completed the full protocol.

INTERVENTION: A 2-week period of institutional respite care during which patients
were admitted to community hospitals (and received routine care) while caregivers remained at home.

MEASUREMENTS: For patients and caregivers, primary sleep outcomes were derived from 6 weeks of continuous wrist actigraphy (2 weeks baseline; 2 weeks respite; 2 weeks follow-up) using the Actiwatch system. For caregivers, actigraphic measures were augmented with assessments of quality of life (using the Medical Outcomes Study 36-item Short Form survey) and quality of sleep (using the Pittsburgh Sleep Quality Index) at baseline and by daily sleep diaries and weekly Epworth Sleepiness Scale ratings throughout the study.

RESULTS: At baseline, caregivers and patients showed profiles of clinically significant sleep disturbance. For caregivers, respite periods were associated with significant (P<.05) increases in total sleep time per night, total time in bed per night, and improvements in subjective sleep quality. The benefits of respite were most evident for caregivers who did not share a bedroom with the patient. For patients, respite was associated with significant (P<.05) increases in sleep onset latency, reductions in total sleep time per night, and weakening of the circadian activity rhythm. All measures shifted in the direction of baseline levels at follow-up.

CONCLUSION: Dementia caregivers show a profile of sleep disturbance consistent with adjustment insomnia, with sleep disturbances partially reversed during periods of institutional respite care. Nevertheless, for patients, respite care worsens already disturbed sleep patterns. To optimize benefits for caregivers and patients, respite care should target sleep management.

DOI: 10.1111/j.1532-5415.2007.01036.x
PMID: 17302663 [Indexed for MEDLINE]

The effect of measuring ambulatory blood pressure on nighttime sleep and daytime activity—implications for dipping.

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BACKGROUND AND OBJECTIVES: Ambulatory blood pressure (BP) monitoring is commonly used to assess the circadian pattern of BP. Circadian BP pattern is influenced by physical activity and sleep cycle. The effect of BP monitoring itself on the level of physical activity and sleep remains unknown. If BP monitoring affects these parameters, then monitoring itself may influence the circadian BP pattern.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: To assess the effect of ambulatory BP monitoring on sleep duration, sleep efficiency, and daytime activity, we measured physical activity using wrist actigraphy in 103 veterans with chronic kidney disease. After 6 to 7 days of continuous activity monitoring, participants underwent ambulatory BP monitoring with simultaneous actigraphy. The above experiment was repeated after 1 mo.

RESULTS: Among the top tertile of patients (most sleep), when wearing ambulatory BP patients spent less time in bed at night (-92 min, P < 0.0001), were less asleep during those hours (-98 min, P < 0.0001), and had reduced sleep efficiency (82% versus 77%, -5% P = 0.02). On the day of ambulatory BP monitoring, patients were more sedentary during waking hours (+27 minutes, P = 0.002). During ambulatory BP monitoring, waking after sleep onset more than median was associated with greater odds for nondipping (odds ratio 10.5, P = 0.008).

CONCLUSIONS: Ambulatory BP monitoring is associated with disturbed sleep and
reduced physical activity, characteristics that influence dipping.
Ambulatory BP monitoring may itself induce nondipping and may thus mitigate the prognostic significance of the dipping phenomenon.

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PMCID: PMC2827604
PMID: 20019118  [Indexed for MEDLINE]


The effect of MELatonin on Depression, anxiety, cognitive function and sleep disturbances in patients with breast cancer. The MELODY trial: protocol for a randomised, placebo-controlled, double-blinded trial.

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Introduction Breast cancer represents about one-third of all cancer diagnoses and accounts for about 15% of cancer deaths in women. Many of these patients experience depression, anxiety, sleep disturbances and cognitive dysfunction. This may adversely affect quality of life and also contribute to morbidity and mortality. Melatonin is a regulatory circadian hormone having, among others, a hypnotic and an antidepressive effect. It has very low toxicity and very few adverse effects compared with the more commonly used antidepressants and hypnotics. Methods and analysis The objective of this double-blind, randomised, placebo-controlled trial is to investigate whether treatment with oral melatonin has a prophylactic or ameliorating effect on depressive symptoms, anxiety, sleep disturbances and cognitive dysfunction in women with breast cancer.
Furthermore, the authors will examine whether a specific clock-gene, PER3, is correlated with an increased risk of depressive symptoms, sleep disturbances or cognitive dysfunction. The MELODY trial is a prospective double-blinded, randomised, placebo-controlled trial in which the authors intend to include 260 patients. The primary outcome is depressive symptoms measured by the Major Depression Inventory. The secondary outcomes are anxiety measured by a Visual Analogue Scale, total sleep time, sleep efficiency, sleep latency and periods awake measured by actigraphy and changes in cognitive function measured by a neuropsychological test battery. Tertiary outcomes are fatigue, pain, well-being and sleep quality/quantity measured by Visual Analogue Scale and sleep diary and sleepiness measured by the Karolinska Sleepiness Scale. The PER3 genotype is also to be determined in blood samples.

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PMCID: PMC3278491
PMID: 22240653


The effect of melatonin on sleep and quality of life in patients with advanced breast cancer.

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(2)Cancer Chronotherapy Unit, Warwick Medical School, Coventry, and Department of Oncology, Queen Elisabeth Hospital Brimingham, Brimingham, UK.
BACKGROUND: Fatigue and sleep problems are prevalent in cancer patients and can be associated with disruption of circadian rhythmicity. In this prospective phase II trial, we sought to assess the effect of melatonin on circadian biomarkers, sleep, and quality of life in breast cancer patients.

METHODS: Thirty-two patients with metastatic breast cancer, receiving hormonal or trastuzumab therapy, took 5 mg of melatonin at bedtime for 2 months. Before starting and after 2 months on melatonin therapy, sleep and circadian rhythmicity were assessed by actigraphy, diurnal patterns of serum cortisol, and the expression of the core clock genes PER2 and BMAL1 in peripheral blood mononuclear cells. The European Organisation for Research and Treatment of Cancer (EORTC) QLQ-C30 questionnaire was completed for subjective parameters.

RESULTS: Bedtime melatonin was associated with a significant improvement in a marker of objective sleep quality, sleep fragmentation and quantity, subjective sleep, fatigue severity, global quality of life, and social and cognitive functioning scales. Morning clock gene expression was increased following bedtime melatonin intake. Melatonin did not affect actigraphy measure of...
circadian rhythmicity, or the diurnal cortisol pattern. 
CONCLUSION: These results invite further investigation of melatonin as a potentially useful therapeutic agent for improving sleep and quality of life in cancer patients.
DOI: 10.1007/s00520-015-2883-6
PMID: 26260726 [Indexed for MEDLINE]

Effect of melatonin on sleep, behavior, and cognition in ADHD and chronic sleep-onset insomnia.

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OBJECTIVE: To investigate the effect of melatonin treatment on sleep, behavior, cognition, and quality of life in children with attention-deficit/hyperactivity disorder (ADHD) and chronic sleep onset insomnia.

METHOD: A total of 105 medication-free children, ages 6 to 12 years, with rigorously diagnosed ADHD and chronic sleep onset insomnia participated in a randomized, double-blind, placebo-controlled trial using 3 or 6 mg melatonin (depending on body weight), or placebo for 4 weeks. Primary outcome parameters were actigraphy-derived sleep onset, total time asleep, and salivary dim light melatonin onset.

RESULTS: Sleep onset advanced by 26.9 +/- 47.8 minutes with melatonin and delayed by 10.5 +/- 37.4 minutes with placebo (p < .0001). There was an advance in dim light melatonin onset of 44.4 +/- 67.9 minutes in melatonin and a delay of 12.8 +/- 60.0 minutes in placebo (p < .0001). Total time asleep increased with melatonin (19.8 +/- 61.9 minutes) as compared to placebo (-13.6 +/- 50.6 minutes;
p = .01). There was no significant effect on behavior, cognition, and quality of life, and significant adverse events did not occur.

CONCLUSION: Melatonin advanced circadian rhythms of sleep-wake and endogenous melatonin and enhanced total time asleep in children with ADHD and chronic sleep onset insomnia; however, no effect was found on problem behavior, cognitive performance, or quality of life.

DOI: 10.1097/01.chi.0000246055.76167.0d
PMID: 17242627 [Indexed for MEDLINE]


Effect of morning bright light on body temperature, plasma cortisol and wrist motility measured during 24 hour of constant conditions.

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Using 24 h constant conditions, time course of body temperature, plasma cortisol and wrist motility was measured in response to a 3 day morning 2 h bright light pulse. This protocol demonstrated that a 2000 lux illumination was sufficient to elicit a shift of about 2 h of temperature minimum and cortisol peak. In reference session, actimetric recordings showed a circadian time course, closely in relation with core temperature. Bright light pulse resulted in a decrease of amplitude and a disappearance of circadian pattern of actimetry.

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PMID: 8377945 [Indexed for MEDLINE]


Effect of morning bright light treatment for rest-activity disruption in institutionalized patients with severe Alzheimer's disease.
BACKGROUND: Disturbances in rest-activity rhythm are prominent and disabling symptoms in Alzheimer's disease (AD). Nighttime sleep is severely fragmented and daytime activity is disrupted by multiple napping episodes. In most institutional environments, light levels are very low and may not be sufficient to enable the circadian clock to entrain to the 24-hour day. The purpose of this randomized, placebo-controlled, clinical trial was to test the effectiveness of morning bright light therapy in reducing rest-activity (circadian) disruption in institutionalized patients with severe AD.

METHOD: Subjects (n = 46, mean age 84 years) meeting the NINCDS-ADRDA (National Institute of Neurological and Communicative Disorders and Stroke--the Alzheimer's Disease and Related Disorders Association) AD diagnostic criteria were recruited from two large, skilled nursing facilities in San Francisco, California. The experimental group received one hour (09:30-10:30) of bright light exposure (> or = 2500 lux in gaze direction) Monday through Friday for 10 weeks. The control group received usual indoor light (150-200 lux). Nighttime sleep efficiency, sleep time, wake time and number of awakenings and daytime wake time were assessed using actigraphy. Circadian rhythm parameters were also determined from the actigraphic data using cosinor analysis and nonparametric techniques. Repeated measures analysis of variance (ANOVA) was used to test the primary study hypotheses.

RESULTS AND CONCLUSION: Although significant improvements were found in subjects with aberrant timing of their rest-activity rhythm, morning bright
light exposure
did not induce an overall improvement in measures of sleep or the
rest-activity
in all treated as compared to control subjects. The results indicate
that only
subjects with the most impaired rest-activity rhythm respond
significantly and
positively to a brief (one hour) light intervention.

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Effect of Morning Light Glasses and Night Short-Wavelength Filter
Glasses on
Sleep-Wake Rhythmicity in Medical Inpatients.

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Sleep and circadian rhythm disorders are common amongst medical
inpatients. They
are caused by a mixture of factors, including noise, loss of habitual
daily
routines, and abnormal exposure to light, which tends to be
insufficient in the
day and too high at night. The aim of the present study was to test
the efficacy
of morning light therapy plus night short-wavelength filter glasses on
sleep
quality/timing, and sleepiness/mood over the daytime hours, in a group of
well-characterized medical inpatients. Thirty-three inpatients were
enrolled and
randomized (2:1) to either treatment (n = 22; 13 males, 48.3 ± 13.3
years) or
standard of care (n = 11; 8 males, 56.9 ± 12.9 years). On admission, all
underwent a baseline assessment of sleep quality/timing and diurnal
preference.
During hospitalization they underwent monitoring of sleep quality/
timing (sleep
diaries and actigraphy), plus hourly assessment of sleepiness/mood during the daytime hours on one, standard day of hospitalization. Patients in the treatment arm were administered bright light through glasses immediately after awakening, and wore short-wavelength filter glasses in the evening hours. Treated and untreated patients were comparable in terms of demographics, disease severity/comorbidity, diurnal preference and pre-admission sleep quality/timing. During hospitalization, sleep diaries documented a trend for a lower number of night awakenings in treated compared to untreated patients (1.6 ± 0.8 vs. 2.4 ± 1.3, p = 0.057). Actigraphy documented significantly earlier day mode in treated compared to untreated patients (06:39 ± 00:35 vs. 07:44 ± 00:40, p = 0.008).

Sleepiness during a standard day of hospitalization, recorded between 09:30 and 21:30, showed physiological variation in treated compared to untreated patients, who exhibited a more blunted profile. The level of sleepiness reported by treated patients was lower over the 09:30–14:30 interval, i.e., soon after light administration (interaction effect: F = 2.661; p = 0.026). Mood levels were generally higher in treated patients, with statistically significant differences over the 09:30–14:30 time interval, i.e., soon after light administration (treatment: F = 5.692, p = 0.026). In conclusion, treatment with morning bright light and short-wavelength filter glasses in the evening, which was well tolerated, showed positive results in terms of sleepiness/mood over the morning hours and a trend for decreased night awakenings.

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Effect of Parental Counseling on Infants' Healthy Sleep Habits in Brazil: A Randomized Clinical Trial.

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Importance: Poor sleep during early childhood is associated with adverse outcomes, including obesity, cognitive impairment, and mental and behavioral disorders.

Objective: To assess the efficacy of an educational intervention in the promotion of nighttime sleep duration.

Design, Setting, and Participants: This single-blind, intent-to-treat randomized clinical trial included participants in Pelotas, Brazil, aged 3 months who were followed up until age 24 months. Eligibility criteria included healthy infants aged approximately 3 months who slept less than 15 hours per 24 hours. Infants were randomized to the intervention group or control group.

Interventions: Information on sleep characteristics, improvements in the environment, establishment of a nighttime sleep routine, and waiting before attending nocturnal awakenings was delivered to mothers in the intervention group by trained home-visitors at baseline. The intervention group received a telephone
call on the first and second day after the intervention and a home visit on the third day after the intervention. The intervention's content was reinforced at health care visits for ages 6 months and 12 months. Mothers allocated to the control group were counseled on the benefits of breastfeeding for the mother's and child's health and given written material with content on breastfeeding.

Main Outcomes and Measures: Nighttime sleep duration was measured by interview and actigraphy at baseline and ages 6, 12, and 24 months and diaries at baseline and age 6 months. At ages 3 and 6 months, nighttime sleep self-regulation was calculated by subtracting nighttime sleep duration recorded by actigraphy from nighttime sleep duration recorded in the diaries and at ages 12 and 24 months by subtracting nighttime sleep duration recorded by actigraphy from nighttime sleep duration obtained by interview.

Results: Among 1812 mother-infant dyads invited to participate, 798 met the inclusion criteria and 586 agreed to participate. The intervention group included 298 infants (154 [52.9%] boys), and the control group included 288 infants (164 [58.2%] boys). At age 6 months, mean (SD) nighttime sleep duration recorded in diaries was 9.80 (1.85) hours in the intervention group and 9.49 (2.07) hours in the control group, a difference of 19 minutes longer for the intervention group.

At age 12 months, mean (SD) nighttime sleep duration based on the Brief Infant Sleep Questionnaire was 8.43 (1.35) hours in the intervention group and 8.52 (1.35) hours in the control group, a difference of 5 minutes shorter for the intervention group. At age 24 months, compared with information from the interview, actigraphy records showed that children in the intervention group stayed awake at night without signalizing for a mean (SD) of 0.52 (2.52) hours, whereas children in the control group stayed awake at night without signalizing for a mean (SD) of 0.23 (2.43) hours. There were no statistically
significant difference between groups in any of the sleep parameters investigated.
Conclusions and Relevance: This randomized clinical trial found that the educational intervention did not achieve longer nighttime sleep duration among infants in the intervention group.
Trial Registration: ClinicalTrials.gov identifier: NCT02788630.

DOI: 10.1001/jamanetworkopen.2019.18062
PMCID: PMC6991232
PMID: 31860110


Effect of tart cherry juice (Prunus cerasus) on melatonin levels and enhanced sleep quality.

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BACKGROUND: Tart Montmorency cherries have been reported to contain high levels of phytochemicals including melatonin, a molecule critical in regulating the sleep-wake cycle in humans.
PURPOSE: The aim of our investigation was to ascertain whether ingestion of a tart cherry juice concentrate would increase the urinary melatonin levels in healthy adults and improve sleep quality.
METHODS: In a randomised, double-blind, placebo-controlled, crossover design, 20 volunteers consumed either a placebo or tart cherry juice concentrate for 7 days. Measures of sleep quality recorded by actigraphy and subjective sleep questionnaires were completed. Sequential urine samples over 48 h were collected and urinary 6-sulfatoxymelatonin (major metabolite of melatonin) determined; cosinor analysis was used to determine melatonin circadian rhythm (mesor,
acrophase and amplitude). In addition, total urinary melatonin content was determined over the sampled period. Trial differences were determined using a repeated measures ANOVA.

RESULTS: Total melatonin content was significantly elevated (P < 0.05) in the cherry juice group, whilst no differences were shown between baseline and placebo trials. There were significant increases in time in bed, total sleep time and sleep efficiency total (P < 0.05) with cherry juice supplementation. Although there was no difference in timing of the melatonin circadian rhythm, there was a trend to a higher mesor and amplitude.

CONCLUSIONS: These data suggest that consumption of a tart cherry juice concentrate provides an increase in exogenous melatonin that is beneficial in improving sleep duration and quality in healthy men and women and might be of benefit in managing disturbed sleep.

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Effect of the 2011 vs 2003 duty hour regulation-compliant models on sleep duration, trainee education, and continuity of patient care among internal medicine house staff: a randomized trial.


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Comment in
IMPORTANCE: On July 1, 2011, the Accreditation Council for Graduate Medical Education implemented further restrictions of its 2003 regulations on duty hours and supervision. It remains unclear if the 2003 regulations improved trainee well-being or patient safety.

OBJECTIVE: To determine the effects of the 2011 Accreditation Council for Graduate Medical Education duty hour regulations compared with the 2003 regulations concerning sleep duration, trainee education, continuity of patient care, and perceived quality of care among internal medicine trainees.

DESIGN AND SETTING: Crossover study design in an academic research setting.

PARTICIPANTS: Medical house staff.

INTERVENTION: General medical teams were randomly assigned using a sealed-envelope draw to an experimental model or a control model.

MAIN OUTCOME MEASURES: We randomly assigned 4 medical house staff teams (43 interns) using a 3-month crossover design to a 2003-compliant model of every fourth night overnight call (control) with 30-hour duty limits or to one of two 2011-compliant models of every fifth night overnight call (Q5) or a night float schedule (NF), both with 16-hour duty limits. We measured sleep duration using actigraphy and used admission volumes, educational opportunities, the number of handoffs, and satisfaction surveys to assess trainee education, continuity of patient care, and perceived quality of care. RESULTS The study included 560 control, 420 Q5, and 140 NF days that interns worked and 834 hospital admissions. Compared with controls, interns on NF slept longer during the on call period (mean, 5.1 vs 8.3 hours; P = .003), and interns on Q5 slept longer during the postcall period (mean, 7.5 vs 10.2 hours; P = .05). However, both the Q5 and NF models increased handoffs, decreased availability for teaching conferences, and reduced intern presence during daytime work hours. Residents and nurses in both experimental models perceived reduced quality of care, so much so with NF that it
was terminated early.
CONCLUSIONS AND RELEVANCE: Compared with a 2003-compliant model, two 2011 duty hour regulation-compliant models were associated with increased sleep duration during the on-call period and with deteriorations in educational opportunities, continuity of patient care, and perceived quality of care.

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Effect of the first night shift period on sleep in young nurse students.

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In young hospital nurses being exposed to a night shift work schedule for the first time in their occupational life, sleep quality is investigated quantitatively. A main sleep period and supplementary sleep periods were defined and analyzed to investigate sleep behavior and quality. A total of 30 young nurses (26 women, 4 men), mean age 20.2 +/- 2.1 years participated. A 3 week nursing school period was followed by a 3 week work period with a 3-5 night shift sub-period and recovery days. Sleep-wake behavior was assessed with an actigraph, sleep diaries, Epworth sleepiness scale (ESS), and quality of life was assessed with a standard questionnaire (SF-36). Comparing the school period with the work shift period when excluding recovery days after night shift period significant increase of total sleep time within 24 h was found during the work days (ANOVA P < 0.05). During the night shift sub-period, there was just a small decline of the main sleep period at day (n.s.) which was not compensated by
supplementary sleep episodes. The supplementary sleep during work day varied between 11 min (school period) and 18 min after recovery days from night shift (n.s.). Young healthy nurses tolerate the first night shift exposure very well, according to objective and subjective parameters related to quality of sleep. An increased sleep need during work days lead to longer total sleep time, but do not lead to longer supplementary sleep episodes. Young nurses tolerate the first rotating shift period and the first night shift period very well.

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Effect of timed bright light treatment for rest-activity disruption in institutionalized patients with Alzheimer's disease.

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BACKGROUND: Disturbances in rest-activity rhythm are prominent and disabling symptoms in Alzheimer's disease (AD). Nighttime sleep is severely fragmented and daytime activity is disrupted by multiple napping episodes. In most institutional environments, light levels are very low and may not be sufficient to entrain the circadian clock to the 24-hour day.

METHOD: The purpose of this randomized clinical trial was to test the effectiveness of timed bright light therapy in reducing rest-activity (circadian) disruption in institutionalized patients with AD. The experimental groups received either morning (9.30-10.30 am) or afternoon (3.30-4.30 pm) bright light exposure ( > or = 2500 lux in gaze direction) Monday through Friday for 10 weeks. The control group received usual indoor light (150-200 lux). Nighttime sleep,
daytime wake, and rest-activity parameters were determined by actigraphy.
Repeated measures analysis of variance was employed to test the primary study hypotheses.
RESULTS: Seventy institutionalized subjects with AD (mean age 84) completed the study. No significant differences in actigraphy-based measures of nighttime sleep or daytime wake were found between groups. Subjects in either experimental light condition evidenced a significantly (p < 0.01) more stable rest-activity rhythm acrophase over the 10-week treatment period compared to the control subjects whose rhythm phase delayed by over two hours.
CONCLUSIONS: One hour of bright light, administered to subjects with AD either in the morning or afternoon, did not improve nighttime sleep or daytime wake compared to a control group of similar subjects. However, exposure to one-hour of bright light in either the morning or afternoon may provide sufficient additional input to the circadian pacemaker to facilitate entrainment to the 24-hour day.

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Effectiveness of evening phototherapy for insomnia is reduced by bright daytime light exposure.

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OBJECTIVE: To examine the effect of ambulatory daytime light exposure
on phase delays and on the advances produced by timed exposure to bright evening or morning light.

METHODS: As a subset of a larger study, 32 older (63.0 ± 6.43 years) adults with primary insomnia were randomized to an at-home, single-blind, 12-week, parallel-group study entailing daily exposure to 45 min of scheduled evening or morning bright (~4000 lux) light. Light exposure patterns during the baseline and the last week of treatment were monitored using actigraphs with built-in illuminance detectors. Circadian phase was determined through analysis of in-laboratory collected plasma melatonin.

RESULTS: Less daytime light exposure during the last week of treatment was significantly associated with larger phase delays in response to evening light (r's>0.78). Less daytime light exposure during the last week of treatment was also associated with a significant delay in wake time (r's>-0.75). There were no such relationships between light exposure history and phase advances in response to morning light.

CONCLUSIONS: Greater light exposure during the daytime may decrease the ability of evening light, but not morning light, exposure to engender meaningful changes of circadian phase.

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Effectiveness of hand self-shiatsu to improve sleep following sport-related concussion in young athletes: a proof-of-concept study.

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OBJECTIVE: The prevalence of sport-related concussion (SRC) is high and results in a number of serious health consequences. One area that has received minimal research is the relationship between SRC and sleep. The literature shows that sleep deficiency is a frequent negative consequence of SRC. At the same time, sleep deficiency delays recovery from SRC and contributes added risk of symptom recurrence. A 2014 study of chronic pain patients who learned to apply the complementary and alternative medicine intervention hand self-shiatsu (HSS) had promising, sleep-promoting results that warrant further investigation with other populations. This proof-of-concept study explored the feasibility of HSS as an intervention to promote sleep onset and continuity for young adults with SRC.

METHODS: This study employed a prospective case-series design, where participants act as their own controls. Baseline and follow-up data included standardized self-reported assessment tools and sleep actigraphy.

RESULTS: Seven athletes, aged between 18 and 25 years, participated in the study. Although statistically significant improvement in actigraphy sleep scores between baseline and follow-up was not achieved, metrics for sleep quality and daytime fatigue showed significant improvement.
CONCLUSION: These findings support the hypothesis that HSS has the potential to improve sleep and reduce daytime fatigue in young postconcussion athletes. This pilot study provides guidance to refine research protocols and lays a foundation for further, large-sample, controlled studies.

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The effects of a 120-minute nap on sleepiness, fatigue, and performance during 16-hour night shifts: A pilot study.

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OBJECTIVE: To investigate sleepiness, fatigue, and performance following a 120-minute nap during simulated 16-hour night shifts based on subjective and objective assessments.

METHODS: Fourteen females participated in this crossover comparative study. Three experimental nap conditions were used: naps from 22:00 to 00:00 (22-NAP), 00:00 to 02:00 (00-NAP), and 02:00 to 04:00 (02-NAP), respectively. Measurement items were sleep parameters, sublingual temperature, a Visual Analog Scale for sleepiness and fatigue, a single-digit mental arithmetic task (for 10 minutes), and heart rate variability. Participants wore an ActiGraph to estimate their sleep state.
RESULTS: There was no difference in the sleep parameters at the time of naps among the three conditions. Immediately following a 120-minute nap, sleepiness and fatigue increased, and the number of calculations performed in the single-digit mental arithmetic task decreased in any of the conditions. In particular, immediately after the 02-NAP, fatigue and high-frequency power (HF) were higher than after the 22-NAP. In the early morning (from 05:00 to 09:00), in the 22-NAP, sleepiness and fatigue increased, and performance and sublingual temperature decreased more than in the 00-NAP and 02-NAP. Furthermore, the ratio of errors was significantly lower in the 00-NAP than in the 22-NAP in the early morning.

CONCLUSIONS: A 120-minute nap taken from 22:00 to 02:00 may cause temporary sleepiness after waking, increase fatigue and reduce performance. Greater attention should be given to naps taken at a later time (ie, 02-NAP). In addition, taking a nap starting at 00:00 might decrease the risks of errors in the morning.


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PMCID: PMC6718932
PMID: 31087442 [Indexed for MEDLINE]


Effects of a dawn-dusk simulation on circadian rest-activity cycles, sleep, mood and well-being in dementia patients.


Author information:
Light is the most powerful "zeitgeber" signal to synchronize circadian sleep-wake cycles. In dementia, these rhythms are often fragmented - probably due to loss of neuronal function of the suprachiasmatic nuclei (the biological "master clock" in the brain) and/or weakness of external zeitgebers. We investigated the effects of a prototype dawn-dusk simulator (DDS) on circadian rest-activity cycles, sleep, mood and well-being in a balanced crossover design during fall and winter in 20 institutionalized patients with dementia (86 ± 6 y, 17 f). All participants had one baseline week followed by exposure to individually timed DDS over their beds for 7–8 weeks. They spent 8 weeks without DDS as a control. Mood, self-reliant daily activity, social behavior, agitation, and quality of life were assessed by standardized questionnaires and visual analogue scales, regularly rated by trained caregivers. Circadian and sleep characteristics of their rest-activity cycles were analyzed by actimetry over 17 weeks. DDS exposure led to significantly better mood in the morning hours after waking. The effects were most pronounced in the second 4 weeks with DDS, indicating that positive effects emerged gradually. Differences in circadian rest-activity cycles and sleep were mainly age-dependent. We found statistically significant correlations between measures of higher quality of life and better mood, greater alertness
and circadian rhythm stability. We conclude that continuous, long-term application of dawn-dusk simulation at the sleep-wake transitions appears to increase external zeitgeber strength in institutionalized patients with dementia. The DDS may provide an effective, non-invasive tool to improve mood and ameliorate patients' quality of life.

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PMID: 31252161


Effects of a standardized pamphlet on insomnia in children with autism spectrum disorders.


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OBJECTIVE: Sleep difficulties are common reasons why parents seek medical intervention in children with autism spectrum disorders (ASDs). We determined whether a pamphlet alone could be used by parents to help their child's insomnia.

METHODS: Thirty-six children with ASD, ages 2 to 10 years, were enrolled. All had prolonged sleep latency confirmed by actigraphy showing a mean sleep latency of 30 minutes or more. Parents were randomly assigned to receive the sleep education pamphlet or no intervention. Children wore an actigraphy device to record baseline sleep parameters, with the primary outcome variable being change in sleep latency. Actigraphy data were collected a second time 2 weeks
after the parent received the randomization assignment and analyzed by using Student's t test. Parents were also asked a series of questions to gather information about the pamphlet and its usefulness.

RESULTS: Although participants randomized to the 2 arms did not differ statistically in age, gender, socioeconomic status, total Children's Sleep Habits Questionnaire score, or actigraphy parameters, some differences may be large enough to affect results. Mean change in sleep-onset latency did not differ between the randomized groups (pamphlet versus no pamphlet). Parents commented that the pamphlet contained good information, but indicated that it would have been more useful to be given specific examples of how to take the information and put it into practice.

CONCLUSIONS: A sleep education pamphlet did not appear to improve sleep latency in children with ASDs.

DOI: 10.1542/peds.2012-0900K
PMCID: PMC4536583
PMID: 23118244 [Indexed for MEDLINE]


Effects of a Tailored Lighting Intervention on Sleep Quality, Rest-Activity, Mood, and Behavior in Older Adults With Alzheimer Disease and Related Dementias: A Randomized Clinical Trial.

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(2)Cognitive Science Department, School of Humanities, Arts and Social Sciences, Rensselaer Polytechnic Institute, Troy, New York, United States.
STUDY OBJECTIVES: We investigated the effectiveness of a lighting intervention tailored to maximally affect the circadian system as a nonpharmacological therapy for treating problems with sleep, mood, and behavior in persons with Alzheimer disease and related dementias (ADRD).

METHODS: This 14-week randomized, placebo-controlled, crossover design clinical trial administered an all-day active or control lighting intervention to 46 patients with ADRD in 8 long-term care facilities for two 4-week periods (separated by a 4-week washout). The study employed wrist-worn actigraphy measures and standardized measures of sleep quality, mood, and behavior.

RESULTS: The active intervention significantly improved Pittsburgh Sleep Quality Index scores compared to the active baseline and control intervention (mean ± SEM: 6.67 ± 0.48 after active intervention, 10.30 ± 0.40 at active baseline, 8.41 ± 0.47 after control intervention). The active intervention also resulted in significantly greater active versus control differences in intradaily variability. As for secondary outcomes, the active intervention resulted in significant improvements in Cornell Scale for Depression in Dementia scores (mean ± SEM: 10.30 ± 1.02 at baseline, 7.05 ± 0.67 after active intervention) and significantly greater active versus control differences in Cohen-Mansfield Agitation Inventory scores (mean ± SEM: -5.51 ± 1.03 for the active intervention, -1.50 ± 1.24 for the control intervention).

CONCLUSIONS: A lighting intervention tailored to maximally entrain the circadian system can improve sleep, mood, and behavior in patients with dementia living in controlled environments.


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The effects of acute sleep restriction and extension on sleep efficiency.

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This study employed a repeated measures design to assess the relationship between sleep efficiency and time-in-bed (TIB). Fourteen subjects underwent three TIB conditions: (5 hour, 8 hour, and 11 hour), which were presented in a Latin Square design. Subjects slept a total of six nights (two nights per condition) while being monitored by a wrist actigraph to determine sleep time. Sleep efficiencies (sleep time/TIB) were analyzed with a two-way repeated-measures ANOVA. The main effect of night was not significant. The main effect of TIB and the interaction of nights and TIB were significant. In the 11-hour condition, sleep efficiency fell from night one to night two, and on night two both the 5-hour and the 11-hour conditions were significantly different from the 8-hour condition. Analysis of total sleep time (TST) yielded the same results with the addition of a significant night-to-night difference in the 5-hour condition. It was concluded that sleep efficiency systematically changes with an extension or restriction of TIB from 8 hour.
Effects of afternoon "siesta" naps on sleep, alertness, performance, and circadian rhythms in the elderly.

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STUDY OBJECTIVES: To determine the effects of a 90-minute afternoon nap regimen on nocturnal sleep, circadian rhythms, and evening alertness and performance levels in the healthy elderly.

DESIGN AND SETTING: Nine healthy elderly subjects (4m, 5f, age range 74y-87y) each experienced both nap and no-nap conditions in two studies each lasting 17 days (14 at home, 3 in the laboratory). In the nap condition a 90-minute nap was enforced between 13:30 and 15:00 every day, in the no-nap condition daytime napping was prohibited, and activity encouraged in the 13:30-15:00 interval. The order of the two conditions was counterbalanced.

PARTICIPANTS: N/A.

INTERVENTIONS: N/A.

MEASUREMENTS: Diary measures, pencil and paper alertness tests, and wrist actigraphy were used at home. In the 72 hour laboratory studies, these measures were augmented by polysomnographic sleep recording, continuous rectal temperature measurement, a daily evening single trial of a Multiple Sleep Latency Test (MSLT), and computerized tests of mood, activation and performance efficiency.

RESULTS: By the second week in the "at home" study, an average of 58 minutes of sleep was reported per siesta nap; in the laboratory, polysomnography confirmed an average of 57 minutes of sleep per nap. When nap and no-nap conditions were compared, mixed effects on nocturnal sleep were observed. Diary measures
indicated no significant difference in nocturnal sleep duration, but a significant increase (of 38 mins.) in 24-hour Total Sleep Time (TST) when nocturnal sleeps and naps were added together (p<0.025). The laboratory study revealed a decrease of 2.4% in nocturnal sleep efficiency in the nap condition (p<0.025), a reduction of nocturnal Total Sleep Time (TST) by 48 mins. in the nap condition (p<0.001) which resulted primarily from significantly earlier waketimes (p<0.005), but no reliable effects on Wake After Sleep Onset (WASO), delta sleep measures, or percent stages 1 & 2. Unlike the diary study, the laboratory study yielded no overall increase in 24-hour TST consequent upon the siesta nap regimen. The only measure of evening alertness or performance to show an improvement was sleep latency in a single-trial evening MSLT (nap: 15.6 mins., no nap: 11.5 mins., p<0.005). No significant change in circadian rhythm parameters was observed.

CONCLUSIONS: Healthy seniors were able to adopt a napping regimen involving a 90-minute siesta nap each day between 13:30 and 15:00, achieving about one hour of actual sleep per nap. There were some negative consequences for nocturnal sleep in terms of reduced sleep efficiency and earlier waketimes, but also some positive consequences for objective evening performance and (in the diary study) 24-hour sleep totals. Subjective alertness measures and performance measures showed no reliable effects and circadian phase parameters appeared unchanged.

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PMID: 11560181 [Indexed for MEDLINE]


Effects of age on activity patterns after coronary artery bypass surgery.

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OBJECTIVE: To examine the effect of age on activity patterns, including circadian rhythms and levels, after coronary artery bypass surgery (CABS).

DESIGN: Repeated measures, correlational.

SETTING: Northeastern university-affiliated tertiary coronary care center.

SUBJECTS: Eight middle-aged (mean age = 57 years) and 14 older (mean age = 72 years) adults who had undergone first, isolated CABS.

OUTCOME MEASURES: Wrist actigraph measures of levels (daytime activity) and circadian patterns of activity (acrophase, amplitude, percent rhythm, mesor), self-reported postoperative clinical activity milestones, and Sickness Impact Profile subscales of ambulation dysfunction and sleep-rest.

INTERVENTION: Measurement of activity over postoperative days 2 through 5, including wrist actigraphy, Sickness Impact Profile ambulation and sleep-rest subscales, and daily clinical activity milestones.

RESULTS: Repeated measures ANOVA was used in the data analysis. Statistically significant increases were found in percent rhythm (P <.001), amplitude (P <.001), activity level (P <.001), and clinical activity milestones (P <.001) over postoperative days 2 through 5. Significant effects of age were found on amplitude (P =.02) and percent rhythm (P =.008). Significant age-by-time effects were found for circadian amplitude (P =.03) and percent rhythm (P =.02). There was a nonstatistically significant (P =.07) age by time interaction effect on daytime activity. Trends in amplitude, percent rhythm, and daytime activity indicated that these activity parameters increased more slowly in older adults, compared with middle-aged adults, after initially similar levels on postoperative days 2 and 3.

CONCLUSION: Both middle-aged and older adults increase daily activity and the strength of circadian activity pattern over days 2 through 5. However,
these variables increase more rapidly in middle-aged adults after essentially identical levels on postoperative days 2 and 3.

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Effects of alertness management training on sleepiness among long-haul truck drivers: A randomized controlled trial.

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Education is a frequently recommended remedy for driver sleepiness in occupational settings, although not many studies have examined its usefulness. To date, there are no previous on-road randomized controlled trials investigating the benefits of training on sleepiness among employees working in road transport.

To examine the effects of an educational intervention on long-haul truck drivers' sleepiness at the wheel, amount of sleep between work shifts, and use of efficient sleepiness countermeasures (SCM) in association with night and
non-night shift, a total of 53 truck drivers operating from southern Finland were
allocated into an intervention and a control group using a stratified randomization method (allocation ratio for intervention and control groups 32:21, respectively). The intervention group received a 3.5-hour alertness management training followed by a two-month consultation period and motivational self-evaluation tasks two and 4-5 months after the training, while the control group had an opportunity to utilize their usual statutory occupational health care services. The outcomes were measured under drivers' natural working and shift conditions over a period of two weeks before and after the intervention using unobtrusive data-collection methods including the Karolinska Sleepiness Scale measuring on-duty sleepiness, a combination of actigraphy and a sleep-log measuring sleep between duty hours, and self-report questionnaire items measuring the use of SCMs while on duty. The data analysis followed a per-protocol analysis. Results of the multilevel regression models showed no significant intervention-related improvements in driver sleepiness, prior sleep, or use of SCMs while working on night and early morning shifts compared to day and/or evening shifts. The current study failed to provide support for a feasible non-recurrent alertness-management training being effective remedy for driver sleepiness in occupational settings. These results cannot, however, be interpreted as evidence against alertness management training in general but propose that driver education is not a sufficient measure as such to alleviate driver sleepiness.

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The Effects of Ambulatory Blood Pressure Monitoring on Sleep Quality
in Men and Women With Hypertension: Dipper vs. Nondipper and Race Differences.

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BACKGROUND: The nondipping circadian blood pressure (BP) profile is associated with both poor sleep quality and increased cardiovascular risk. The present study aimed to clarify the potential confounding effects of 24-hour ambulatory blood pressure monitoring (ABPM) used to characterize the circadian BP profile by assessing its impact on sleep quality.

METHODS: Participants were 121 middle-aged men and women with untreated hypertension (age = 46 ± 8 years; 43% women; 45% African-American). Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index. Wrist actigraphy was used to measure sleep quality objectively as sleep efficiency (SE) and total sleep time (TST) on 7 consecutive non-ABPM days (baseline) and 3 subsequent 24-hour ABPM days.

RESULTS: Average ambulatory BP was 137.2 ± 10.8/84.3 ± 8.5 mm Hg during the day and 119.6 ± 12.4/69.5 ± 9.8 mm Hg at night. Using the criterion of <10% dip in systolic BP (SBP) to define nondippers, there were 40 nondippers (SBP dip = 7.3 ± 2.6%) and 81 dippers (SBP dip = 15.5 ± 3.4%). There was no effect of time on SE or TST over non-ABPM and ABPM days, suggesting that ABPM does not adversely affect sleep quality. Sleep quality was generally poorer (lower SE) in nondippers compared with dippers (P = 0.033), but differences were independent of whether or not participants were undergoing 24-hour ABPM. African-American race (P = 0.002) was also associated with lower SE.

CONCLUSION: Sleep quality generally appears to be poor in men and women with untreated hypertension and especially among African-Americans.
Importantly, for both dippers and nondippers, we found no evidence that ABPM had an adverse effect on sleep quality.

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PMCID: PMC6284749
PMID: 30204833 [Indexed for MEDLINE]


Effects of an adapted mattress in musculoskeletal pain and sleep quality in institutionalized elders.

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We aimed to evaluate the impact in sleep quality and musculoskeletal pain of a Medium-Firm Mattress (MFM), and their relationship with objective sleep parameters in a group of institutionalized elders. The sample size included forty older adults with musculoskeletal pain. We did a clinical assessment at baseline and weekly through the study period of four weeks. We employed the Pittsburgh Sleep Quality Index (PSQI) and Pain Visual Analog Scale (P-VAS). Additionally a sub-group of good sleepers, selected from PSQI baseline evaluation, were studied with actigraphy and randomized to MFM or High Firm Mattress (HFM), in two consecutive nights. We found a significant reduction of cervical, dorsal and
lumbar pain. PSQI results did not change. The actigraphy evaluation found a
significant shorter sleep onset latency with MFM, and a slightly
better, but not
statistically significant, sleep efficiency. The medium firmness
mattress
improved musculoskeletal pain and modified the sleep latency.

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PMCID: PMC4688575
PMID: 26779317

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24.

Effects of an advanced sleep schedule and morning short wavelength
light exposure
on circadian phase in young adults with late sleep schedules.

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OBJECTIVE: We examined the effects of an advanced sleep/wake schedule
and morning
short wavelength (blue) light in 25 adults (mean age±SD=21.8±3 years;
13 women)
with late sleep schedules and subclinical features of delayed sleep
phase
disorder (DSPD).
METHODS: After a baseline week, participants kept individualized,
fixed, advanced
7.5-h sleep schedules for 6 days. Participants were randomly assigned
to groups to
receive "blue" (470nm, ~225lux, n=12) or "dim" (<1lux, n=13) light for
1h after
waking each day. Head-worn "Daysimeters" measured light exposure;
actigraphs and
sleep diaries confirmed schedule compliance. Salivary dim light
melatonin onset
(DLMO), self-reported sleep, and mood were examined with 2×2 ANOVA.
RESULTS: After 6 days, both groups showed significant circadian phase
advances,
but morning blue light was not associated with larger phase shifts than dim-light exposure. The average DLMO advances (mean±SD) were 1.5±1.1h in the dim light group and 1.4±0.7h in the blue light group.

CONCLUSIONS: Adherence to a fixed advanced sleep/wake schedule resulted in significant circadian phase shifts in young adults with subclinical DSPD with or without morning blue light exposure. Light/dark exposures associated with fixed early sleep schedules are sufficient to advance circadian phase in young adults.

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Effects of blue- and red-enriched light on attention and sleep in typically developing adolescents.

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Differential effects of blue- and red-enriched light on attention and sleep have been primarily described in adults. In our cross-over study in typically developing adolescents (11-17 years old), we found attention enhancing effects of blue- compared to red-enriched light in the morning (high intensity of ca. 1000 lx, short duration: <1 h) in two of three attention tasks: e.g. better performance in math tests and reduced reaction time variability in a computerized attention test. In our pilot study, actigraphy measures of sleep indicated slight benefits for red- compared to blue-enriched light in the evening: tendencies toward a lower number of phases with movement activity after sleep onset in the complete sample and shorter sleep onset latency in a subgroup with later evening exposure times. These findings point to the relevance of light concepts regarding attention and sleep in typically developing adolescents. Such concepts should be developed and tested further in attention demanding contexts (at school) and for therapeutic purposes in adolescents with impaired attention or impaired circadian rhythms.

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PMID: 30381244  [Indexed for MEDLINE]
We investigated the effectiveness of bright light therapy on cognitive disturbances and its effect on circadian (sleep-wake) rhythm in Alzheimer-type dementia (ATD). Twenty-seven patients with ATD were treated with bright light therapy in the morning for 4 consecutive weeks. We evaluated the cognitive functions and circadian rhythms of the patients as a whole, and as members of two groups (one: questionable and mild dementia; the other: moderate and severe dementia; both groups classified by the severity criteria of Clinical Dementia Rating). We assessed circadian rhythms by actigraphy and cognitive states by Mini-Mental-State Examination (MMSE) and Alzheimer's Disease Assessment Scale (ADAS) before and after light therapy. Bright light therapy improved circadian rhythm. Although bright light therapy had no significant effect on the severity of dementia, it improved the MMSE scores, cognitive functions of ADAS scores (memory > language) and non-cognitive functions of ADAS scores (behavior = mood), especially in the questionable and mild dementia group. These results suggest that bright light therapy improves cognitive functions with the modification of circadian rhythm, especially in the early stages of ATD.

DOI: 10.1272/jnms.66.229
PMID: 10466338 [Indexed for MEDLINE]
The effects of chronic marijuana use on circadian entrainment.

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Animal literature suggests a connection between marijuana use and altered circadian rhythms. However, the effect has not yet been demonstrated in humans. The present study examined the effect of chronic marijuana use on human circadian function. Participants consisted of current users who reported smoking marijuana daily for at least a year and non-marijuana user controls. Participants took a neurocognitive assessment, wore actigraphs and maintained sleep diaries for three weeks. While no significant cognitive changes were found between groups, data revealed that chronic marijuana use may act as an additional zeitgeber and lead to increased entrainment in human users.

DOI: 10.3109/07420528.2015.1004078
PMID: 25801606 [Indexed for MEDLINE]

The effects of chronic partial sleep deprivation on cognitive functions of medical residents.


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OBJECTIVES: Because of on-call responsibilities, many medical residents are
subjected to chronic partial sleep deprivation, a form of sleep restriction whereby individuals have chronic patterns of insufficient sleep. It is unclear whether deterioration in cognitive processing skills due to chronic partial sleep deprivation among medical residents would influence educational exposure or patient safety.

METHOD: Twenty-six medical residents were recruited to participate in the study. Participants wore an Actigraph over a period of 5 consecutive days and nights so their sleep pattern could be recorded. Thirteen participants worked on services that forced chronic partial sleep deprivation (<6 hours of sleep per 24h for 5 consecutive days and nights). The other thirteen residents worked on services that permitted regular and adequate sleep patterns. Following the 5-day sleep monitoring period, the participants completed the three following cognitive tasks: (a) the Wisconsin Card Sorting Test (WCST) to assess abstract reasoning and prefrontal cortex performance; (b) the Time Perception Task (TPT) to assess time estimation and time reproduction skills; and (c) the Iowa Gambling Task (IGT) to assess decision-making ability.

RESULTS: The results of independent samples t-tests found no significant differences between the group who was chronically sleep deprived and the group who rested adequately (all ps > .05).

CONCLUSION: THESE RESULTS MAY HAVE EMERGED FOR SEVERAL POSSIBLE REASONS: (a) chronic partial sleep deprivation may have a lesser impact on prefrontal cortex function than on other cognitive functions; (b) fairly modest chronic sleep restriction may be less harmful than acute and more significant sleep restriction; or (c) our research may have suffered from poor statistical power. Future research is recommended.

PMCID: PMC3430498
PMID: 22952495
Effects of circadian typology on sleep–wake behavior of air traffic controllers.

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The effects of circadian typology on sleep–wake behavior in shiftworkers were investigated using wrist actigraph in 18 air traffic controllers (ATC), nine morning types and nine evening types, working in a backward 1-1-1 super rapid rotation shift schedule. The ATC wore a wrist actigraph continuously over 6 days (3 days on duty and 3 days off duty). Evening types presented more flexible sleep habits and slept significantly less than morning types. Regardless of circadian typology, the morning shift tended to reduce the amount of sleep whereas night shift produced a decrease in daily activity.

DOI: 10.1046/j.1440-1819.2003.01160.x
PMID: 12950710 [Indexed for MEDLINE]

Effects of Cognitive Behavioral Therapy for Insomnia on Sleep-Related Cognitions Among Patients With Stable Heart Failure.

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OBJECTIVE/BACKGROUND: Cognitive behavioral therapy for insomnia (CBT-I) improves insomnia and fatigue among chronic heart failure (HF) patients, but the extent to
which sleep-related cognitions explain CBT-I outcomes in these patients is unknown. We examined the effects of CBT-I on sleep-related cognitions, associations between changes in sleep-related cognitions and changes in sleep and symptoms after CBT-I, and the extent to which cognitions mediated the effects of CBT-I.

PARTICIPANTS: Stable New York Heart Association Class II–III HF patients (total n = 51; n = 26 or 51.0% women; M age = 59.1 ± 15.1 years).

METHODS: HF patients were randomized in groups to group CBT-I (n = 30) or attention control (HF self-management education, n = 21) and completed actigraphy, the Insomnia Severity Index, Pittsburgh Sleep Quality Index, Dysfunctional Beliefs and Attitudes about Sleep (DBAS) and Sleep Disturbance Questionnaires (SDQ), and self-reported fatigue, depression, anxiety, and sleepiness (baseline, immediately after treatment, six months). We used mixed-effects modeling, mediation analysis with a bootstrapping approach, and Pearson correlations.

RESULTS: There was a statistically significant group × mult time effect on DBAS. DBAS mediated the effects of CBT-I on insomnia severity and partially mediated CBT-I effects on fatigue. Improvements in dysfunctional cognitions were associated with improved sleep quality, insomnia severity, sleep latency and decreased fatigue, depression, and anxiety, with sustained effects at six months.

CONCLUSIONS: Improvement in dysfunctional sleep-related cognitions is an important mechanism for CBT-I effects among HF patients who are especially vulnerable to poor sleep and high symptom burden.

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PMCID: PMC5904007
PMID: 28745520  [Indexed for MEDLINE]

Effects of Cognitive Behavioral Therapy for Insomnia on Sleep, Symptoms, Stress, and Autonomic Function Among Patients With Heart Failure.


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Background: Insomnia is common among patients with stable heart failure (HF) and associated with inflammation and altered autonomic function. Purpose: The purposes of this study were to examine the effects of cognitive behavioral therapy for insomnia (CBT-I) on the Hypothalamic Pituitary (HPA) Axis, autonomic function, inflammation, and circadian rhythmicity and the associations between these biomarkers and insomnia, sleep characteristics, symptoms, functional performance, and sleep-related cognitions. Methods: We conducted a subanalysis of a pilot randomized controlled trial (RCT, NCT02827799) whose primary aim was to test the effects of CBT-I on insomnia. We randomized 51 patients with stable Class II-IV HF to CBT-I (n = 30) or attention control (n = 21). Participants completed wrist actigraphy and self-reported insomnia severity, sleep characteristics, sleep-related cognitions, daytime symptoms, and functional performance. We measured day and nighttime urinary free cortisol, melatonin sulfate, epinephrine, and norepinephrine at baseline, and two weeks after CBT-I and computed general linear models and partial correlations. Results: CBT-I had no effects on the biomarkers, but there were statistically significant negative cross-sectional correlations between the ratio of day and night urinary free cortisol and sleep disturbance, anxiety, fatigue, depression, and
negative sleep cognitions. Increases in the ratio between day and night cortisol were associated with statistically significant improvements in fatigue, depression, sleep duration, and sleep-related cognitions. Conclusions: Biomarkers of stress and autonomic function are associated with sleep, sleep-related symptoms, and cognitions among people with chronic HF. Future studies are needed to identify potential causal relationships and the impact of sleep interventions.

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PMID: 30461315


Effects of midazolam on sleep disturbances associated with westward and eastward flights: evidence for directional effects.

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This double-blind parallel groups study investigated the effects of 7.5 mg midazolam on transient insomnia caused by eastward and westward multiple time zone flights. Three groups of six subjects each were treated with either midazolam or placebo during the first four post-flight nights in both directions. Sleep-wake behavior was monitored throughout the study by actigraphic recordings from the wrist of the non-dominant hand in 1 min bins and by morning questionnaires. The results showed that midazolam significantly lengthened sleep and increased the percentages of bins defined as sleep after the eastward flight. These results are discussed in view of recent findings that short-acting benzodiazepines induced phase shifts in mammalian circadian rhythms.

DOI: 10.1007/BF02244135
Effects of N-acetylcysteine and imipramine in a model of acute rhythm disruption in BALB/c mice.


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Circadian rhythm disturbances are among the risk factors for depression, but specific animal models are lacking. This study aimed to characterize the effects of acute rhythm disruption in mice and investigate the effects of imipramine and N-acetylcysteine (NAC) on rhythm disruption-induced changes. Mice were exposed to 12:12-hour followed by 10:10-hour light:dark cycles (LD); under the latter, mice were treated with saline, imipramine or NAC. Rhythms of rest/activity and temperature were assessed with actigraphs and iButtons, respectively. Hole-board and social preference tests were performed at the beginning of the experiment and again at the 8th 10:10 LD, when plasma corticosterone and IL-6 levels were also assessed. Actograms showed that the 10:10 LD schedule prevents the entrainment of temperature and activity rhythms for at least 13 cycles. Subsequent light regimen change activity and temperature amplitudes showed similar patterns of decline followed by recovery attempts. During the 10:10 LD schedule, activity and temperature amplitudes were significantly decreased (paired t test), an effect
exacerbated by imipramine (ANOVA/SNK). The 10:10 LD schedule increased anxiety (paired t test), an effect prevented by NAC (30 mg/kg). This study identified mild but significant behavioral changes at specific time points after light regimen change. We suggest that if repeated overtime, these subtle changes may contribute to lasting behavioral disturbances relevant to anxiety and mood disorders. Data suggest that imipramine may contribute to sustained rhythm disturbances, while NAC appears to prevent rhythm disruption-induced anxiety. Associations between sleep/circadian disturbances and the recurrence of depressive episodes underscore the relevance of potential drug-induced maintenance of disturbed rhythms.

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Effects of one night's sleep deprivation on anaerobic performance the following day.

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The purpose of this study was to determine the effect of one night's sleep deprivation on anaerobic performance in the morning and afternoon of the following day. Thirteen healthy males were studied twice in a balanced, randomized design. The experiment consisted of two conditions 1 week apart. In the sleep deprivation condition (SDN) subjects remained awake overnight and in the control condition (reference night, RN) the same subjects slept at home, retiring between 2230 and 2330 hours, as decided individually, and rising at 0500
hours. In both conditions, activity, sleep and diet were monitored by actimetry and daily activity and dietary diaries. Physical performance testing was carried out at 0600 hours and at 1800 hours after the one night of sleep and the one night of sleep deprivation. At each test occasion, subjects were measured for maximal power (P(max)), peak power (P(peak)) and mean power (P(mean)). Blood lactate concentrations were measured at rest, at the end of the force-velocity (F-V) test, just before and just after the Wingate test and again 5 min later.

Oral temperatures were measured every 2 h. In both conditions, the results showed a circadian rhythm in temperature. Analysis of variance revealed a significant (sleep x time of day of test) interaction effect on P(peak), P(mean) and P(max).

These variables improved significantly from morning to afternoon after RN and SDN. The reference night was followed by a greater improvement than the SDN. Up to 24 h of waking, anaerobic power variables were not affected; however, they were impaired after 36 h without sleep. Analysis of variance revealed that blood lactate concentrations were unaffected by sleep loss, by time of day of testing or by the interaction of the two. In conclusion, sleep deprivation reduced the difference between morning and afternoon in anaerobic power variables. Anaerobic performances were unaffected after 24 h of wakefulness but were impaired after 36 h without sleep.

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The effects of pain, gender, and age on sleep/wake and circadian rhythm parameters in oncology patients at the initiation of radiation therapy.
To date, no studies have evaluated for differences in subjective and objective measures of sleep disturbance in oncology outpatients with and without pain. This descriptive study, recruited 182 patients from 2 radiation therapy (RT) departments at the time of the patient's simulation visit. Approximately 38% of the sample reported moderate to severe pain (ie, worst pain intensity of 6.2 ± 2.4). After controlling for age, patients in pain reported worse sleep quality and more sleep disturbance using the Pittsburgh Sleep Quality Index. With the General Sleep Disturbance Scale, patients in pain reported poorer sleep quality, increased use of sleep medications, and more daytime sleepiness. In addition using an objective measure of sleep disturbance (ie, actigraphy), significant gender × pain interactions were found for sleep onset latency, percentage of time awake at night, wake duration, total sleep time, and sleep efficiency. While no differences were found in female patients, males in pain had worse scores than males without pain. Findings from this study suggest that pain and sleep disturbance are prevalent in oncology outpatients and that a patient's age and gender need to be considered in any evaluation of the relationship between pain and sleep. PERSPECTIVE: The effects of pain on subjective and objective sleep parameters appear to be influenced by both patients' age and gender.

[Effects of ramelteon on a patient with circadian rhythm sleep disorder and mood disorder].

[Article in Japanese]


Ramelteon is a novel hypnotic characterized by its action as a melatonin receptor (MT1/MT2) agonist. It has been reported that ramelteon can alter the phase of the sleep period. We report a patient with circadian rhythm sleep disorder and mood disorder who improved with ramelteon. A 25-year-old man had a 5-year history of emotional instability, excessive daytime sleepiness, and difficulty awakening. He had been diagnosed with mood disorder and narcolepsy by a psychiatrist.

Sertraline, milnacipran, valproate, and methylphenidate were ineffective, and so he presented to our hospital. Interview data and a sleep log demonstrated a delayed sleep phase. As other examinations such as actigraphy and video-polysomnography indicated no other diseases, the patient was diagnosed with circadian rhythm sleep disorder, delayed sleep phase type (ICSD-2). In addition, his mental symptoms were consistent with the criteria for cyclothymia (ICD-10).

After the administration of ramelteon, the phase of his sleep period gradually advanced and his emotional instability improved. Because of the high rate of comorbidity between these two diseases, we should be aware of circadian rhythm sleep disorders that are masked by mood disorders.
Effects of Shift Work on the Postural and Psychomotor Performance of Night Workers.

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The purpose of the study was to investigate the effects of shift work on the psychomotor and postural performance of night workers. The study included 20 polysomnography technicians working schedule of 12-h night shift by 36-h off. On the first day of protocol, the body mass and height were measured, and an actigraph was placed on the wrist of each participant. On the second day of protocol, sleepiness by Karolinska Sleepiness Scale, postural control by force platform (30 seconds) and psychomotor performance by Psychomotor Vigilance Task (10 minutes) were measured before and after 12-h night work. Results showed that after 12-h night work, sleepiness increased by 59% (p<0.001), postural control variables increased by 9% (p = 0.048), and 14% (p = 0.006). Mean reaction time, and the number of lapses of attention increased by 13% (p = 0.006) and 425% (p = 0.015), respectively, but the mean reciprocal reaction time decreased by 7%. In addition, there were correlations between sleepiness and postural control variables with opened eyes (r = 0.616, 95% confidence interval [CI] = 0.361–0.815; r = 0.538; 95% CI = 0.280–0.748) and closed eyes (r = 0.557; 95% CI = 0.304–0.764, r = 0.497; 95% CI = 0.325–0.715) and a pronounced effect of...
sleepiness on postural sway (R² = 0.393; 95% CI = 0.001–0.03). Therefore, 12-h night work system and sleepiness showed a negative impact in postural and psychomotor vigilance performance of night workers. As unexpected, the force platform was feasibility to detect sleepiness in this population, underscoring the possibility of using this method in the workplace to prevent occupational injuries and accidents.

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Effects of short-term quetiapine treatment on emotional processing, sleep and circadian rhythms.

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BACKGROUND: Quetiapine is an atypical antipsychotic that can stabilise mood from any index episode of bipolar disorder. This study investigated the effects of seven-day quetiapine administration on sleep, circadian rhythms and emotional processing in healthy volunteers.

METHODS: Twenty healthy volunteers received 150 mg quetiapine XL for seven nights and 20 matched controls received placebo. Sleep-wake actigraphy was completed for one week both pre-dose and during drug treatment. On Day 8,
participants completed emotional processing tasks. 
RESULTS: Actigraphy revealed that quetiapine treatment increased sleep duration and efficiency, delayed final wake time and had a tendency to reduce within-day variability. There were no effects of quetiapine on subjective ratings of mood or energy. Quetiapine-treated participants showed diminished bias towards positive words and away from negative words during recognition memory. Quetiapine did not significantly affect facial expression recognition, emotional word categorisation, emotion-potentiated startle or emotional word/faces dot-probe vigilance reaction times.
CONCLUSIONS: These changes in sleep timing and circadian rhythmicity in healthy volunteers may be relevant to quetiapine's therapeutic actions. Effects on emotional processing did not emulate the effects of antidepressants. The effects of quetiapine on sleep and circadian rhythms in patients with bipolar disorder merit further investigation to elucidate its mechanisms of action.

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The effects of sleep extension and sleep hygiene advice on sleep and depressive symptoms in adolescents: a randomized controlled trial.

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OBJECTIVE: Sleep problems are common and persistent during adolescence and can have negative effects on adolescents' mood. To date, studies that investigate the effects of sleep extension on adolescents' sleep and depressive symptoms are still lacking. This study aims to investigate the effects of gradual sleep extension combined with sleep hygiene advice in adolescents with chronic sleep reduction on objectively measured sleep, self-reported sleep problems and depressive symptoms.

METHODS: Fifty-five adolescents with chronic sleep reduction (mean age: 15.44 years; 85.5% females) were included in the study. Participants were randomly assigned to either a sleep extension group (gradual sleep extension by advancing bedtimes in the evening and receiving sleep hygiene advice) or to a control group (no instruction). Sleep was measured with actigraphy during three weeks, the first week was the baseline week, and the last two weeks were the experimental weeks during which sleep was extended. Other outcome variables were self-reported sleep problems (daytime sleepiness, symptoms of insomnia and circadian rhythm sleep disorder) and depressive symptoms, which were assessed before and after the experimental manipulation.

RESULTS: During the third week of the experiment, adolescents in the sleep extension group had earlier bedtimes, earlier sleep onsets, spent more time in bed and slept longer than adolescents in the control group. Their chronic sleep reduction, insomnia symptoms and depressive symptoms diminished significantly. In addition, there was a trend of improved circadian rhythm sleep disorder symptoms and sleep quality.

CONCLUSION: Gradual sleep extension combined with sleep hygiene advice seems to have beneficial effects on sleep, self-reported sleep problems and
depressive symptoms of adolescents with chronic sleep reduction. Although we cannot distinguish between the effects of sleep extension and sleep hygiene advice, the results suggest that advancing bedtimes can extend sleep and improve depressive symptoms.


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Effects of sleep loss and strenuous physical activity on the rest-activity circadian rhythm: a study on 500 km and 1,000 km dogsled racers.

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OBJECTIVE: Rest-activity circadian rhythm is strongly linked to an organism's entrainment. Sleep loss and prolonged fatigue could affect the circadian system, inducing neurobehavioral deficits. The Finnmarkslopet is Europe's longest dogsled race. In this competition, lasting up to 7 days, participants (mushers) are physically active most of the time, having little and fragmented rest. Therefore, the race provides an opportunity to investigate the effects of prolonged fatigue and sleep loss.

METHODS: Ten mushers, participating in the 500 km and 1,000 km categories, underwent continuous actigraph monitoring (5 days) before and after the race. During the competition, heart rate (HR) was recorded by an HR monitor.

RESULTS: There was a reduction in the average activity values during
the 24-hr cycle after the race. Although there were signs of a forward phase shift, these were weak and unstable. Nonparametric circadian rhythm analysis (NPCRA) showed reductions in interdaily stability (IS) and relative amplitude (RA). 1,000 km mushers also showed sleep disturbances.

CONCLUSION: A period of 3 days of little and fragmented sleep (3-4 hr of total rest per day), in which subjects were engaged in a prolonged physical effort, was enough to significantly affect the rest-activity rhythm. A longer period (5 days) in such a condition induced even more accentuated alterations, with a disturbance in nocturnal sleep. Disrupted sleep is common among hospitalized patients and those working long shifts. This study demonstrates changes in the structure of the rest-activity circadian rhythm that can result and may suggest opportunities for intervention.

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Effects of sleep loss on the rest-activity circadian rhythm of helpers participating in continuous dogsled races.

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OBJECTIVE: The Finnmarksløpet dogsled race lasts up to 7 days. Helpers, who keep time, coach, and transport equipment, have to be alert though they have little and fragmented sleep. This study investigated disruptions of the rest-activity rhythm among helpers.

METHODS: 10 helpers were monitored by actigraph a week before, during,
and after
the race. Sleep logs, sleepiness rate, and self-reported quality of
sleep were
collected.
RESULTS: Nonparametric circadian rhythm analysis showed significant
differences
between the pre- and postrace interdaily stability and amplitude of
rhythm.
Compared to prerace, sleepiness at bedtime was increased and number of
nocturnal
awakenings was reduced postrace, although the actigraphic outputs
showed no
improvement in sleep quality. Helpers who were engaged in the race for a
longer
span (5-6 days) had more difficulty recovering from the sleep loss
accumulated
during the race than those engaged for a shorter time (2-3 days).
CONCLUSION: Poor sleep combined with prolonged and demanding mental
focus for 2
days or more has a negative influence upon the rest-activity cycle, though
complete restoration of the cycle occurs over 1 week or more. Being in
such a
condition for ≥ 5 days leads to disruptions of the circadian component of
the
sleep-wake cycle that hampers the sleep recovery process. Disrupted
sleep and
demanding mental requirements are common in long-distance sporting
events as well
as among shift workers. Follow-up intervention should be made in such
cases to
ensure the return of a healthy rest-activity rhythm and sleep quality.

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The effects of sleep on circulating catecholamines and aqueous flow in
human
subjects.
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We measured the rate of aqueous flow and analysed its relation to the
time of
day, the state of wakefulness and the urinary excretion of catecholamines. Two
groups of subjects were studied. One group comprised 20 normal subjects who were
studied over two 22-hr periods. During one period, the subjects were permitted to
sleep during their customary hours of sleep; during the other, they were not
permitted to sleep, but remained active for all 22 hr. The other group comprised
ten subjects with obstructive sleep apnea who were studied over a 22-hr period
and slept during their customary hours of sleep but without the aid of any
respiratory device. Aqueous flow was measured with fluorophotometry. Motion of
the wrist was monitored by a seismograph (wrist Actigraph) and served as a
surrogate of activity and wakefulness. Urinary catecholamine excretion was
measured during different periods of the wake/sleep cycle. Both groups exhibited
the normal nocturnal suppression of flow (59% lower compared to morning in the
normal group; 56% lower compared to morning in the apneic group). During sleep
deprivation, the rate of flow at night in normal subjects was 30% lower than
during the morning (P < 0.001) and 60% higher than during sleep (P < 0.001). Lid
closure during sleep deprivation had no effect on the results. Aqueous flow
correlated with a 'catecholamine index', derived from the combined excretion of
epinephrine and norepinephrine. Flow also correlated with an 'activity index',
and 'sleep efficiency', indices derived from motion of the wrist. We conclude
that the day–night difference of aqueous humor flow as measured by clearance of
fluorescein from the human eye is driven partly by a factor that has a circadian
rhythm and partly by a factor that depends on the activity of the subject. We
hypothesize that these factors are the catecholamines, epinephrine and norepinephrine.

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Effects of sleep/wake history and circadian phase on proposed pilot fatigue safety performance indicators.


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The Karolinska Sleepiness Scale and Samn–Perelli fatigue ratings, and psychomotor vigilance task performance are proposed as measures for monitoring commercial pilot fatigue. In laboratory studies, they are sensitive to sleep/wake history and circadian phase. The present analyses examined whether they reliably reflect sleep/wake history and circadian phase during transmeridian flight operations. Data were combined from four studies (237 pilots, 730 out-and-back flights between 13 city pairs, 1–3-day layovers). Sleep was monitored (wrist actigraphy, logbooks) before, during and after trips. On duty days, sleepiness, fatigue and mean response speed were measured pre-flight and at the top of the descent. Mixed-model analysis of variance examined associations between these measures and sleep/wake history, after controlling for operational factors. Circadian phase was approximated by local (domicile) time in the city where each trip began and ended. More sleep in the 24 h prior to duty was associated with lower pre-flight sleepiness and fatigue and faster response speed. Sleepiness and fatigue were greater before flights departing during the domicile night and early morning. At the top of the descent, pilots felt less sleepy and fatigued after more in-flight sleep and less time awake. Flights arriving in the early–mid–morning (domicile time) had greater sleepiness and fatigue and slower response speeds.
than flights arriving later. Subjective ratings showed expected associations with sleep/wake history and circadian phase. The response speed showed expected circadian variation but was not associated with sleep/wake history at the top of the descent. This may reflect moderate levels of fatigue at this time and/or atypically fast responses among pilots.

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The effects of time of day and chronotype on cognitive and physical performance in healthy volunteers.

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BACKGROUND: Whether you are a morning lark or a night owl has proven to be a key contributor in the timing of peak athletic performance. Recent evidence suggests that accounting for these differences, known as one's chronotype, results in significantly different diurnal performance profiles. However, there is limited research investigating multiple measures of performance simultaneously over the course of a socially constrained day.

OBJECTIVES: This study aimed to investigate the impact of chronotype
on indices of cognitive and physical performance at different times of day in healthy volunteers.

METHODS: We recruited 56 healthy individuals categorised as early (ECT, n = 25) or late (LCT, n = 31) chronotypes using the Munich ChronoType Questionnaire, circadian phase markers and objective actigraphy. Measures of cognitive and physical performance, along with self-reported daytime sleepiness, were taken at multiple times of day (14:00 h, 20:00 h and 08:00 h the following morning).

RESULTS: Here, we find significantly different diurnal variation profiles between ECTs and LCTs, for daytime sleepiness, psychomotor vigilance, executive function and isometric grip strength. LCTs were significantly impaired in all measures in the morning compared to ECTs.

CONCLUSION: Our results provide evidence to support the notion that 'night owls' are compromised earlier in the day. We offer new insight into how differences in habitual sleep patterns and circadian rhythms impact cognitive and physical measures of performance. These findings may have implications for the sports world, e.g. athletes, coaches and teams, who are constantly looking for ways to minimise performance deficits and maximise performance gains.

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PMID: 30357501


Effects of transitions into and out of daylight saving time on the quality of the sleep/wake cycle: an actigraphic study in healthy university students.

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The main goal of the present study was to examine the effects of transition into and out of daylight saving time (DST) on the quality of the sleep/wake cycle, assessed through actigraphy. To this end, 14 healthy university students (mean age: 26.86 ± 3.25 yrs) wore an actigraph for 7 d before and 7 d after the transition out of and into DST on fall 2009 and spring 2010, respectively. The following parameters have been compared before and after the transition, separately for autumn and spring changes: bedtime (BT), get-up time (GUT), time in bed (TIB), sleep onset latency (SOL), fragmentation index (FI), sleep efficiency (SE), total sleep time (TST), wake after sleep onset (WASO), mean activity score (MAS), and number of wake bouts (WB). After the autumn transition, a significant advance of the GUT and a decrease of TIB and TST were observed. On the contrary, spring transition led to a delay of the GUT, an increase of TIB, TST, WASO, MAS, and WB, and a decrease of SE. The present results highlight a more strong deterioration of sleep/wake cycle quality after spring compared with autumn transition, confirming that human circadian system more easily adjusts to a phase delay (autumn change) than a phase advance (spring transition).

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Effects of vitamin B12 on bright light on cognitive and sleep-wake rhythm in Alzheimer-type dementia.


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The present study investigated the effects of vitamin B12 (VB12) on circadian rhythm in Alzheimer-type dementia (ATD). Twenty-eight ATD patients were treated with bright light therapy (BLT) for 8 weeks. For the latter 4 weeks, half were treated with VB12 with BLT (BLT + VB12). We evaluated the cognitive state with Mini-Mental State Examination and the circadian rhythm with actigraphy after the fourth and eighth week. After the first 4 weeks BLT improved the circadian rhythm disturbances and cognitive state especially in the early stage of ATD. Although the latter 4 week-BLT caused no significant effects on the circadian rhythm; BLT + VB12 improved the vigilance level during the daytime. These results suggest that VB12 has some efficiency to enhance vigilance for ATD patients.

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PMID: 11422876 [Indexed for MEDLINE]


Effects of Zero-time Exercise on inactive adults with insomnia disorder: a pilot randomized controlled trial.

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OBJECTIVE: To evaluate the feasibility and clinical effects of a lifestyle-integrated exercise, namely zero-time exercise (ZTE), on improving insomnia in inactive adults with insomnia disorder.

METHODS: In this pilot randomized controlled trial, 37 physically inactive adults (mean age: 49.9 years; SD: 13.6; 91.9% female) fulfilling the diagnostic criteria of insomnia disorder recruited from the community were randomly assigned to ZTE group training or sleep hygiene education (SHE) groups. Subjects in the ZTE group (n = 18) attended two 2-hour training lessons to learn ZTE which they then practiced daily for eight weeks. Subjects in the SHE group (n = 19) attended two lessons of the same schedule and duration. The primary outcome measure was the Insomnia Severity Index (ISI).

RESULTS: The ZTE group had lower ISI scores than the SHE group, with a large between-group effect size of 0.93-1.10 at weeks two, four, six, and eight, but the difference became non-significant at week eight, suggesting a loss of efficacy two months after the training. For secondary outcomes, no significant between-group differences were found in sleep parameters by sleep diary or objective actigraphy. The adherence to the ZTE training course was satisfactory, with 83% of the group completing two sessions and 78% continuing to practice ZTE for five days or more per week during the eight-week intervention period.

CONCLUSION: The simple and brief ZTE training showed high acceptability and exercise compliance and the first evidence of efficacy in reducing insomnia severity in inactive adults with insomnia disorder. Confirmatory trials with longer follow-up are justified.

TRIAL REGISTRATION NUMBER: ClinicalTrials.gov, #NCT03155750.

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Effects on resident work hours, sleep duration, and work experience in a randomized order safety trial evaluating resident-physician schedules (ROSTERS).


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STUDY OBJECTIVES: We compared resident physician work hours and sleep in a multicenter clustered-randomized crossover clinical trial that randomized resident physicians to an Extended Duration Work Roster (EDWR) with extended-duration (≥24 hr) shifts or a Rapidly Cycling Work Roster (RCWR), in which scheduled shift lengths were limited to 16 or fewer consecutive hours.

METHODS: Three hundred two resident physicians were enrolled and completed 370 1 month pediatric intensive care unit rotations in six US academic medical centers. Sleep was objectively estimated with wrist-worn actigraphs. Work hours and subjective sleep data were collected via daily electronic diary.

RESULTS: Resident physicians worked fewer total hours per week during the RCWR compared with the EDWR (61.9 ± 4.8 versus 68.4 ± 7.4, respectively; p < 0.0001). During the RCWR, 73% of work hours occurred within shifts of ≤16 consecutive hours. In contrast, during the EDWR, 38% of work hours occurred on shifts of ≤16 consecutive hours. Resident physicians obtained significantly more sleep per week on the RCWR (52.9 ± 6.0 hr) compared with the EDWR (49.1 ± 5.8 hr, p < 0.0001). The percentage of 24 hr intervals with less than 4 hr of actigraphically measured sleep was 9% on the RCWR and 25% on the EDWR (p < 0.0001).

CONCLUSIONS: RCWRs were effective in reducing weekly work hours and the occurrence of >16 consecutive hour shifts, and improving sleep.
duration of resident physicians. Although inclusion of the six operational healthcare sites increases the generalizability of these findings, there was heterogeneity in schedule implementation. Additional research is needed to optimize scheduling practices allowing for sufficient sleep prior to all work shifts. Clinical Trial: Multicenter Clinical Trial of Limiting Resident Work Hours on ICU Patient Safety (ROSTERS), https://clinicaltrials.gov/ct2/show/NCT02134847.

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Efficacy of brief behavioral treatment for chronic insomnia in older adults.

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BACKGROUND: Chronic insomnia is a common health problem with substantial consequences in older adults. Cognitive behavioral treatments are
efficacious but not widely available. The aim of this study was to test the efficacy of brief behavioral treatment for insomnia (BBTI) vs an information control (IC) condition.

METHODS: A total of 79 older adults (mean age, 71.7 years; 54 women [70%]) with chronic insomnia and common comorbidities were recruited from the community and 1 primary care clinic. Participants were randomly assigned to either BBTI, consisting of individualized behavioral instructions delivered in 2 intervention sessions and 2 telephone calls, or IC, consisting of printed educational material. Both interventions were delivered by a nurse clinician. The primary outcome was categorically defined treatment response at 4 weeks, based on sleep questionnaires and diaries. Secondary outcomes included self-report symptom and health measures, sleep diaries, actigraphy, and polysomnography.

RESULTS: Categorically defined response (67% [n = 26] vs 25% [n = 10]; χ(2) = 13.8) (P < .001) and the proportion of participants without insomnia (55% [n = 21] vs 13% [n = 5]; χ(2) = 15.5) (P < .001) were significantly higher for BBTI than for IC. The number needed to treat was 2.4 for each outcome. No differential effects were found for subgroups according to hypnotic or antidepressant use, sleep apnea, or recruitment source. The BBTI produced significantly better outcomes in self-reported sleep and health (group × time interaction, F(5,73) = 5.99, P < .001), sleep diary (F(8,70) = 4.32, P < .001), and actigraphy (F(4,74) = 17.72, P < .001), but not polysomnography. Improvements were maintained at 6 months.

CONCLUSION: We found that BBTI is a simple, efficacious, and durable intervention for chronic insomnia in older adults that has potential for dissemination across medical settings.

TRIAL REGISTRATION: clinicaltrials.gov Identifier: NCT00177203.

DOI: 10.1001/archinternmed.2010.535
Efficacy of Cognitive Behavioral Therapy for Insomnia in Adolescents: A Randomized Controlled Trial with Internet Therapy, Group Therapy and A Waiting List Condition.

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Comment in

STUDY OBJECTIVES: To investigate the efficacy of cognitive behavioral therapy for insomnia (CBTI) in adolescents.

DESIGN: A randomized controlled trial of CBTI in group therapy (GT), guided internet therapy (IT), and a waiting list (WL), with assessments at baseline, directly after treatment (post-test), and at 2 months follow-up.

SETTING: Diagnostic interviews were held at the laboratory of the Research Institute of Child Development and Education at the University of Amsterdam. Treatment for GT occurred at the mental health care center UvAMinds in Amsterdam, the Netherlands.

PARTICIPANTS: One hundred sixteen adolescents (mean age = 15.6 y, SD = 1.6 y, 25% males) meeting DSM-IV criteria for insomnia, were randomized to IT, GT, or WL.

INTERVENTIONS: CBTI of 6 weekly sessions, consisted of psychoeducation, sleep hygiene, restriction of time in bed, stimulus control, cognitive therapy, and relaxation techniques. GT was conducted in groups of 6 to 8 adolescents, guided by 2 trained sleep therapists. IT was applied through an online guided self-help website with programmed instructions and written feedback from a
MEASUREMENTS AND RESULTS: Sleep was measured with actigraphy and sleep logs for 7 consecutive days. Symptoms of insomnia and chronic sleep reduction were measured with questionnaires. Results showed that adolescents in both IT and GT, compared to WL, improved significantly on sleep efficiency, sleep onset latency, wake after sleep onset, and total sleep time at post-test, and improvements were maintained at follow-up. Most of these improvements were found in both objective and subjective measures. Furthermore, insomnia complaints and symptoms of chronic sleep reduction also decreased significantly in both treatment conditions compared to WL. Effect sizes for improvements ranged from medium to large. A greater proportion of participants from the treatment conditions showed high end-state functioning and clinically significant improvement after treatment and at follow-up compared to WL.

CONCLUSIONS: This study is the first randomized controlled trial that provides evidence that cognitive behavioral therapy for insomnia is effective for the treatment of adolescents with insomnia, with medium to large effect sizes. There were small differences between internet and group therapy, but both treatments reached comparable endpoints.

CLINICAL TRIAL REGISTRATION: This study was part of the clinical trial: Effectiveness of cognitive behavioral therapy for sleeplessness in adolescents; URL: http://www.isrctn.com/ISRCTN33922163; registration: ISRCTN33922163.

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The efficacy of Cognitive-Behavioural Therapy (CBT) as related to sleep quality and hyperarousal level in the treatment of primary insomnia.

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BACKGROUND: Primary insomnia (PI) is a common sleep disorder affecting diurnal functioning. It may contribute to the development of several comorbidities such as major depression or arterial hypertension. It affects about 7% of the adult population. Pharmacotherapy remains the most common treatment for insomnia. However, many studies suggest CBT may be a supreme therapeutic approach resulting in a better long-term outcome. The aim of the study was to determine the efficacy of a CBT-protocol in the treatment of PI by means of sleep onset latency and the number of awakenings during night parameters along with sleep quality and the level of psychophysiological hyperarousal. The secondary outcomes were focused on CBT efficacy as determined by the predisposition to insomnia as related to higher vulnerability to stress (measured with FIRST) MATERIAL AND METHODS: Twenty-six individuals from a tertiary reference sleep disorders outpatients' clinic (22 women; mean age 41.4; 4 men; mean age 42.5) with primary insomnia (DSM-IV-TR) were included in the study. The exclusion covered other primary sleep disorders, secondary insomnia (psychiatric illness, unstable somatic illness, shift work), substance abuse/dependence, high results in HADS-M scale (score above 11). The participants were scored with HADS-M, Ford Insomnia Response to Stress Test (FIRST) at the beginning of the study. The Athens Insomnia Scale (AIS), Hyperarousal Scale, Leeds Sleep Questionnaire (LSQ) were applied at
the beginning, at the end and three months after the end of the study. The participants were also examined by 7 days actigraphic records before and after treatment. During the course of the treatment patients completed a Sleep Diary (SD). The CBT program employed was based on the Perlis protocol. Standard individual sessions of 50 minutes were provided on a weekly basis for 8-10 weeks by a board certified CBT therapist. After 3 months a follow-up session was scheduled.

RESULTS: The significant improvement as related to the CBT treatment was present in the measures of sleep onset latency (67.2 vs. 23.4 min.; p<0.000), numbers of awakenings during night (2 vs. 0.4; p<0.000) and sleep efficiency (77.3 vs. 91%; p<0.000) - data from SD, quality of falling asleep (3.2 vs. 6; p<0.000), quality of sleep (3.3 vs. 5.8; p<0.000) and quality of morning awakening (3.2 vs. 6; p<0.000) - data from LSEQ. The improvement reached the significance level in the measure of psychophysiological arousal (52.3 vs. 42.4; p<0.000) and AIS (15.7 vs. 6.8; p<0.000). No significant differences were identified between actigraphic records (light/dark ratio) before and after CBT. FIRST scores allocating patients to high and low stress vulnerability groups were non-contributory to the observed treatment efficacy.

CONCLUSION: CBT is an effective treatment in primary insomnia. No relationship between CBT efficacy and predisposition to insomnia as determined by higher vulnerability to stress was identified.

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Efficacy of melatonin with behavioural sleep-wake scheduling for delayed
sleep–wake phase disorder: A double-blind, randomised clinical trial.


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BACKGROUND: Delayed Sleep–Wake Phase Disorder (DSWPD) is characterised by sleep initiation insomnia when attempting sleep at conventional times and difficulty waking at the required time for daytime commitments. Although there are published therapeutic guidelines for the administration of melatonin for DSWPD, to our
knowledge, randomised controlled trials are lacking. This trial tested the efficacy of 0.5 mg melatonin, combined with behavioural sleep-wake scheduling, for improving sleep initiation in clinically diagnosed DSWPD patients with a delayed endogenous melatonin rhythm relative to patient-desired (or required) bedtime (DBT).

METHODS: This randomised, placebo-controlled, double-blind clinical trial was conducted in an Australian outpatient DSWPD population. Following 1-wk baseline, clinically diagnosed DSWPD patients with delayed melatonin rhythm relative to DBT (salivary dim light melatonin onset [DLMO] after or within 30 min before DBT) were randomised to 4-wk treatment with 0.5 mg fast-release melatonin or placebo 1 h before DBT for at least 5 consecutive nights per week. All patients received behavioural sleep-wake scheduling, consisting of bedtime scheduled at DBT. The primary outcome was actigraphic sleep onset time. Secondary outcomes were sleep efficiency in the first third of time in bed (SE T1) on treatment nights, subjective sleep-related daytime impairment (Patient Reported Outcomes Measurement Information System [PROMIS]), PROMIS sleep disturbance, measures of daytime sleepiness, clinician-rated change in illness severity, and DLMO time.

FINDINGS: Between September 13, 2012 and September 1, 2014, 307 participants were registered; 116 were randomised to treatment (intention-to-treat n = 116; n = 62 males; mean age, 29.0 y). Relative to baseline and compared to placebo, sleep onset occurred 34 min earlier (95% confidence interval [CI] -60 to -8) in the melatonin group. SE T1 increased; PROMIS sleep-related impairment, PROMIS sleep disturbance, insomnia severity, and functional disability decreased; and a greater proportion of patients showed more than minimal clinician-rated improvement following melatonin treatment (52.8%) compared to placebo (24.0%) (P < 0.05). The groups did not differ in the number of nights treatment was taken.
per protocol. Post-treatment DLMO assessed in a subset of patients (n = 43) was not significantly different between groups. Adverse events included light-headedness, daytime sleepiness, and decreased libido, although rates were similar between treatment groups. The clinical benefits or safety of melatonin with long-term treatment were not assessed, and it remains unknown whether the same treatment regime would benefit patients experiencing DSWPD sleep symptomology without a delay in the endogenous melatonin rhythm. CONCLUSIONS: In this study, melatonin treatment 1 h prior to DBT combined with behavioural sleep-wake scheduling was efficacious for improving objective and subjective measures of sleep disturbances and sleep-related impairments in DSWPD patients with delayed circadian phase relative to DBT. Improvements were achieved largely through the sleep-promoting effects of melatonin, combined with behavioural sleep-wake scheduling.

TRIAL REGISTRATION: This trial was registered with the Australian New Zealand Clinical Trials Registry, ACTRN12612000425897.

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Conflict of interest statement: I have read the journal’s policy and the authors of this manuscript have the following competing interests: TLS reports her institution has received equipment donations or other support from Philips Lighting and Philips Respironics. DJK reports he and his institution receive royalties under a licence agreement with Buhlmann Laboratories to supply reagents for melatonin analysis. LCL is a shareholder in Re-Time Pty Ltd. RRG has provided advisory board services for Merck and Teva and has been a medico-legal expert witness for Queensland Health, NSW Nurses Federation, NSW Health, and NSW Director of Public Prosecutions. SWL declares no conflicts of interest related to the published work. In the past 5 years, he has held consulting contracts and
received reimbursement from Akili Interactive; Consumer Sleep Solutions; Delos Living LLC; Headwaters Inc.; Hintsa Performance AG; Light Cognitive; Lighting Science Group Corporation; Mental Workout; Pegasus Capital Advisors LP; PlanLED; Six Senses; and Wyle Integrated Science and Engineering. He has also received one-off consulting fees from Carbon Limiting Technologies and OpTerra Energy Services Inc. in relation to lighting; from several sports teams in relation to jetlag; and from 15 investment firms for short briefings on non-24-hour sleep-wake disorder. Through Brigham & Women’s Hospital, he has received unrestricted equipment gifts from Bioilluminations LLC, Bionetics Corporation, F. Lux Software LLC, and Philips Lighting; service agreements from Rio Tinto Iron Ore and Vanda Pharmaceuticals Inc.; three completed sponsored initiated clinical research contracts with Vanda Pharmaceuticals Inc.; investigator-initiated research grants from Biological Illumination LLC, F. Lux Software, LLC and Vanda Pharmaceuticals Inc.; and a patent for a method for determining and/or controlling sleep quality. SWL has also served as a paid expert witness in an arbitration related to work hours, and in legal proceedings related to light, sleep, and health. SMWR reports that he has served as a consultant through his institution to Vanda Pharmaceuticals, Philips Respironics, and Teva Pharma Australia and has, through his institution, received research grants and/or unrestricted educational grants from Vanda Pharmaceuticals, Takeda Pharmaceuticals North America, Philips Lighting, Philips Respironics, Cephalon, and ResMed Foundation as well as reimbursements for conference travel expenses from Vanda Pharmaceuticals. TLS, JMM, and CJG serve as Project Leaders, and RRG, SWL, and SMWR serve as Program Leaders in the Cooperative Research Centre for Alertness, Safety and Productivity. The other authors declare no conflicts of interest.
Efficacy of the novel antidepressant agomelatine on the circadian
rest-activity
cycle and depressive and anxiety symptoms in patients with major
depressive
disorder: a randomized, double-blind comparison with sertraline.

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OBJECTIVE: This study evaluates the efficacy of agomelatine, the first
antidepressant to be an agonist at MT(1)/MT(2) receptors and an
antagonist at
5-HT(2C) receptors, versus sertraline with regard to the amplitude of the
circadian rest-activity cycle and depressive and anxiety symptoms in patients
with major depressive disorder (MDD).

METHOD: Outpatients with DSM-IV-TR-defined MDD received either
agomelatine 25 to
50 mg (n = 154) or sertraline 50 to 100 mg (n = 159) during a 6-week,
randomized,
double-blind treatment period. The study was conducted from 2005 to
2006. The
main outcome measure was the relative amplitude of the individual
rest-activity
cycles, expressed as change from baseline to week 6 and collected from
continuous
records using wrist actigraphy and sleep logs. Secondary outcome
measures were
sleep efficiency and sleep latency, both derived from actigraphy, and
efficacy on
depression symptoms (17-Item Hamilton Depression Rating Scale total
score and
Clinical Global Impressions scale scores) and anxiety symptoms
(Hamilton Anxiety
Rating Scale total score and subscores).

RESULTS: A significant difference in favor of agomelatine compared to
sertraline
on the relative amplitude of the circadian rest-activity cycle was
observed at the end of the first week (P = .01). In parallel, a significant improvement of sleep latency (P < .001) and sleep efficiency (P < .001) from week 1 to week 6 was observed with agomelatine as compared to sertraline. Over the 6-week treatment period, depressive symptoms improved significantly more with agomelatine than with sertraline (P < .05), as did anxiety symptoms (P < .05).

CONCLUSIONS: The favorable effect of agomelatine on the relative amplitude of the circadian rest-activity/sleep-wake cycle in depressed patients at week 1 reflects early improvement in sleep and daytime functioning. Higher efficacy results were observed with agomelatine as compared to sertraline on both depressive and anxiety symptoms over the 6-week treatment period, together with a good tolerability profile. These findings indicate that agomelatine offers promising benefits for MDD patients.

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Efficient and regular patterns of nighttime sleep are related to increased vulnerability to microsleeps following a single night of sleep restriction.

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Sleep-deprived people, or those performing extended monotonous tasks, can exhibit brief episodes in which they suspend performance and appear to fall asleep momentarily-behavioral microsleeps ("microsleeps"). In this study,
Microsleeps were identified using eye video and tracking response during a 20-min continuous tracking task undertaken by 16 healthy volunteers (mean age 24.9 yrs; 8 females, 8 males) in the early afternoon following a normally rested night and a night of restricted sleep (time-in-bed restricted to 4 h). Sessions were 1 wk apart and counterbalanced. Wrist actigraphy, self-reported sleepiness, and sleep quality were also recorded. We hypothesized that high microsleep rates when normally rested or after a night of sleep restriction would be related to poor sleep quality, sleep disturbance, circadian type, irregular sleep patterns, low daily sleep duration, or poor sleep efficiency. We also hypothesized that prior performance on a 10-min psychomotor vigilance task (PVT) (mean reaction time or number of PVT lapses) would be related to the number of microsleeps during the tracking task and that PVT performance could, therefore, be used as a fitness-for-duty indicator. The number of microsleeps during the tracking task increased following sleep restriction (mean 11.4 versus 27.9; p = 0.03). There were no correlations between the number of microsleeps in the normally rested session and any of the actigraphically measured or self-reported sleep measures. However, the number of microsleeps following sleep restriction was correlated with sleep efficiency (r = 0.73, p = 0.001), sleep onset latency (r = -0.57, p = 0.02), and sleep onset time-of-day standard deviation (r = -0.54, p = 0.03) over 11 normally rested nights. There was no correlation between PVT performance and the subsequent number of microsleeps during the tracking task in either session. Attributes usually associated with beneficial nighttime sleep patterns—going to sleep at a similar time each night, falling asleep quickly, and infrequent arousals—were related to greater vulnerability to microsleeps following sleep restriction. There were intercorrelations between all the sleep measures associated with microsleep rate following sleep restriction,
indicating that the measures form a pattern of behaviors and are not independently related to microsleep rate. Perhaps some people maintain a regular sleep pattern because they experience sleepiness the following day when their pattern is disrupted. Conversely, people with more variation in their sleep pattern may do so because this does not substantially increase sleepiness the following day. We conclude that people with consistent sleep patterns and efficient sleep may be more prone to microsleeps than other people when their usual regular pattern is disrupted by sleep restriction.

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Electroacupuncture for treatment-resistant insomnia: study protocol for a randomised, controlled, assessor-blinded, pilot clinical trial.

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INTRODUCTION: A considerable number of insomnia patients experience sleep disturbance even with long-term use of hypnotic medication. Previous studies have indicated that electroacupuncture (EA) could be an efficacious treatment for managing insomnia. However, few trials have been conducted to evaluate the effectiveness and safety of EA for treatment-resistant insomnia. This pilot study aims to explore the feasibility and preliminary effectiveness and safety of EA as an adjunct treatment for treatment-resistant insomnia.

METHODS AND ANALYSIS: This is a multicentre, randomised, usual care controlled and assessor-blinded pilot study protocol. Fifty patients presenting with sleep problems who have been taking hypnotic medication for more than 3 months will be randomly allocated to either an EA group or a usual care group at a 1:1 ratio. The EA group will undergo 12 EA treatment sessions twice a week for 6 weeks whereas the usual care group will not receive EA treatment. All the participants will receive a brochure containing educational information on sleep hygiene. The primary outcome will be the measured mean change of the total score of the Insomnia Severity Index from the baseline to week 7. The secondary outcome regarding sleep quality will be measured using the Pittsburgh Sleep Quality Index, a sleep diary and actigraphy. Moreover, we will assess the quality of life, the direct and indirect cost of treating insomnia for economic evaluation. After 4 weeks, the subjects will visit the research sites for a follow-up assessment.

ETHICS AND DISSEMINATION: Ethical approval of this study protocol was established by the institutional review boards of the each involved study site. All potential subjects will be provided written informed consent. The results of this study will be accessible in peer-reviewed publications and be presented at academic conference.

TRIAL REGISTRATION NUMBER: KCT0003235.
Elevated serum cytokines correlated with altered behavior, serum cortisol rhythm, and dampened 24-hour rest-activity patterns in patients with metastatic colorectal cancer.


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PURPOSE: Incapacitating symptom burden in cancer patients contributes to poor quality of life (QOL) and can influence treatment outcomes because of poor tolerance to therapy. In this study, the role of circulating cytokines in the production symptoms in cancer patients is evaluated.

EXPERIMENTAL DESIGN: Eighty patients with metastatic colorectal cancer with either normal (group I, n = 40) or dampened (group II, n = 40) 24-hour rest/activity patterns measured by actigraphy were identified. Actigraphy patterns were correlated with QOL indices, serum cortisol obtained at 8:00 a.m. and 4:00 p.m. and with serum levels of transforming growth factor-alpha, tumor necrosis factor-alpha, and interleukin 6 (IL-6) obtained at 8:00 a.m. and analyzed in duplicate by ELISA. Cytokine levels and survival were also correlated.

RESULTS: Group II patients had significantly higher pre treatment levels of all
three cytokines, displayed significantly poorer emotional and social functioning, had higher fatigue, more appetite loss, and poorer performance status compared with group I patients. Transforming growth factor-alpha (TGF-alpha) and IL-6 were significantly increased in the patients with WHO performance status >1 and in those with appetite loss. Fatigue was significantly associated with elevated TGF-alpha only. IL-6 was increased in those patients with extensive liver involvement and multiple organ replacement, and it was significantly correlated with dampened cortisol rhythm. In a multivariate analysis, IL-6 was correlated with poor treatment outcome.

CONCLUSIONS: Significant correlations were found between serum levels of TGF-alpha and IL-6, circadian patterns in wrist activity and serum cortisol and tumor-related symptoms in patients with metastatic colorectal cancer. These data support the hypothesis that some cancer patient's symptoms of fatigue, poor QOL, and treatment outcome are related to tumor or host generated cytokines and could reflect cytokine effects on the circadian timing system. This interplay between cytokine signaling pathways, the hypothalamic-pituitary-adrenal axis, the autonomic nervous system, and efferent pathways of the suprachiasmatic nucleus that control circadian physiology, opens the way to new rational interventions for symptom management in cancer patients.

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Emergency nurses' activity levels across rotating shifts.

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BACKGROUND: Emergency nurses work consecutive, rotating shift patterns. However, how their occupational physical activity levels are associated between these shifts is unknown. This study aimed to examine the associations between emergency nurses' time spent in different activity levels across one shift and the following day's shift.

METHODS: Fifty emergency nurses (45 female, five male) wore an ActiGraph accelerometer and completed work and sleep diaries across four weeks in 2018. A sub-sample (n = 42) also wore an activPAL inclinometer. Time spent sedentary, physically active, and in postural positions was determined. Multi-level analyses examined associations between one shift and the following day's shift.

RESULTS: Additional time spent sedentary and in light-intensity physical activity during the first shift was associated with more time spent being physically active in the following day's shift for all rotations except back-to-back night shifts. However, additional time spent engaged in moderate- to vigorous-intensity physical activity during the first shift was associated with less time spent physically active in the following day's shift for afternoon-morning and morning-afternoon rotations.
CONCLUSION: These findings demonstrate that shift sequences may impact emergency nurses' physical activity across shifts. Future research should identify the strategies emergency nurses use to maintain activity levels between shifts.

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Emotional trait and memory associates of sleep timing and quality.

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Poor ability to remember the extinction of conditioned fear, elevated trait anxiety, and delayed or disrupted nocturnal sleep are reported in anxiety disorders. The current study examines the interrelationship of these factors in healthy young-adult males. Skin-conductance response was conditioned to two differently colored lamps. One color but not the other was then extinguished. After varying delays, both colors were presented to determine extinction recall and generalization. Questionnaires measured sleep quality,
morningness–eveningness, neuroticism and trait anxiety. A subset produced a mean 7.0 nights of actigraphy and sleep diaries. Median split of mean sleep midpoint defined early- and late-"sleep timers". Extinction was more rapidly learned in the morning than evening only in early timers who also better generalized extinction recall. Extinction recall was greater with higher sleep efficiency. Sleep efficiency and morningness were negatively associated with neuroticism and anxiety. However, neuroticism and anxiety did not predict extinction learning, recall or generalization. Therefore, neuroticism/anxiety and deficient fear extinction, although both associated with poor quality and late timing of sleep, are not directly associated with each other. Elevated trait anxiety, in addition to predisposing directly to anxiety disorders, may thus also indirectly promote such disorders by impairing sleep and, consequently, extinction memory.

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Employment status and the association of sociocultural stress with sleep in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL).

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STUDY OBJECTIVES: We examined the association of sociocultural stress severity (i.e. acculturation stress, ethnic discrimination) and chronic stress burden with multiple dimensions of sleep in a population-based sample of US Hispanics/Latinos. We also explored whether employment status modified stress-sleep associations.

METHODS: We conducted survey linear regressions to test the cross-sectional association of sociocultural stress severity and stress burden with sleep dimensions using data collected between 2010 and 2013 from individuals who participated in both the Hispanic Community Health Study/Study of Latinos Sueño and Sociocultural Ancillary studies (N = 1192).

RESULTS: Greater acculturation stress (B = 0.75, standard error [SE] = 0.26, p < .01) and chronic psychosocial stress burden (B = 1.04, SE = 0.18, p < .001) were associated with greater insomnia symptoms but were not associated with actigraphic measures of sleep. Ethnic discrimination was not associated with any of the sleep dimensions. The association of acculturation stress with insomnia severity was greater in unemployed (B = 2.06, SE = 0.34) compared to employed (B = 1.01, SE = 0.31) participants (p-interaction = .08).

CONCLUSIONS: Acculturation stress severity and chronic stress burden are
important and consistent correlates of insomnia, but not actigraphically measured sleep dimensions. If replicated, future research should test whether interventions targeting the resolution of sociocultural stress improve sleep quality in Hispanics/Latinos.

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Employment status is related to sleep problems in adults with autism spectrum disorder and no comorbid intellectual impairment.

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Both sleep problems and unemployment are common in adults with autism spectrum disorder; however, little research has explored this relationship in this population. This study aimed to explore factors that may be associated with the presence of an International Classification of Sleep Disorders–Third Edition defined sleep disorder in adults with autism spectrum disorder (IQ > 80). A total of 36 adults with autism spectrum disorder and 36 controls were included in the study. Participants completed a 14-day actigraphy assessment and questionnaire battery. Overall, 20 adults with autism spectrum disorder met the International Classification of Sleep Disorders–Third Edition criteria for insomnia and/or a circadian rhythm sleep–wake disorder, while only 4 controls met criteria for
these disorders. Adults with autism spectrum disorder and an International Classification of Sleep Disorders–Third Edition sleep disorder had higher scores on the Pittsburgh Sleep Quality Index and were more likely to be unemployed compared to adults with autism spectrum disorder and no sleep disorder. The findings demonstrate, for the first time, that sleep problems are associated with unemployment in adults with autism spectrum disorder. Further research exploring the direction of this effect is required; sleep problems that have developed during adolescence make attainment of employment for those with autism spectrum disorder difficult, or unemployment results in less restrictions required for optimal and appropriate sleep timing.

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Endocrinological and polysomnographic findings in Kleine-Levin syndrome: no evidence for hypothalamic and circadian dysfunction.

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Five subjects—four men, ages 17–28, and one woman, age 30—with Kleine-Levin syndrome were investigated during symptomatic (SP) and asymptomatic (ASP) periods. Investigations comprised medical history, MRI, polysomnography, 24-hour hormone profile of human growth hormone, melatonin, TSH, cortisol and FSH (in the woman only) assessed every 2 hours, actimetry, and sleep logs. Medical history confirmed presence of the three symptoms diagnostic of of typical Kleine-Levin syndrome: hypersomnia, excessive food intake, and psychic alteration. MRIs of the brain were normal in all patients. Symptomatic periods were triggered
by unspecific events, such as infection, sleep deprivation, and alcohol. Polysomnography revealed low sleep efficiency during SPs, decreased amount of slow-wave sleep, and high frequency of stage shifts, indicating sleep fragmentation. Mean 24-hour growth hormone levels were reduced during the SPs in only two patients. Their hGH peaks were dissociated from slow-wave sleep during attacks and intervals, often occurring during wake time. Twenty-four-hour melatonin levels were increased during the SPs in all patients, but were lower in two patients during the nocturnal sleep period. Cortisol, TSH and FSH did not reveal important differences between attacks and intervals. Except for hGH, all hormones had normal circadian excretion during symptomatic and asymptomatic periods. Amplitude of nocturnal activity as assessed by actimetry was significantly increased in two patients, whereas amplitude of daytime activity was significantly reduced in three patients. Actimetry and sleep logs demonstrated prolonged sleep phases during SPs. Our investigation could confirm changes of sleep structure described in the literature. The neuroendocrinological findings could not confirm decreased hGH and cortisol and increased TSH levels during SPs, as previously reported in single cases by many authors. Endocrinological findings did not support an underlying circadian disorder in KLS.

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Endogenous melatonin predicts efficacy of exogenous melatonin in consolidation of fragmented wrist-activity rhythm of adult patients with developmental brain disorders: a double-blind, placebo-controlled, crossover study.

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OBJECTIVE: We studied whether the endogenous melatonin patterns in adult patients with developmental brain disorders have any role in response to exogenous melatonin given as a sleep-promoting medicine.

METHODS: Participants included 15 adults (18-60 years, five females) with developmental brain disorders of varying etiologies, motor handicaps, and long-term history of sleep problems. According to the 24-h patterns of serum melatonin, patients were divided into two subgroups: lower and higher secretors. The pretreatment sleep disorder was characterized by a structured interview, 24-h ambulatory polysomnography and 7-day wrist actigraphy. Patients received 1, 3, or 6mg fast-release melatonin tablets, each for 4 weeks in increasing order, at a constant time of 30min before the desired sleep onset. Similarly, placebos with different codes were given during 3x4 weeks. The 7-day actigraphy was repeated at the end of each drug period. Outcome measures were six different parameters of non-parametric circadian rhythm analysis. Drug effects and 40 confounding/modulating factors were evaluated by applying two-level regression analyses with co-variables.

RESULTS: Exogenous melatonin decreased the fragmentation of the rest-activity rhythm, increased the day/night ratio of activity and advanced the onset of rest period. The effects on fragmentation and day/night ratio were more pronounced in the lower than higher secretors of melatonin. Other contributing factors in the drug effects were blindness and some features of the original sleep disorder (disrupted cyclicity of the sleep architecture in polysomnography or reported daytime somnolence).

CONCLUSIONS: Exogenous melatonin consolidated the fragmented rest-activity in
about half of the patients. Low endogenous serum melatonin levels at night predicted improvement by the drug. Higher doses were not more effective than the lowest dose.

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Environmental and behavioural factors associated with school children's sleep in Aotearoa/New Zealand.

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AIM: To collect objective and subjective sleep data on 6- to 8-year-old children across the week and to identify factors within the family environment associated with sleep differences.

METHODS: Data were collected (n = 52) using actigraphy and diaries for 7 consecutive days and nights and a questionnaire incorporating the Children's Sleep Habits Questionnaire was completed by parents.

RESULTS: Children's actigraphic sleep periods averaged 10 h on school nights and 9.5 h on non-school nights and parents over-estimated children's sleep compared with actigraphy. One third (37%) of children had potential sleep problems. Children who shared a bedroom (31%) had shorter sleep onset latencies and those who consumed caffeinated drinks (33%) went to sleep and awoke later. Increased screen time was associated with later bedtimes on school nights and children with screens in bedrooms (12%) went to bed later and slept less on school nights, and
had higher Children's Sleep Habits Questionnaire scores. Children living with a shift-working adult (27%) slept longer on non-school nights and had shorter sleep onset latencies on school nights.

CONCLUSIONS: It is important to consider children's sleep within the wider family context and to be aware that parents may over-estimate their children's sleep. Simple strategies to promote sleep health in clinical settings or education programmes include regular weekend bedtimes that align with those on school nights, removing technology from bedrooms and minimising caffeine consumption. An awareness of potential sleep differences associated with shift-working adults may ensure children are supported to have consistent sleep routines that promote adequate sleep.

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Equivalence Testing as a Tool for Fatigue Risk Management in Aviation.

Wu LJ, Gander PH, van den Berg M, Signal TL.

BACKGROUND: Many civilian aviation regulators favor evidence-based strategies that go beyond hours-of-service approaches for managing fatigue risk. Several countries now allow operations to be flown outside of flight and duty hour limitations, provided airlines demonstrate an alternative method of compliance that yields safety levels "at least equivalent to" the prescriptive regulations. Here we discuss equivalence testing in occupational fatigue risk management. We present suggested ratios/margins of practical equivalence when comparing...
operations inside and outside of prescriptive regulations for two common aviation safety performance indicators: total in-flight sleep duration and psychomotor vigilance task reaction speed. Suggested levels of practical equivalence, based on expertise coupled with evidence from field and laboratory studies, are ≤ 30 min in-flight sleep and ± 15% of reference response speed.

METHODS: Equivalence testing is illustrated in analyses of a within-subjects field study during an out-and-back long-range trip. During both sectors of their trip, 41 pilots were monitored via actigraphy, sleep diary, and top of descent psychomotor vigilance task. Pilots were assigned to take rest breaks in a standard lie-flat bunk on one sector and in a bunk tapered 9 from hip to foot on the other sector.

RESULTS: Total in-flight sleep duration (134 ± 53 vs. 135 ± 55 min) and mean reaction speed at top of descent (3.94 ± 0.58 vs. 3.77 ± 0.58) were equivalent after rest in the full vs. tapered bunk.

DISCUSSION: Equivalence testing is a complimentary statistical approach to difference testing when comparing levels of fatigue and performance in occupational settings and can be applied in transportation policy making.


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Estimating adolescent sleep patterns: parent reports versus adolescent self-report surveys, sleep diaries, and actigraphy.

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BACKGROUND: In research and clinical contexts, parent reports are often used to gain information about the sleep patterns of their adolescents; however, the degree of concordance between parent reports and adolescent-derived measures is unclear. The present study compares parent estimates of adolescent sleep patterns with adolescent self-reports from surveys and sleep diaries, together with actigraphy.

METHODS: A total of 308 adolescents (59% male) aged 13–17 years completed a school sleep habits survey during class time at school, followed by a 7-day sleep diary and wrist actigraphy. Parents completed the Sleep, Medical, Education and Family History Survey.

RESULTS: Parents reported an idealized version of their adolescent's sleep, estimating significantly earlier bedtimes on both school nights and weekends, significantly later wake times on weekends, and significantly more sleep than either the adolescent self-reported survey, sleep diary, or actigraphic estimates.

CONCLUSION: Parent reports indicate that the adolescent averages a near-optimal amount of sleep on school nights and a more than optimal amount of sleep on weekends. However, adolescent-derived averages indicate patterns of greater sleep restriction. These results illustrate the importance of using adolescent-derived estimates of sleep patterns in this age group and the importance of sleep education for both adolescents and their parents.

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Estimating long-haul airline pilots' at-home baseline sleep duration.
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OBJECTIVE: Characterize the baseline sleep of long-haul airline pilots.
METHODS: Sleep of 332 pilots (median age = 51 years, range = 23-64 years) from 4 airlines was measured by actigraphy while at home and off-duty and by retrospective estimate of the total amount of nighttime sleep usually obtained at home.
RESULTS: Mean actigraphic sleep per 24 hours during baseline periods was 6.8 hours (SD = 1.0 hour), 52 minutes shorter than mean self-reported usual nighttime sleep (7.6 hours, SD = 1.1 hours).
CONCLUSIONS: Pilots' self-reported sleep duration was comparable to weekend sleep of men in general population samples, but their actigraphic baseline sleep was longer than objectively monitored sleep of other samples. Long-haul pilots routinely experience sleep restriction and circadian disruption across trips, both of which are implicated in increased health risks. We recommend that they be educated about the long-term importance for health of obtaining adequate sleep on off-duty days.

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Evaluating sleep characteristics in intensive care unit and non-intensive care unit physicians.

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Healthcare workers' cognitive performances and alertness are highly vulnerable to sleep loss and circadian rhythms. The purpose of this study was to investigate the changes in sleep characteristics of intensive care unit (ICU) and non-ICU physicians. Actigraphic sleep parameters, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale and Hamilton Depression Rating Scale were evaluated for ICU and non-ICU physicians on the day before shift-work and on three consecutive days after shift-work. Total sleep time, sleep latency, wakefulness after sleep onset, total activity score, movement fragmentation index, sleep efficiency, daytime naps and total nap duration were also calculated by actigraph. In the ICU physicians, the mean Pittsburgh Sleep Quality Index score was significantly higher than the non-ICU physicians (P = 0.001), however mean Epworth Sleepiness Scale scores were not found significantly different between the two groups. None of the scores for objective sleep parameters were statistically different between the groups when evaluated before and after shift-work (P > 0.05). However in both ICU and non-ICU physicians, sleep latency was observed to be decreased within the three consecutive-day period after shift-work with respect to basal values (P < 0.001). Total sleep time, total activity score and sleep efficiency scores prior to shift-work were significantly different from shift-work and the three consecutive-days after shift-work, in both groups. Working in the ICU does not
have an impact on objective sleep characteristics of physicians in this study. Large cohort studies are required to determine long-term health concerns of shift-working physicians.

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PMID: 22165360 [Indexed for MEDLINE]


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OBJECTIVES: Bipolar disorder is an illness characterized by sleep and circadian disturbance, and monitoring sleep in this population may signal an impending mood change. Actigraphy is an important clinical and research tool for examining sleep, but has not yet been systematically compared to polysomnography or sleep diary in bipolar disorder. The present study compares actigraphy, polysomnography, and sleep diary estimates of five standard sleep parameters in individuals with bipolar disorder and matched controls across two nights of assessment.

METHODS: Twenty-seven individuals who met diagnostic criteria for bipolar disorder type I or II and were currently between mood episodes, along with 27 matched controls with no history of psychopathology or sleep disturbance, underwent two nights of research laboratory monitoring. Sleep was estimated via polysomnography, actigraphy, and sleep diary.

RESULTS: Over the 108 nights available for comparison, sleep parameter estimates from actigraphy and polysomnography were highly correlated and did not differ between the two groups or across the two nights for sleep onset.
latency, wake after sleep onset, number of awakenings, total sleep time, or sleep efficiency percentage. The medium wake threshold algorithm in the actigraphy software was the most concordant with polysomnography and diaries across the five sleep parameters. Concordance between actigraphy, polysomnography, and sleep diary was largely independent of insomnia presence and medication use. CONCLUSIONS: Actigraphy is a valid tool for estimating sleep length and fragmentation in bipolar disorder.

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Evaluating the role of melatonin in the long-term treatment of delayed sleep phase syndrome (DSPS).

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Delayed sleep phase syndrome (DSPS) involves a mismatch between the usual daily schedule required by the individual's environment and his or her circadian sleep-wake pattern. Patients suffering from DSPS are treated with chronotherapy, light therapy, or melatonin administration. While chronotherapy and light therapy are demanding and difficult treatments that usually lead to compliance problems, melatonin administration is a relatively simple and easy treatment option. Previous studies carried out on relatively small samples of DSPS patients have shown that melatonin has a sleep-promoting and entraining action when taken in
the evening. The present study, which accompanied routine treatment in our sleep
clinic, examined the efficiency of melatonin treatment in a relatively large
population of DSPS subjects by means of subjective reports. The 61 subjects, 37
males and 24 females, were diagnosed with DSPS by means of clinical assessment
and actigraphy at our sleep clinic. Their mean pretreatment falling asleep and
waking times were 03:09 (SD = 86.22 minutes) and 11:31 (SD = 98.58 minutes),
respectively. They were treated with a 6-week course of 5 mg of oral melatonin
taken daily at 22:00. A survey questionnaire was sent to the home of each subject
12–18 months after the end of the treatment; the survey investigated the
efficiency of the melatonin treatment and its possible side effects. Of the
patients, 96.7% reported that the melatonin treatment was helpful, with almost no
side effects. Of these, 91.5% reported a relapse to their pretreatment sleeping
patterns within 1 year of the end of treatment. Only 28.8% reported that the
relapse occurred within 1 week. The pretreatment falling asleep and waking times
of patients in whom the changes were retained for a relatively long period of
time were significantly earlier than those of patients whose relapse was
immediate (t = 2.18, p < .05; t = 2.39, p < .05, respectively), with no
difference in sleep duration. The implications of these findings, as well as
further research possibilities, are discussed.

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PMID: 9562922 [Indexed for MEDLINE]

Evaluation of a brief treatment program of cognitive behavior therapy for
insomnia in older adults.

Lovato N(1), Lack L(1), Wright H(1), Kennaway DJ(2).
OBJECTIVE: To evaluate the efficacy of a brief 4-w group-administered treatment program of cognitive behavior therapy for insomnia (CBT-I) for older adults with sleep maintenance insomnia.

DESIGN: Randomized controlled trial of CBT-I compared to waitlist control with comparisons at pretreatment, posttreatment, and 3-mo follow-up.

SETTING: Flinders University Sleep and Circadian Rhythm Research Laboratory, Adelaide, South Australia.

PARTICIPANTS: One-hundred eighteen adults with sleep maintenance insomnia (mean age = 63.76 y, standard deviation = 6.45 y, male = 55).

INTERVENTIONS: A 4-w, group-based treatment program of CBT-I including bedtime restriction therapy, sleep education, and cognitive restructuring.

MEASUREMENTS: Seven-day sleep diaries, actigraphy, and several self-report measures to assess perceived insomnia severity, daytime functioning, and confidence in and beliefs about sleep.

RESULTS: The brief group-administered CBT-I program produced improvements in the timing and quality of sleep including later bedtimes, earlier out-of-bed times, reduced wake after sleep onset, and improved sleep efficiency. Participants also reported a reduction of the Insomnia Severity Index, Flinders Fatigue Scale, Epworth Sleepiness Scale, Daytime Feeling and Functioning Scale, Sleep Anticipatory Anxiety Questionnaire, the Dysfunctional Beliefs and Attitudes Scale, and increased Sleep Self-Efficacy Scale.

CONCLUSIONS: The treatment program used in the current study has demonstrated potential for a brief, inexpensive, and effective treatment of sleep maintenance insomnia in the older adult population.

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PMCID: PMC3902874
PMID: 24470701 [Indexed for MEDLINE]
An evaluation of a non-contact biomotion sensor with actimetry.

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Actimetry is a widely accepted technology for the diagnosis and monitoring of sleep disorders such as insomnia, circadian sleep/wake disturbance, and periodic leg movement. In this study we investigate a very sensitive non-contact biomotion sensor to measure actimetry and compare its performance to wrist-actimetry. A data corpus consisting of twenty subjects (ten normals, ten with sleep disorders) was collected in the unconstrained home environment with simultaneous non-contact sensor and ActiWatch actimetry recordings. The aggregated length of the data is 151 hours. The non-contact sensor signal was mapped to actimetry using 30 second epochs and the level of agreement with the ActiWatch actimetry determined. Across all twenty subjects, the sensitivity and specificity was 79% and 75% respectively. In addition, it was shown that the non-contact sensor can also measure breathing and breathing modulations. The results of this study indicate that the non-contact sensor may be a highly convenient alternative to wrist-actimetry as a diagnosis and screening tool for sleep studies. Furthermore, as the non-contact sensor measures breathing modulations, it can additionally be used to screen for respiratory disturbances in sleep caused by sleep apnea and COPD.

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PMID: 18002543 [Indexed for MEDLINE]
Evaluation of actigraphy and automated telephoned questionnaires to assess hypnotic effects in insomnia.


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This study aimed to explore new methodologies in insomnia research, namely whether actigraphy was suitable to show hypnotic effects over weeks in insomnia, and to compare an automated method of questionnaire data collection with traditional methods. Thirty-eight insomniacs took part in a 5-week, double-blind, placebo-controlled study of the effects of 2 weeks of administration of temazepam 20 mg on sleep. Outcome measures were actigraphy and daily St Mary's Hospital Sleep Questionnaires (SMHSQ). Actigraphy was performed using Actiwatch (CNT) and analysed using both the automated Actiwatch sleep analysis software and non-parametric analysis of rest-activity rhythms. The questionnaires were administered as straightforward pencil-and-paper for half of the time and an automated telephoned system for the other half. The experimental paradigm allowed within-subject comparison of traditional and automated data collection, both on and off drug. Actigraphy showed a high degree of inter-subject variability but, nevertheless, some sleep variables (Fragmentation Index, Actual Sleep Time %) showed significant improvement during drug treatment, and Sleep Efficiency and Actual Sleep Time were significantly worsened during the first post-drug week. Nonparametric circadian rhythm analysis showed no significant effect. Subjective data from the SMHSQ showed significant drug effects and there was no significant difference in scores between the automated and pencil-and-paper methods; automated data collection was slightly more acceptable to patients and
minimized
data entry and management. Effect sizes using within-subject and
between-subject
comparisons were calculated for the subjective and objective measures
to inform
future studies

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PMID: 15076015  [Indexed for MEDLINE]

536. BMJ Open. 2015 Dec 7;5(12):e008589. doi: 10.1136/
bmjopen-2015-008589.

Evaluation of actigraphy-measured sleep patterns among children with
disabilities
and associations with caregivers' educational attainment: results from a
cross-sectional study.

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OBJECTIVES: To use wrist-actigraphy to collect objective measures of
sleep and to
characterise actigraphy-measured sleep patterns among children with
disabilities.
We also assessed the extent to which, if at all, caregivers' education is
associated with children's sleep disturbances.
DESIGN: Cross-sectional study.
SETTING: A rehabilitation centre in the Patagonia region, Chile.
METHODS: This study was conducted among 125 children aged 6–12 years
with
disabilities (boys: 55.2%) and their primary caregivers in Chile.
Children wore ActiSleep monitors for 7 days. A general linear model was fitted to generate least-square means and SEs of sleep efficiency (proportion of the sleep period spent asleep) across caregivers' education levels adjusting for children's age, sex, disability type, caregiver-child relationship and caregivers' age. Multivariable logistic regression analyses were conducted to estimate ORs and 95% CIs of longer sleep latency (≥ 30 min) and longer wake after sleep onset (WASO) (≥ 90 min) (a measure of sleep fragmentation) in relation to caregivers' educational attainment.

RESULTS: Median sleep latency was 27.3 min, WASO 88.1 min and sleep duration 8.0 h. Mean sleep efficiency was 80.0%. Caregivers' education was positively and significantly associated with children's sleep efficiency (p trend<0.001).

Adjusted mean sleep efficiency was 75.7% (SE=1.4) among children of caregivers <high school education, and 81.9% (SE=1.0) among children of caregivers >high school education. Compared to children whose caregivers had >high school, children of caregivers with <high school had higher odds of longer sleep latency (OR=3.27; 95% CI 1.12 to 9.61) and longer WASO (OR=5.95; 95% CI 1.91 to 18.53).

Associations were consistent across disability types.

CONCLUSIONS: Children with disabilities experience difficulties initiating sleep (prolonged sleep latency) and maintaining sleep (long WASO, low sleep efficiency). Among children with disabilities, lower level of caregivers' education is associated with more sleep disturbances.
Evaluation of an individualised programme to promote self-care in sleep-activity in patients with coronary artery disease -- a randomised intervention study.

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AIMS AND OBJECTIVES: To evaluate the effectiveness of an individualised programme to promote self-care in sleep-activity in patients with coronary artery disease.

BACKGROUND: Recent scientific findings have shown that low physical exercise and stress interfere with coronary artery disease patients' sleep quality and sleep efficiency independent of gender, age and co-morbidity.

DESIGN: A randomised pretest-post-test control design.

METHODS: Forty-seven patients who had undergone a coronary revascularisation procedure and/or pharmacological treatment three to seven weeks earlier at a general hospital were randomised to either an intervention group or a control group. Data collection was carried out by questionnaires, a study-specific sleep diary and actigraphy registration for 10 consecutive 24-hour periods, with a follow-up after three to four months. The intervention group underwent a nurse-led individualised education programme to promote self-care of sleep-activity. Sleep habits and sleep-related lifestyle together formed the basis for setting up individual goals together with the nurse. Individual advice on physical training, relaxation exercise and a CD-based relaxation programme was provided by a physiotherapist. Both groups received a brochure about
sleep and stress.

RESULTS: At a three- to four-month follow-up, the main improvements were seen in the intervention group regarding sleep quality, sleep duration and sleep efficiency in the sleep diary and sleep efficiency in actigraphy. Statistical improvements in health-related quality of life were revealed. This was not so obvious in the control group.

CONCLUSIONS: An individualised intervention programme to promote self-care of sleep-activity including relaxation in patients with coronary artery disease led by a nurse may improve sleep quality. However, a longitudinal study to promote self-care in sleep-activity should be performed using a larger sample and multiple sites with continuous follow-ups to determine whether any positive effects remain stable over time.

RELEVANCE TO CLINICAL PRACTICE: Implementation of a multiprofessional individualised programme to promote self-care of sleep-activity including relaxation based on patients' needs, supported by a healthcare team and led by nurses, is important in clinical practice.

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Evaluation of an interactive school-based sleep education program: a cluster-randomized controlled trial.

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OBJECTIVES: Shortened sleep has negative consequences on adolescents' well-being. The present study evaluated an interactive school-based sleep education program (SEP) aimed at increasing adolescent sleep duration. DESIGN AND INTERVENTION: A cluster-randomized controlled trial with 12 clusters (classes) was used. The intervention group received a SEP and the active control group received a healthy living program (HLP). Both groups underwent a 4-week class-based education program. The SEP students learned about the importance of sleep, the barriers to getting enough sleep, and how to improve their time management to increase their sleep opportunity. The HLP students learned about various health-related topics not including sleep. PARTICIPANTS: A total of 210 students (mean age = 14.04 ± 0.32 years) were randomly assigned to the SEP (n = 102) or the HLP (n = 108) group, with 6 classes per group. MEASUREMENTS: Sleep (actigraphically measured), sleep knowledge, and time usage were assessed using linear mixed models at three time points: baseline, immediately after intervention, and 1-month follow-up. RESULTS: Sleep knowledge improved at follow-up in the SEP relative to the HLP group (p = .017). Although students were receptive of the program and self-reported the intention to create more time for sleep, no changes in sleep were found following the SEP. Some benefit may have been masked by exam preparations at the follow-up evaluation. CONCLUSIONS: Sleep education alone may not be sufficient to change sleep behavior. A combination of sleep education, starting school later, and parental...
involvement may be needed to encourage and enable changes in adolescent sleep duration.

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Evening intake of alcohol, caffeine, and nicotine: night-to-night associations with sleep duration and continuity among African Americans in the Jackson Heart Sleep Study.


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STUDY OBJECTIVES: We examined the night-to-night associations of evening use of alcohol, caffeine, and nicotine with actigraphically estimated sleep duration, sleep efficiency, and wake after sleep onset (WASO) among a large cohort of African American adults.

METHODS: Participants in the Jackson Heart Sleep Study underwent wrist actigraphy for an average of 6.7 nights and completed concurrent daily sleep diary assessments to record any consumption of alcohol, caffeine, and nicotine within 4 hours of bedtime. Linear mixed-effect models were fit and adjusted for age, sex, educational attainment, body mass index, depression, anxiety, stress, and having work/school the next day.

RESULTS: Eligible participants (n = 785) were an average of 63.7 years (SD: 10.6), and were predominantly female (67.9%). There were 5164 days of concurrent actigraphy and sleep diary data. Evening alcohol use was associated with that night's lower sleep efficiency (-0.98% [95% CI: -1.67% to -0.29%], p = 0.005), but not with WASO or sleep duration. Evening nicotine use was associated with that night's lower sleep efficiency [1.74% (95% CI: -2.79 to -0.68), p = 0.001] and 6.09 minutes higher WASO ([95% CI: 0.82 to 11.35], p = 0.02), but was not associated with sleep duration. Evening caffeine use was not associated with any of the sleep parameters.

CONCLUSION: Nicotine and alcohol use within 4 hours of bedtime were associated with increased sleep fragmentation in the associated night, even after controlling for multiple potential confounders. These findings support the importance of sleep health recommendations that promote the restriction of evening alcohol and nicotine use to improve sleep continuity.

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Eveningness as a risk for behavioral problems in late adolescence.


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Circadian preference toward eveningness has been associated with increased risk for mental health problems both in early adolescence and in adulthood. However, in late adolescence, when circadian rhythm naturally shifts to later, its significance for mental health is not clear. Accordingly, we studied how circadian rhythm estimated both by self-reported chronotype and by actigraph-defined midpoint of sleep was associated with self-reported psychiatric problems based on Youth Self Report (YSR). The study builds on a community cohort born in 1998, Helsinki, Finland. At age 17 years (mean age = 16.9, SD = 0.1 years), 183 adolescents (65.6% of the invited) participated in the study. We used the shortened version of the Horne-Östberg morningness–eveningness Questionnaire to define the chronotype, and actigraphs to define the naturally occur circadian rhythm over a 4 to 17 days' period (mean nights N = 8.3, SD = 1.8).
The Achenbach software was used to obtain T-score values for YSR psychiatric problem scales. The analyses were adjusted for important covariates including gender, socioeconomic status, body mass index, pubertal maturation, mother's licorice consumption during pregnancy, and actigraph-defined sleep duration and quality. Eveningness was associated with higher scores in rule-breaking behavior and conduct problems (as assessed either by midpoint of sleep or by self-reported chronotype, p-values <0.05), attention deficit/hyperactivity problems (by self-reported chronotype, p-values <0.05), with affective problems (by midpoint of sleep and by self-reported chronotype, p-values <0.05) and somatic complaints (by self-reported chronotype, p-values <0.05), as compared to circadian tendency toward morningness. Our results suggest that the association between eveningness and externalizing problem behavior, present in children and younger adolescents, is also present in late adolescence when circadian rhythms shift toward evening.

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Event marker compliance in actigraphy.

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Actigraphy is a versatile tool for evaluating sleep-wake cycles over time in the home-environment. Patients using the Phillips Actiwatch place an event
marker when going to sleep and upon awakening. We investigate compliance in pressing the Actiwatch event marker button for patients referred for insomnia, hypersomnia and disorders of circadian rhythm. We retrospectively analysed event markers from 150 patients undergoing actigraphy for 2,117 nights combined. Compliance was evaluated from inspection of actigraphy records, and coded as full or partial. From patient records, a construct called the C-factor, designed to describe poor social resources and chronic unemployment, was used together with age and sex to predict compliance. We found a mean compliance between 54.0% and 76.3% for a median monitoring duration of 14 days. There was an overall insignificant effect of age (p = .081), but when analysed only for females there was a significant effect of 0.56% pr. year (p = .0038). Compliance was higher for women, Cohen's $d = 0.65$ (p = .01). The C-factor predicts 18.3% (confidence interval 9%-27.5%) lower compliance. Morning and evening compliance are correlated at $r = .65$. In conclusion, actigraphy event marker compliance is generally moderate or high, with older women exhibiting the highest compliance. C-factor predicts lower compliance, and this pattern may further translate to other circumstances. If compliance is important, clinicians may want to consider the effects of age, sex and C-factor.

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Evidence-Based Design Features Improve Sleep Quality Among Psychiatric Inpatients.
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OBJECTIVE: The primary aim of the present study was to compare sleep characteristics pre- and post-move into a state-of-the-art mental health facility, which offered private sleeping quarters. BACKGROUND: Significant evidence points toward sleep disruption among psychiatric inpatients. It is unclear, however, how environmental factors (e.g., dorm-style rooms) impact sleep quality in this population. METHODS: To assess sleep quality, a novel objective technology, actigraphy, was used before and after a facility move. Subjective daily interviews were also administered, along with the Horne-Ostberg Morningness-Eveningness Questionnaire and the Pittsburgh Sleep Quality Index. RESULTS: Actigraphy revealed significant improvements in objective sleep quality following the facility move. Interestingly, subjective report of sleep quality did not correlate with the objective measures. Circadian sleep type appeared to play a role in influencing subjective attitudes toward sleep quality. CONCLUSIONS: Built environment has a significant effect on the sleep quality of psychiatric inpatients. Given well-documented disruptions in sleep quality present among psychiatric patients undergoing hospitalization, design elements like single patient bedrooms are highly desirable.
Evidence for daily and weekly rhythmicity but not lunar or seasonal rhythmicity of physical activity in a large cohort of individuals from five different countries.


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BACKGROUND: Biological rhythmicity has been extensively studied in animals for many decades. Although temporal patterns of physical activity have
been identified in humans, no large-scale, multi-national study has been published, and no comparison has been attempted of the ubiquity of activity rhythms at different time scales (such as daily, weekly, monthly, and annual). METHODS: Using individually worn actigraphy devices, physical activity of 2,328 individuals from five different countries (adults of African descent from Ghana, South Africa, Jamaica, Seychelles, and the United States) was measured for seven consecutive days at different times of the year. RESULTS: Analysis for rhythmic patterns identified daily rhythmicity of physical activity in all five of the represented nationalities. Weekly rhythmicity was found in some, but not all, of the nationalities. No significant evidence of lunar rhythmicity or seasonal rhythmicity was found in any of the groups. CONCLUSIONS: These findings extend previous small-scale observations of daily rhythmicity to a large cohort of individuals from around the world. The findings also confirm the existence of modest weekly rhythmicity but not lunar or seasonal rhythmicity in human activity. These differences in rhythm strength have implications for the management of health hazards of rhythm misalignment.

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Evidence of sub-optimal sleep in adolescent Middle Eastern academy soccer players which is exacerbated by sleep intermission proximal to dawn.

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The purpose was to assess sleep patterns, quantity and quality in adolescent (16.2 ± 1.2 yr) Middle Eastern academy soccer players (n = 20) and the influence of an intermission upon these characteristics. On a 17-day training camp (located one time zone west of home) including three discrete matches, sleep was assessed pre- (PRE) and post-match (POST) via wrist actigraphy. Retrospective actigraphy analysis identified sleep characteristics, including if players experienced a sleep intermission (YES) or not (NO) proximal to dawn, and bedtime (hh:mm), get-up time (hh:mm), time in bed (h), sleep duration (h) and sleep efficiency (%). Within YES two bouts were identified (BOUT1 and BOUT2). No differences were seen between PRE and POST, nor between BOUT1 and BOUT2 (p > .05). Overall players did not meet National Sleep Foundation (NSF) guidelines (7:04 ± 1:16 h vs. recommended 8-10 h for 14-17 yr). Sleep duration was significantly reduced (~13% or ~1:06) in YES compared to NO (6:33 ± 1:05 vs. 7:29 ± 1:17, p < .01).

Despite players in YES waking earlier due to an intermission, they did not compensate for this with a later wake time, rising significantly earlier compared to NO (09:40 ± 00:38 vs. 10:13 ± 00:40, p < .05). These players on average do not obtain sufficient sleep durations relative to NSF guidelines, with decrements increased by an intermission proximal to dawn. High inter- and intra-individual variance in the players sleep characteristics indicates the need for individualized sleep education strategies and interventions to promote appropriate sleep.
Evolution of severe sleep-wake cycle disturbances following traumatic brain injury: a case study in both acute and subacute phases post-injury.


BACKGROUND: Sleep-wake disturbances are frequently reported following traumatic brain injury (TBI), but they remain poorly documented in the acute stage of injury. Little is known about their origin and evolution.

CASE PRESENTATION: This study presents the case of a patient in the acute phase of a severe TBI. The patient was injured at work when falling 12 m into a mine.
and was hospitalized in the regular wards of a level I trauma centre. From days 31 to 45 post-injury, once he had reached a level of medical stability and continuous analgosedation had been ceased, his sleep-wake cycle was monitored using actigraphy. Results showed significant sleep-wake disturbances and severe sleep deprivation. Indeed, the patient had an average nighttime sleep efficiency of 32.7 ± 15.4 %, and only an average of 4.8 ± 1.3 h of sleep per 24-h period.

After hospital discharge to the rehabilitation centre, where he remained for 5 days, the patient was readmitted to the same neurological unit for paranoid delusions. During his second hospital stay, actigraphy recordings resumed from days 69 to 75 post-injury. A major improvement in his sleep-wake cycle was observed during this second stay, with an average nighttime sleep efficiency of 96.3 ± 0.9 % and an average of 14.1 ± 0.9 h of sleep per 24-h period.

CONCLUSION: This study is the first to extensively document sleep-wake disturbances in both the acute and subacute phases of severe TBI. Results show that prolonged sleep deprivation can be observed after TBI, and suggest that the hospital environment only partially contributes to sleep-wake disturbances. Continuous actigraphic monitoring may prove to be a useful clinical tool in the monitoring of patients hospitalized after severe TBI in order to detect severe sleep deprivation requiring intervention. The direct impact of sleep-wake disturbances on physiological and cognitive recovery is not well understood within this population, but is worth investigating and improving.

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Examination of Sleep and Injury Among College Football Athletes.

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Burke, TM, Lisman, PJ, Maguire, K, Skeiky, L, Choynowski, JJ, CapaldiIII, VF, Wilder, JN, Brager, AJ, and Dobrosielski, DA. Examination of sleep and injury among college football athletes. J Strength Cond Res 34(3): 609-616, 2020—The purpose of this study was to characterize subjective sleep metrics in collegiate football players at the start of the season, determine the relationship between preseason subjective sleep measures and in-season objective sleep characteristics, and examine the association between subjective and objective sleep metrics and incidence of time-loss injury during the competitive season. Ninety-four Division I football players completed 5 validated sleep-related questionnaires to assess sleep quality, insomnia severity, daytime sleepiness, sleep apnea risk, and circadian preference before the start of the season. Clinical thresholds for sleep questionnaires were used to determine risk of sleep disorders. Continuous wrist actigraphy was collected throughout the season to generalize sleep behaviors. Time-loss injury incidence data were recorded and used for analysis. Results indicated that 67.4% (60 of 89) of athletes scored above clinical threshold in at least 1 questionnaire to indicate sleep disorder risk. At the start of the season, players subjectively reported an average sleep duration of 7:16 ± 1:18 hours:minutes, which was in contrast to the 6:04 ± 0:41
hours:minutes measured through actigraphy during the season. Logistic regression
models adjusted for age and body mass index revealed no significant associations
between injury and subjective (odds ratio [OR] = 1.00; 95% confidence interval
[CI] = 0.99–1.01) and objective (OR = 1.01; 95% CI = 0.99–1.02) sleep duration or
measures attained from sleep questionnaires (ORs ranged from 1.01 to
2.87). Sleep metrics (quantity and quality) were not associated with increased risk
of injury in this cohort of collegiate football players.

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An examination of the association between chronic sleep restriction
and electrocortical arousal in college students.

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OBJECTIVE: The deleterious neurocognitive effects of laboratory-
controlled short-term sleep deprivation are well-known. The present study investigated
neurocognitive changes arising from chronic sleep restriction outside the
laboratory.

METHODS: Sleep patterns of 24 undergraduates were tracked via
actigraphy across a
15-week semester. At the semester beginning, at a midpoint, and a week before finals, students performed the Psychomotor Vigilance Test (PVT) and cortical arousal was measured via event-related potentials (ERP) and resting state electroencephalography (EEG).

RESULTS: Average daily sleep decreased between Session 1 and Sessions 2 and 3. Calculated circadian rhythm measures indicated nighttime movement increased and sleep quality decreased from Sessions 1 and 2 to Session 3. Parallel to the sleep/activity measures, PVT reaction time increased between Session 1 and Sessions 2 and 3 and resting state alpha EEG reactivity magnitude and P3 ERP amplitude decreased between Session 1 and Sessions 2 and 3. Cross-sectional regressions showed PVT reaction time was negatively associated with average daily sleep, alpha reactivity, and P3 changes; sleep/circadian measures were associated with alpha reactivity and/or P3 changes.

CONCLUSIONS: Small, but persistent sleep deficits reduced cortical arousal and impaired vigilant attention.

SIGNIFICANCE: Chronic sleep restriction impacts neurocognition in a manner similar to laboratory controlled sleep deprivation.

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Examining courses of sleep quality and sleepiness in full 2 weeks on/2 weeks off offshore day shift rotations.

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To better understand sleep quality and sleepiness problems offshore, we examined courses of sleep quality and sleepiness in full 2-weeks on/2-weeks off offshore day shift rotations by comparing pre-offshore (1 week), offshore (2 weeks) and post-offshore (1 week) work periods. A longitudinal observational study was conducted among N=42 offshore workers. Sleep quality was measured subjectively with two daily questions and objectively with actigraphy, measuring: time in bed (TIB), total sleep time (TST), sleep latency (SL) and sleep efficiency percentage (SE%). Sleepiness was measured twice a day (morning and evening) with the Karolinska Sleepiness Scale. Changes in sleep and sleepiness parameters during the pre/post and offshore work periods were investigated using (generalized) linear mixed models. In the pre-offshore work period, courses of SE% significantly decreased (p=.038). During offshore work periods, the courses of evening sleepiness scores significantly increased (p<.001) and significantly decreased during post-offshore work periods (p=.004). During offshore work periods, TIB (p<.001) and TST (p<.001) were significantly shorter, SE% was significantly higher (p=.002), perceived sleep quality was significantly lower (p<.001) and level of rest after wake was significantly worse (p<.001) than during the pre- and post-offshore work periods. Morning sleepiness was
significantly higher during offshore work periods (p=.015) and evening sleepiness was significantly higher in the post-offshore work period (p=.005) compared to the other periods. No significant changes in SL were observed. Courses of sleep quality and sleepiness parameters significantly changed during full 2-weeks on/2-weeks off offshore day shift rotation periods. These changes should be considered in offshore fatigue risk management programmes.

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Examining the Behavioural Sleep-Wake Rhythm in Adults with Autism Spectrum Disorder and No Comorbid Intellectual Disability.

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This study aimed to examine the behavioural sleep-wake rhythm in 36 adults with autism spectrum disorder (ASD) and to determine the prevalence of circadian sleep-wake rhythm disorders compared to age- and sex-matched controls. Participants completed an online questionnaire battery, a 14-day sleep-wake diary and 14-day actigraphy assessment. The results indicated that a higher proportion of adults with ASD met criteria for a circadian rhythm sleep-wake disorder compared to control adults. In particular, delayed sleep-wake phase disorder was particularly common in adults with ASD. Overall the findings suggest that individuals with ASD have sleep patterns that may be associated with
circadian rhythm disturbance; however factors such as employment status and co-morbid anxiety and depression appear to influence their sleep patterns.

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Excessive daytime sleepiness, objective napping and 11-year risk of Parkinson's disease in older men.

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Background: It is unknown whether subjective daytime sleepiness or objective napping could precede the risk of Parkinson's disease (PD) in the long term.
Methods: We studied 2920 men (mean age 76 years) without a history of PD and followed them for 11 years. Excessive daytime sleepiness (EDS) was defined as having an Epworth Sleepiness Scale score >10. Objective naps were defined as ≥5 consecutive minutes of inactivity as measured by actigraphy, and napping duration was the accumulated time of naps outside the main sleep period. We used logistic regression to compare PD risk across four groups: no EDS& napping <1
Results: We identified 106 incident PD cases over 11 years. After multivariable adjustment, men with napping ≥ 1h/day alone were twice as likely [odds ratio (OR) = 1.96, 95% confidence interval (CI) 1.25-3.08], and men with both EDS and napping ≥ 1 h/day were almost three times as likely to develop PD (2.52, 1.21-5.27), compared with the referent group. Compared with those with naps for <30 min, men who napped for ≥1 h/day had more than double the risk of PD. No association was found for EDS alone and PD risk. Further adjustment for chronotype and circadian stability, or excluding PD cases identified within 2 years after napping measurements, showed similar results. Conclusions: Objective long napping rather than subjective EDS was prospectively associated with a higher risk of PD in older men. Objective measures of napping might be valuable as a preclinical marker for PD.

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Exercise during early pregnancy is associated with greater sleep continuity.

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OBJECTIVES/BACKGROUND: Pregnant women report disturbed sleep beginning in early pregnancy. Among nonpregnant populations, exercise has been associated with improved sleep; however, research in pregnant samples has been equivocal. We examined whether varying degrees of exercise were associated with better nocturnal sleep among pregnant women during early gestation.

PARTICIPANTS: 172 pregnant women.

METHODS: Self-reported sleep and exercise and objective sleep were collected during early gestation: T1 (10-12 weeks), T2 (14-16 weeks), and T3 (18-20 weeks) from 172 pregnant women. Exercise was categorized into three time-varying groups: 0 metabolic equivalent minutes per week (MET-min/week), 1 to < 500 MET-min/week, or ≥ 500 MET-min/week. Linear mixed-effects models were employed to test hypotheses.

RESULTS: A significant main effect for Time (F[2,254] = 9.77, p < 0.0001) and Time*Exercise group interaction were observed for actigraphic sleep efficiency (aSE) (F[4,569] = 2.73, p = 0.0285). At T2, women who reported ≥ 500 MET-min/week had higher aSE than those who reported 0 MET-min/week. Significant main effects for Exercise Group and Time were observed for actigraphic wake after sleep onset (aWASO; F[2,694] = 3.04, p = 0.0483 and F[2,260] = 3.21, p = 0.0419). aWASO was lowest for those reporting 1 to < 500 MET-min/week (t[701] = 2.35, adjusted p = 0.0489) and aWASO decreased from T1 to T3 (t[258] = 2.53, adjusted p value = 0.036). Lastly, there was a main effect for Time for the PSQI (F[2,689] = 52.11, p < 0.0001), indicating that sleep quality improved over time.

CONCLUSIONS: Some level of exercise among pregnant women appears to be more advantageous than no exercise at all. Moderate exercise, while still unclearly
defined, may be a worthwhile adjunct treatment to combat sleep disturbances
during pregnancy.

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PMID: 27739877 [Indexed for MEDLINE]


Exogenous melatonin in periodic limb movement disorder: an open clinical trial
and a hypothesis.

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STUDY OBJECTIVES: The etiology of Periodic Limb Movement Disorder (PLMD) as well
as the precise role of melatonin in human physiology remains poorly understood.
Inspired by a single case observation we performed the presented study in order
to obtain first evidence for the hypothesis that exogenous melatonin would
decrease PLM's and thereby improves symptoms of PLMD patients.

DESIGN: N/A.
SETTING: N/A.

PATIENTS/PARTICIPANTS: Nine patients with first time diagnosis of PLMD without
RLS were treated over a six-week period with 3 mg melatonin, taken
between 10 and
11 p.m.

INTERVENTIONS: N/A.

RESULTS: Melatonin improved well-being in 7 of the 9 patients.
Polysomnography,
performed prior and at the end of melatonin treatment, demonstrated a significant
reduction of investigated movement parameters, such as PLMs, PLM
index, PLMs with
arousals and PLM-arousal index. Actigraphy, measured over 14 nights prior and
during the last 14 days of melatonin treatment, showed a significant reduction in
movement rate and minutes with movements during Time in Bed.

CONCLUSIONS: The temporal distribution of PLMs, as well as the
coupling of PLMs with the phase position of circadian temperature curve, suggest an involvement of the circadian timing system in the pathophysiology of PLMD. Locomotor activity in animals clearly exhibits a circadian pattern and can be strongly influenced by exogenous melatonin. Results suggest a chronobiotic effect of exogenous melatonin in PLMD. More specifically, we hypothesize that the mode of action of melatonin in the presented PLMD patients might have been an increase of output-amplitude of the circadian timing system, thereby enhancing the circadian rhythmicity of locomotor activity with a reduction of sleep motor activity.

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Exploration of Circadian Rhythms in Patients with Bilateral Vestibular Loss.


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BACKGROUND: New insights have expanded the influence of the vestibular system to the regulation of circadian rhythmicity. Indeed, hypergravity or bilateral vestibular loss (BVL) in rodents causes a disruption in their daily rhythmicity for several days. The vestibular system thus influences hypothalamic regulation of circadian rhythms on Earth, which raises the question of whether daily rhythms might be altered due to vestibular pathology in humans. The aim of this study was to evaluate human circadian rhythmicity in people presenting a total bilateral vestibular loss (BVL) in comparison with control participants.

METHODOLOGY AND PRINCIPAL FINDINGS: Nine patients presenting a total idiopathic BVL and 8 healthy participants were compared. Their rest-activity cycle was recorded by actigraphy at home over 2 weeks. The daily rhythm of temperature was continuously recorded using a telemetric device and salivary cortisol was recorded every 3 hours from 6:00AM to 9:00PM over 24 hours. BVL patients displayed a similar rest activity cycle during the day to control participants but had higher nocturnal actigraphy, mainly during weekdays. Sleep efficiency was reduced in patients compared to control participants. Patients had a marked temperature rhythm but with a significant phase advance (73 min) and a higher variability of the acrophase (from 2:24 PM to 9:25 PM) with no correlation to rest-activity cycle, contrary to healthy participants. Salivary cortisol levels were higher in patients compared to healthy people at any time of day.

CONCLUSION: We observed a marked circadian rhythmicity of temperature in patients with BVL, probably due to the influence of the light-dark cycle. However, the lack of synchronization between the temperature and rest-activity cycle supports the hypothesis that the vestibular inputs are salient input to the circadian
An exploratory analysis of the association of circadian rhythm dysregulation and insomnia with suicidal ideation over the course of treatment in individuals with depression, insomnia and suicidal ideation.

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STUDY OBJECTIVES: Sleep disturbance is significantly associated with suicidal ideation. However, the majority of research has examined the relationship between insomnia and suicidality. The current exploratory study examined the relationship of circadian rhythm dysregulation (eveningness, seasonality, and rhythmicity) with suicidality.

METHODS: We examined the association of insomnia, eveningness, seasonality, and rhythmicity with suicidal ideation in 103 participants with depression, insomnia, and suicidality within a larger 8-week double-blinded randomized control trial primarily examining whether cautious use of zolpidem extended-release (ER) or placebo reduced suicidal ideation. All participants additionally received an open-label selective serotonin reuptake inhibitor (SSRI). Methodological
Strengths of the current analyses included consideration of multiple sleep-wake constructs, adjustment for relevant covariates, investigation of relationships over the course of treatment, and use of both self-report measures and objective measurement with actigraphy.

RESULTS: Over the course of treatment, self-reported eveningness and greater insomnia severity were independently correlated with greater suicidal ideation, whereas actigraphic delayed sleep timing was related to suicidal ideation at a trend level. At the end of treatment, those with greater suicidal ideation demonstrated lower actigraphic activity levels. There were no significant relationships between self-reported seasonality and actigraphic measures of sleep disturbance and suicidality.

CONCLUSIONS: Self-reported delays in sleep timing, objectively lower activity levels, and self-reported insomnia severity correlated independently to greater suicidal ideation in those with depression, insomnia, and suicidality. These exploratory findings highlight the need to consider sleep-wake constructs more broadly in those with suicidality in future research studies to more definitively improve both assessment and intervention efforts.

CLINICAL TRIAL REGISTRATION: ClinicalTrials.gov identifier: NCT01689909.

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Exploring sleep disturbances in adolescent borderline personality disorder using actigraphy: a case report.

Guilé JM(1), Huynh C, Desrosiers L, Bouvier H, MacKay J, Chevrier E, Godbout R, Breton JJ.
Actigraphy has been used in clinical pediatric populations for many years, including attention deficit-hyperactivity disorder and mood disorders to characterize circadian rhythms of motor activity, and as an alternative evaluation of sleep patterns. We present a case of an adolescent presenting with borderline personality disorder (BPD) and substance dependence for whom an investigation of sleep patterns using actigraphy and a sleep diary appeared to be useful in managing the case. Actigraphy contributed to the diagnostic clarification and disconfirmed the relevance of prescribing medication to this patient for sleep problems. Actigraphy is a cost-effective measure to evaluate sleep/wake patterns allowing for several-day-periods of observation. From the patient standpoint, actigraphy is less invasive than more in-depth investigation as polysomnography. Actigraphy might be a promising tool in those clinical occurrences when disentangling sleep disturbances from primary diagnosis or substance use is required.

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Children's sleep is critical for optimal health and development; yet sleep duration has decreased in recent decades, and many children do not have adequate sleep. Certain sleep behaviours ('sleep hygiene') are commonly recommended, and there is some evidence that they are associated with longer nighttime sleep.

Parents of 84 British 3-year-old children were interviewed about their children's sleep and completed five-night/four-day sleep diaries documenting their children's sleep, from which daily sleep duration was estimated. Diaries were validated by actigraphy in a subgroup of children. Sleep hygiene behaviours (regular bedtime, reading at bedtime, falling asleep in bed) were associated with each other, and were more common in the high socioeconomic status compared to the low socioeconomic status group. Parents' reasons for not practicing sleep hygiene included difficulty, inability or inconvenience. Sleep hygiene behaviours were associated with significantly longer child sleep at night but not over 24 h.

Longer daytime napping compensated for shorter nighttime sleep in children whose parents did not implement sleep hygiene behaviours. Parents may need to be advised that certain behaviours are associated with longer nighttime sleep and given practical advice on how to implement these behaviours. © 2014 The Authors. Infant and Child Development published by John Wiley & Sons, Ltd.

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PMID: 25598710


Exponential state transition dynamics in the rest-activity architecture of
patients with bipolar disorder.


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OBJECTIVE: Our goal was to model the temporal dynamics of sleep-wake transitions, represented by transitions between rest and activity obtained from actigraphic data, in patients with bipolar disorder using a probabilistic state transition approach.

METHODS: We collected actigraphic data for 14 days from 20 euthymic patients with bipolar disorder, who had been characterized clinically, demographically, and with respect to their circadian preferences (chronotype). We processed each activity record to generate a series of transitions in both directions between the states of rest (R) and activity (A) and plotted the estimated transition probabilities (pRA and pAR). Each 24-hour period was also divided into a rest phase consisting of the eight consecutive least active hours in each day and an active phase consisting of the 16 consecutive most active hours in each day. We then calculated separate transition probabilities for each of these phases for each participant. We subsequently modeled the rest phase data to find the best fit for rest-activity transitions using maximum likelihood estimation. We also examined the association of transition probabilities with clinical and demographic variables.

RESULTS: The best-fit model for rest-activity transitions during the rest phase was a mixture (bimodal) of exponential functions. Of those patients with rapid cycling, 75% had an evening-type chronotype. Patients with bipolar II
disorder taking antidepressants had a lower probability of transitioning back to rest than those not on antidepressants [mean ± SD = 0.050 ± 0.006 versus 0.141 ± 0.058, \( F(1,15) = 3.40, p < 0.05 \)].

CONCLUSIONS: The dynamics of transitions between rest and activity in bipolar disorder can be accounted for by a mixture (bimodal) of exponential functions. Patients taking antidepressants had a reduced probability of sustaining and returning to sleep.

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Extreme Violation of Sleep Hygiene: Sleeping Against the Biological Clock During a Multiday Relay Event.


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BACKGROUND: Sleep hygiene is important for sleep quality and optimal performance during the day. However, it is not always possible to follow sleep hygiene requirements. In multiday relay events, athletes have to sleep immediately after physical exertion and sometimes against their biological clock.
OBJECTIVES: In this pilot study we investigated the effect of having
to sleep at
an abnormal circadian time on sleep duration.
PATIENTS AND METHODS: Eight runners and two cyclists performing a 500
km relay
race were followed. They were divided into two groups that took turns
in running
and resting. Each group ran four times for approximately five hours
while the
other group slept. As a result, sleep times varied between normal and
abnormal
times. All athletes wore actigraphs to record the duration and onset
of sleep.
RESULTS: Linear mixed model analyses showed that athletes slept on
average 43
minutes longer when they slept during usual (night) times than during
abnormal
(day) times. In general, sleep duration decreased during the race with
on average
18 minutes per period.
CONCLUSIONS: This pilot study shows that, even under extreme violation
of sleep
hygiene rules, there still is an apparent effect of circadian rhythm
on sleep
duration in relay race athletes.

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PMCID: PMC4691309
PMID: 26715971

Factors associated with objective (actigraphic) and subjective sleep
quality in
young adult women.

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OBJECTIVE: The aim of this study was to describe factors associated
with
actigraphic and subjective sleep quality in young women.
METHODS: Participants were 73 regularly menstruating women, 20-40
years old, who
were not taking oral contraceptives, pregnant, or shift workers. Women
contributed an average of 7 nights of actigraphy data during the luteal menstrual cycle phase, resulting in a total of 595 nights of data.

RESULTS: One night of actigraphy data was unreliable for measuring total sleep time, sleep onset, and time in bed (intraclass correlation < or = .15) but was acceptable for measuring sleep efficiency and total wake time (intraclass correlation [ICC]=.52). Going to bed late, medication use, employment, increased daylight hours, longer menstrual cycle length, and higher body mass index (BMI) were associated with poorer actigraphic sleep measures. Employment, age, and perceived stress were associated with subjective sleep quality.

CONCLUSION: Multiple factors were associated with sleep quality in these young women who were sleeping at home. However, the associations differed for subjectively versus actigraphically assessed sleep quality. Actigraphy is feasible for measuring sleep, but multiple recording nights may be needed to obtain reliable estimates.

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Family exemplars during implementation of a home pain management intervention.

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Postoperative pain and symptom management at home following pediatric tonsillectomy and adenoidectomy (T & A) is challenging. There are few randomized clinical trials that have established postoperative care interventions that are specific and effective during home recovery. The purpose of this pilot feasibility study was to describe how children and their families
implemented a randomly assigned alarm intervention designed to promote postoperative around-the-clock administration of analgesics. Thirteen children from 12 through 18 years of age were randomly assigned to either the around-the-clock (RTC) intervention group (n = 7) or the usual care group (UCG) of controls (n = 6). The RTC intervention group was requested to use an alarm as a reminder to awaken and administer analgesia during the nighttime hours of sleep. Children randomly assigned to the UCG of controls were given the same discharge education as the RTC intervention group that emphasized around-the-clock administration of analgesia. The UCG of controls were not requested to use the alarm intervention. Both groups documented pain intensity and other symptoms daily for 3 days in a diary. All children wore an actigraphy-score wrist monitor to assess sleep during the same 3 days. Telephone interviews were conducted with the children and mothers at 24 hours and 10 to 14 days after surgery. Nonparametric statistics were used to compare differences between the two groups. Children in the RTC intervention group administered significantly (p = .014) more analgesics by the second postoperative day than the UCG of controls. Pain intensity was moderate to severe for both groups. The mean hours of nighttime sleep for the two groups did not differ. Themes that emerged from the qualitative analysis of the interviews included painful challenges; struggling with decisions; making things work; a lengthy recovery; and family support. Results supported the need for research to establish evidenced-based home care interventions specific for T & A postoperative recovery. Mothers and children suggested the need for education and support that extends longer into the recovery period.

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PMID: 19919172  [Indexed for MEDLINE]

561. Behav Sleep Med. 2011 Dec 28;10(1):70-80. doi:
This study examined associations among socioeconomic status (SES), SES-related variables, and sleep in young middle school adolescents. Participants included 155 seventh-graders attending two urban New England middle schools. Aspects of the SES environment included parent demographic variables (e.g., income and education), neighborhood environment, and family home environment. Students completed 1 week of actigraphy to estimate sleep patterns. Results demonstrated that the timing and consistency of school-night sleep were associated with demographic and behavioral aspects of SES, whereas weekend sleep schedules were associated with demographic, behavioral, and neighborhood aspects of SES. Finally, regularity in school-night and weekend sleep schedules were associated with demographic and neighborhood aspects of SES.
BACKGROUND: Bright light therapy and exercise interventions are effective methods for treating seasonal and non-seasonal affective disorders. Synchronization of internal circadian rhythms with the external environment by light therapy and physical activity may partly explain its efficacy. In the present study, we objectively measured daytime light exposure and physical activity in real life situations with elderly participants, and investigated the association between farming habits and the prevalence of depressive symptoms.

METHODS: This cross-sectional was conducted among 1005 participants (mean age: 71.5) of a community-based cohort study. Depressive symptoms were assessed by the Geriatric Depression Scale (GDS score $\geq 6$) and administration of antidepressant.

RESULTS: Farming habit with long duration (> 7.0 h/week) showed significantly lower odds ratios (OR) for depressive symptoms (adjusted OR 0.63, 95% confidential interval, 0.41 to 0.96) compared with participants without farming habit independent of confounders such as age, gender, body mass index, smoking, drinking, daytime ambulatory systolic blood pressure, diabetes, living alone, education, income, and daylength. Even in farming with short duration ($\leq 7.0$ h/week), we found significant association with lower OR for depressive symptoms (adjusted OR 0.64, 95%CI, 0.42 to 0.97). Light exposure and daytime physical activity measured by wrist actigraphy were significantly higher among participants with longer farming habits ($p$ for trend < 0.01). Physical activity
mediated 12.0% of association between farming habit and depressive symptoms.
LIMITATIONS: A cross-sectional association may be found because the participants with depressive symptoms tended to avoid farming. A longitudinal study is warranted to determine the direction of causality.
CONCLUSIONS: Participants with farming habit showed significantly lower OR for depressive symptoms than those without farming habit, and it was partly mediated by physical activity.

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Fatigue and Circadian Activity Rhythms in Breast Cancer Patients Before and After Chemotherapy: A Controlled Study.

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BACKGROUND: Breast cancer (BC) patients often experience cancer-related fatigue (CRF) before, during, and after their chemotherapy. Circadian rhythms are 24-hour cycles of behavior and physiology that are generated by internal pacemakers and entrained by zeitgebers (e.g., light). A few studies have suggested a relationship between fatigue and circadian rhythms in some clinical populations.

METHODS: One hundred and forty-eight women diagnosed with stage I-III breast cancer and scheduled to receive at least four cycles of adjuvant or neoadjuvant chemotherapy, and 61 controls (cancer-free healthy women) participated in this study. Data were collected before (Baseline) and after four cycles of
chemotherapy (Cycle-4). Fatigue was assessed with the Short Form of Multidimensional Fatigue Symptom Inventory (MFSI-SF); circadian activity rhythm (CAR) was recorded with wrist actigraphy (six parameters included: amplitude, acrophase, mesor, up-mesor, down-mesor and F-statistic). A mixed model analysis was used to examine changes in fatigue and CAR parameters compared to controls, and to examine the longitudinal relationship between fatigue and CAR parameters in BC patients. RESULTS: More severe CRF (total and subscale scores) and disrupted CAR (amplitude, mesor and F-statistic) were observed in BC patients compared to controls at both Baseline and Cycle-4 (all p's<0.05); BC patients also experienced more fatigue and decreased amplitude and mesor, as well as delayed up-mesor time at Cycle-4 compared to Baseline (all p's<0.05). The increased total MFSI-SF scores were significantly associated with decreased amplitude, mesor and F-statistic (all p's<0.006). CONCLUSION: CRF exists and CAR is disrupted even before the start of chemotherapy. The significant relationship between CRF and CAR indicate possible underlying connections. Re-entraining the disturbed CAR using effective interventions such as bright light therapy might also improve CRF.

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PMID: 23412418


Fatigue and other variables during adjuvant chemotherapy for colon and rectal cancer.

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PURPOSE/OBJECTIVES: To examine patterns of fatigue and other variables (sleep quality, sleep-wake variables, activity and rest, circadian rhythms, quality of life [QOL], blood counts, and demographic and medical variables) during colon and rectal cancer adjuvant chemotherapy, as well as feasibility of the study.

DESIGN: Longitudinal, descriptive feasibility study.

SETTING: Two oncology clinics in the midwestern region of the United States.

SAMPLE: From April 2006–December 2008, 27% of screened subjects (n = 21) enrolled and 14 completed the study. Participants were middle aged, partnered, and employed and had postsecondary education.

METHODS: Measurements completed during the first week of three two-week cycles (chemotherapy 1–3) and at six weeks (before chemotherapy 4) were the Piper Fatigue Scale, Pittsburgh Sleep Quality Index, wrist actigraphy, Functional Assessment of Cancer Therapy–Colon, blood counts, and demographic and medical data form. Analysis included descriptive statistics and repeated-measures analysis of variance.

MAIN RESEARCH VARIABLES: Fatigue, sleep quality, sleep-wake variables, activity-rest, circadian activity rhythms, and QOL.

FINDINGS: Fatigue was mild at baseline and rose to moderate levels during chemotherapy 1–3. Sleep quality was poor the months prior to chemotherapy 1 and chemotherapy 4. Actigraphy data revealed disturbed sleep, low daytime activity, and impaired circadian activity rhythms during the first week after chemotherapy 1–3. QOL ratings were similar to those in other cancer populations. Fatigue increased, and white blood cell counts decreased significantly over time.

CONCLUSIONS: During adjuvant chemotherapy, patients reported moderate fatigue and poor sleep quality; actigraphs confirmed problems with sleep maintenance as well as low daytime activity and disturbed circadian rhythms. Multiple barriers were encountered during the study.

IMPLICATIONS FOR NURSING: Clinicians should screen for fatigue and
Fatigue, sleep, and circadian rhythms prior to chemotherapy for breast cancer.

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GOALS: Previous investigations have shown that women undergoing chemotherapy for breast cancer experience both disturbed sleep and fatigue. However, most of the previous research examined women either during or after chemotherapy. This study examined sleep, fatigue, and circadian rhythms in women with breast cancer before the start of chemotherapy.

PATIENTS AND METHODS: Eighty five women with Stages I–IIIA breast cancer who were scheduled to begin adjuvant or neoadjuvant anthracycline-based chemotherapy participated. Each had sleep/wake activity recorded with actigraphy for 72 consecutive hours and filled out questionnaires on sleep, fatigue, depression, and functional outcome.

MAIN RESULTS: On average, the women slept for about 6 h a night and napped for over an hour during the day. Sleep was reported to be disturbed and fatigue levels were high. Circadian rhythms were robust, but women who were more phase-delayed reported more daily dysfunction (p<0.01).

CONCLUSIONS: The data from the current study suggest that the women with breast cancer likely experience both disturbed sleep and fatigue before the beginning of
chemotherapy. Although their circadian rhythms are robust, breast cancer patients with more delayed rhythms experience more daily dysfunction secondary to fatigue. These data suggest that strategies to improve disturbed sleep and to phase-advance circadian rhythms prior to initiation of chemotherapy may be beneficial in improving daily function in breast cancer patients.

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PMCID: PMC1599708
PMID: 16010529 [Indexed for MEDLINE]


Fatigue, sleep disturbances and circadian rhythm in multiple sclerosis.

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The aim of this study was to investigate whether fatigue and sleep disturbances in multiple sclerosis (MS) patients might be due to disrupted circadian sleep wake regulation. Actigraphy and a multiple sleep latency test (MSLT) were performed in 16 MS patients with both prominent sleep complaints and fatigue. Actigraphy scores did not differ from control values, whereas sleep onset latency values were altered in subgroups of MS patients. No evidence was found for a generalized circadian disturbance in MS patients.

DOI: 10.1007/BF00867360
PMID: 8410088 [Indexed for MEDLINE]


Feasibility and acceptability of brief behavioral therapy for cancer-
BACKGROUND: This phase II RCT was conducted to determine the feasibility and acceptability of brief behavioral therapy for cancer-related insomnia (BBT-CI) in breast cancer patients undergoing chemotherapy. We also assessed the preliminary effects of BBT-CI on insomnia and circadian rhythm in comparison to a Healthy Eating Education Learning control condition (HEAL).

METHODS: Of the 71 participants recruited, 34 were randomised to receive BBT-CI and 37 to receive HEAL. Oncology staff was trained to deliver the intervention in four community clinics affiliated with the NCI. Insomnia was assessed with the Insomnia Severity Index (ISI), and circadian rhythm was assessed using a wrist-worn actiwatch.

RESULTS: Community staff interveners delivered 72% of the intervention components, with a recruitment rate of 77% and an adherence rate of 73%, meeting acceptability and feasibility benchmarks. Those randomised to BBT-CI improved their ISI scores by 6.3 points compared to a 2.5-point improvement in those randomised to HEAL (P = 0.041). Actigraphy data indicated that
circadian functioning improved in the BBT-CI arm as compared to the HEAL arm at post-intervention (all P-values <0.05).

CONCLUSIONS: BBT-CI is an acceptable and feasible intervention that can be delivered directly in the community oncology setting by trained staff. The BBT-CI arm experienced significant improvements in insomnia and circadian rhythm as compared to the control condition.

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PMID: 30026614 [Indexed for MEDLINE]


Feasibility and behavioral effects of an at-home multi-night sleep restriction protocol for adolescents.

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BACKGROUND: Sleep deprivation is common among adolescents and has been associated with adverse behavioral and educational outcomes. However, it is difficult to draw strong causal conclusions because of a dearth of experimental sleep research. In part, this appears related to methodological challenges when working with this population. This study tested the feasibility and behavioral effects of a multi-night, at-home experimental sleep restriction protocol in a sample of adolescents.

METHODS: Twenty healthy adolescents aged 13.9–16.9 years were enrolled in a three-week sleep manipulation protocol using a counterbalanced cross-over
experimental design. The protocol included a baseline week, followed in random order by a short sleep week (Monday–Friday nights limited to 6.5 hours time in bed) and an extended sleep week (10 hours lights-out time in bed Monday–Friday nights). Sleep was monitored via self-report and objective actigraphy. These were reviewed with participants and parents on the Saturdays at the end of each week, when parents and participants also completed behavior rating questionnaires. RESULTS: One participant dropped out of the study, but each of the remaining 19 displayed markedly less sleep in the short sleep condition than the extended sleep condition (average nightly gap approximately 2.5 hours). Data also reflected indirect effects of sleep deprivation that are consistent with an increase in homeostatic sleep drive. Compared to the extended sleep week, parents during the short sleep week reported that the participants displayed significantly greater problems with sleepiness, attention, oppositionality/irritability, behavior regulation, and metacognition. Participant self-report results were similar, though less robust. CONCLUSIONS: A multi-night, at-home sleep manipulation protocol for use with adolescents is indeed feasible. This study also provided the first experimental evidence that chronic sleep restriction during adolescence is causally related to a wide range of behavioral deficits.

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PMID: 18564072  [Indexed for MEDLINE]

Feasibility and Preliminary Efficacy of a Bright Light Intervention in Ovarian and Endometrial Cancer Survivors.

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BACKGROUND: Cancer-related sleep disturbance is common and can adversely affect physical and mental health. Bright light (BL) therapy is a novel intervention that targets sleep by promoting circadian regulation. Emerging evidence suggests BL can improve sleep disturbance, symptom burden, and health-related quality of life in cancer and other populations; however, this research is limited. The present two-phase pilot study assessed the feasibility and preliminary intended effects of BL therapy on sleep in ovarian and endometrial cancer survivors, and explored biologic and chronobiologic factors that may underlie intervention effects.

METHODS: In phase I, focus groups were conducted with 12 survivors and 9 gynecologic oncology clinicians to evaluate and gather feedback about the proposed study. In phase II, a pilot randomized controlled trial was conducted with 18 ovarian or endometrial cancer survivors who were randomized 1:1 to receive 45 min of BL or dim light (DL) for 4 weeks. Participants wore wrist actigraphs; completed sleep diaries and self-report questionnaires;
and provided blood, saliva, and urine samples at baseline (T1), post-intervention (T2), and 3-month follow-up (T3).

RESULTS: Study procedures were modified according to focus group results. Enrollment, retention, and adherence were all ≥ 80%. Mixed-model ANOVAs demonstrated that the number of nighttime awakenings per actigraphy, and sleep quality and depression per self-report, trended toward improvements in the BL condition compared to the DL condition. These variables improved from T1 to T2 before returning to baseline at T3. Effect sizes were generally medium to large.

CONCLUSIONS: Study findings suggest that BL therapy is feasible among ovarian and endometrial cancer survivors. It may be an effective, non-pharmacological approach to reduce sleep disturbance and symptom burden in this population.

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PMID: 32080797


Feasibility of using actigraphy and motivational-based interviewing to improve sleep among school-age children and their parents.

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Inadequate sleep occurs in 25% of our nation's children; poor sleep is associated with physical, cognitive, and social consequences. Developing good sleep hygiene in middle childhood is important, because habits typically extend to adolescence and adulthood; yet, there has been little research on sleep interventions for school-age children. The purpose of this study was to determine the
Feasibility of a developmentally tailored, motivation-based intervention (MBI) focused on improving sleep behaviors in school-age children aged 8–11. Nine parent–child dyads participated in an 8-week protocol utilizing MBI and comparisons of objective (actigraphy) and subjective (sleep diaries) data. Results suggest that parent and children are able to identify a target behavior to change and complete the protocol. Further, preliminary evidence indicates that sleep patterns change using MBI. Future research will be directed toward comparative effectiveness testing and exploring ways in which it can be adapted and incorporated into school nursing practice.

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Fighting fire and fatigue: sleep quantity and quality during multi-day wildfire suppression.

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This study examined firefighters' sleep quantity and quality throughout multi-day wildfire suppression, and assessed the impact of sleep location, shift length, shift start time and incident severity on these variables. For 4 weeks, 40 volunteer firefighters' sleep was assessed using wrist actigraphy. Analyses
revealed that the quantity of sleep obtained on fire days was restricted, and pre- and post-sleep fatigue ratings were higher, compared to non-fire days. On fire days, total sleep time was less when: (i) sleep location was in a tent or vehicle, (ii) shifts were greater than 14 h and (iii) shifts started between 05:00 and 06:00 h. This is the first empirical investigation providing objective evidence that firefighters' sleep is restricted during wildfire suppression. Furthermore, sleep location, shift length and shift start time should be targeted when designing appropriate controls to manage fatigue-related risk and preserve firefighters' health and safety during wildfire events. Practitioner Summary: During multi-day wildfire suppression, firefighters' sleep quantity was restricted, and pre- and post-sleep fatigue ratings were higher, compared to non-fire days. Furthermore, total sleep time was less when: (i) sleep occurred in a tent/vehicle, (ii) shifts were >14 h and (iii) shifts started between 05:00 and 06:00 h.

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PMID: 26452576 [Indexed for MEDLINE]


First postoperative week activity patterns and recovery in women after coronary artery bypass surgery.

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The purpose of this study was to examine the relationship between activity-rest patterns and recovery in women during the first week after coronary artery bypass surgery (CABS). Twenty-five women wore wrist actigraphs to measure activity
objectively throughout the first postoperative week. The Sickness Impact Profile (SIP) and length of postoperative hospital stay (LOS) were used as measures of recovery. Analysis of the activity data indicated that 21 (84%) of the participants had statistically significant positive linear trends in activity. Spectrum analysis indicated that 18 participants had periods that could be defined as circadian, 1 had a shorter period, and 6 had longer periods. After controlling for the effect of preoperative functional status, the period and linear trend of activity explained 28% of the variance in the SIP score at 1 week and 33% of the variance in length of stay. Positive linear trends in activity and circadian activity periods were related to better functioning and shorter length of stay.

PMID: 8183659 [Indexed for MEDLINE]


A follow-up study of actigraphic measures in home-residing Alzheimer's disease patients.

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This article reports cross-sectional and follow-up data with actigraphic measures of nocturnal sleep and rest/activity in 61 Alzheimer's disease (AD) patients as well as the relation of actigraphic measures to levels of behavioral disturbance across different stages of the disease. Over the course of approximately 1.5 years' follow-up, patients showed significant deterioration of nocturnal sleep
parameters, but no significant change in rest/activity circadian rhythm parameters. There were also significant correlations among nocturnal sleep, rest/activity circadian rhythm, and behavioral disturbance measures, but only in relatively early stages of AD. It is argued that study of nocturnal sleep and circadian rhythm in relation to behavioral disturbance in AD requires longitudinal data and analyses that take into account the stage of disease at which patients are assessed.

DOI: 10.1177/089198879801100103
PMID: 9686746 [Indexed for MEDLINE]


Food Insecurity is Associated with Objectively Measured Sleep Problems.

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Objective/Background: Food Insecurity (FI) can be a profound source of stress, which may increase the risk for sleep disturbance. This is the first study to examine the association between FI and objectively and subjectively measured sleep. Participants: The sample included 785 adults living in two low-income neighborhoods (mean age = 56; 95% African American). Methods: FI was measured using a validated 10-item survey that assesses conditions and behaviors that
characterize households when they lack financial resources to meet basic food needs. Sleep duration, efficiency, wakefulness after sleep onset (WASO), and variability in sleep duration were measured via actigraphy. Sleep quality was assessed via sleep diary. Sleep outcomes were analyzed as a function of FI, adjusting for covariates. Psychological distress was tested as a potential mediator. Results: Greater FI was associated with shorter actigraphy-assessed sleep duration (B = -2.44; SE = 1.24; i.e., 24 minutes shorter for the most as compared to least insecure group), poorer sleep efficiency (B = -.27; SE = .13; p's < .05), and poorer subjective sleep quality (B = -.03; SE = .01; p < .01). Greater FI was also associated with greater likelihood of short (<7 hours; OR = 1.11; CI: 1.02-1.21) and long sleep (>9 hours; OR = 1.19; CI: 1.01-1.39), compared to the recommended sleep duration of 7-9 hours. Psychological distress partially mediated the association between FI and subjective sleep quality.

Conclusions: Addressing or mitigating food insecurity may present a novel opportunity for improving sleep health among low-income populations.

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Forced entrainment by using light therapy, modafinil and melatonin in a sighted patient with non-24-hour sleep-wake disorder.

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Circadian rhythms and sleep patterns change as people age. Little is known about the associations between circadian rhythms and mortality rates. We investigated whether 24-hour activity rhythms and sleep characteristics independently predicted mortality. Actigraphy was used to determine the stability and fragmentation of the 24-hour activity rhythm in 1,734 persons (aged 45–98 years) from the Rotterdam Study (2004–2013). Sleep was assessed objectively using actigraphy and subjectively using sleep diaries to estimate sleep duration, sleep onset latency, and waking after sleep onset. The mean follow-up time was 7.3 years; 154 participants (8.9%) died. Sleep measures were not related to mortality after adjustment for health parameters. In contrast, a more stable 24-hour activity rhythm was associated with a lower mortality risk (per 1 standard deviation, hazard ratio = 0.83, 95% confidence interval: 0.71, 0.96), and a more fragmented rhythm was associated with a higher mortality risk (per 1 standard deviation, hazard ratio = 1.22, 95% confidence interval: 1.04, 1.44). Low stability and high fragmentation of the 24-hour activity rhythm predicted all-cause mortality, whereas estimates from actigraphy and sleep
Disturbed circadian activity rhythms reflect age-related alterations in the biological clock and could be an indicator of disease.

Fragmentation of daily rhythms associates with obesity and cardiorespiratory fitness in adolescents: The HELENA study.

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BACKGROUND & AIMS: Chronobiology studies periodic changes in living organisms and it has been proposed as a promising approach to investigate obesity. We analyze
the association of the characteristics of the rest–activity rhythms with obesity, cardiorespiratory fitness and metabolic risk in adolescents from nine European countries.

METHODS: 1044 adolescents (12.5–17.5 y) were studied. Circadian health was evaluated by actigraphy with accelerometers (Actigraph GT1M). Characteristics of the daytime activity such as fragmentation (intradaily variability), estimated acrophase, and 10 h mean daytime activity index were obtained. Body composition was assessed using Bioelectrical-Impedance-Analysis, skinfold thickness, air-displacement-plethysmography and Dual-energy-X-ray-Absorptiometry. Cardiorespiratory fitness (VO2max) and metabolic risk were studied.

RESULTS: Highly fragmented activity rhythms were associated with obesity and central adiposity (P < 0.05). Obese adolescents had ~3 times higher odds of having a high fragmentation of daytime activity compared to normal weight adolescents OR (95% CI) = 2.8 (1.170, 6.443). A highly fragmented rhythm was also related to lower cardiorespiratory fitness and higher metabolic risk (P < 0.05) so those adolescents classified as low fitness showed a significantly higher fragmentation of daytime activity than those included in the high fitness group (P < 0.0001). Other characteristics of the rhythms such as smaller 10 h daytime mean activity index and delayed estimated acrophase were also related to obesity and metabolic risk (P < 0.05).

CONCLUSIONS: Our results indicate that the daily organization of the rest–activity cycle is more fragmented in obese and less fit adolescents and correlates with higher metabolic risk. This fact reinforces our hypothesis that disturbances in daily rhythms can be considered as sensitive markers of poorer adolescent's health.
Fragmented maternal sleep is more strongly correlated with depressive symptoms than infant temperament at three months postpartum.

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To determine the contribution of infant temperament to the relationship between maternal sleep disturbance and depressive symptoms. Utilizing a repeated measures design, 112 couples recruited from childbirth education classes were assessed in third trimester and postpartum. Instruments included Center for Epidemiologic Studies Depression Scale, General Sleep Disturbance Scale, wrist actigraphy, and an investigator-developed tool to assess infant temperament completed by mothers and fathers. Regardless of infant temperament, mothers who slept < 4 h between midnight and 6 am and mothers who napped < 60 min during the day were at increased risk for depression at three months postpartum. Infant temperament was associated with maternal sleep but was not a significant predictor of depressive symptoms after controlling for other contextual factors. Postpartum clinical visits should include questions about maternal sleep so interventions can be directed toward sufficient sleep to minimize risk of postpartum depression.

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Free-living cross-comparison of two wearable monitors for sleep and physical activity in healthy young adults.

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There is a growing need for free-living monitoring of the full 24 h spectrum of behaviors with a single or integrated set of sensors. The validity of field standard wearable monitors in sleep and physical activity have yet to be assessed for the complementary behavior in the context of 24 h continuous monitoring. We conducted a free-living comparison study of the Actigraph GT3X+ (GT3X+) to assess sleep parameters as compared with the Actiwatch-64 (AW-64) and concurrently, the AW-64 to assess sedentary and physical activity behaviors as compared with the GT3X+. Thirty young adults (15 female, 19.2±0.86 years) wore both monitors for 3 consecutive days and 2 consecutive nights. Agreement of sleep, sedentary, and physical activity metrics were evaluated using analyses of variance, intraclass correlation coefficients, Bland-Altman plots with associated confidence limits,
mean absolute percentage of errors and equivalence tests. For sleep, the GT3X+
showed high agreement for total sleep time and sleep efficiency, but
underestimated wakefulness after sleep onset and sleep onset latency relative to
the AW-64. For sedentary behavior and physical activity, the AW-64 showed a
moderate agreement for activity energy expenditure, but not for
sedentary, light
or moderate–vigorous physical activities relative to the GT3X+.
Overall our
results showed good agreement of the GT3X+ with AW-64 for assessing
sleep but a
lack of agreement between AW-64 and GT3X+ for physical activity and
sedentary
behaviors. These results are likely due to the monitor placement
(wrist vs hip),
as well as the algorithm employed to score the data. Future validation
work of
existing and emerging technologies that may hold promise for 24 h
continuous
monitoring is needed.

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A Functional Data Analysis Approach for Circadian Patterns of Activity
of Teenage
Girls.

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BACKGROUND: Longitudinal or time-dependent activity data are useful to characterize the circadian activity patterns and to identify physical activity differences among multiple samples. Statistical methods designed to analyze multiple activity sample data are desired, and related software is needed to perform data analysis. METHODS: This paper introduces a functional data analysis (fda) approach to perform a functional analysis of variance (fANOVA) for longitudinal circadian activity count data and to investigate the association of covariates such as weight or body mass index (BMI) on physical activity. For multiple age group adolescent school girls, the fANOVA approach is developed to study and to characterize activity patterns. The fANOVA is applied to analyze the physical activity data of three grade adolescent girls (i.e., grades 10, 11, and 12) from the NEXT Generation Health Study 2009-2013. To test if there are activity differences among girls of the three grades, a functional version of the univariate F-statistic is used to analyze the data. To investigate if there is a longitudinal (or time-dependent activity count) difference between two samples, functional t-tests are utilized to test: (1) activity differences between grade pairs; (2) activity differences between low-BMI girls and high-BMI girls of the NEXT study. RESULTS: Statistically significant differences existed among the physical activity patterns for adolescent school girls in different grades.
Girls in grade 10 tended to be less active than girls in grades 11 & 12 between 5:30 and 9:30. Significant differences in physical activity were detected between low-BMI and high-BMI groups from 8:00 to 11:30 for grade 10 girls, and low-BMI group girls in grade 10 tended to be more active.

CONCLUSIONS: The fda approach is useful in characterizing time-dependent patterns of actigraphy data. For two-sample data defined by weight or BMI values, fda can identify differences between the two time-dependent samples of activity data. Similarly, fda can identify differences among multiple physical activity time-dependent datasets. These analyses can be performed readily using the fda R program.

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Gender and racial/ethnic differences in sleep duration in the North Texas heart study.

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OBJECTIVE: Short sleep duration has been linked with a wide array of poor mental and physical health outcomes. Such risks, however, may be moderated by
demographic factors such as gender and race/ethnicity. In a diverse community sample, the current study examined the relationship between gender, race/ethnicity and objectively measured sleep duration, controlling for select potential confounds.

METHODS: Participants were 300 community adults (50% female), aged 21 to 70 years, and included 60% non-Hispanic Whites, 15% non-Hispanic Blacks, 19% Hispanic/Latino, and 6% other. As part of a larger study, participants wore an actigraphy device over two nights to assess sleep duration (averaged across both nights). Gender and race/ethnicity were used as grouping variables in a two-way analysis of covariance (ANCOVA) predicting objectively assessed total sleep time, with age, income, and employment status as covariates.

RESULTS: On average, males slept 34 min less than females (P=.002). After controlling for socioeconomic factors, there was a gender by race/ethnicity interaction (P=.030). Within males, Hispanics slept 45 min less than non-Hispanic Whites (P=.002) and 57 min less than non-Hispanic others (P=.008). Males also slept significantly less than females within the non-Hispanic White (difference=-22.9; P=.016) and the Hispanic (difference=-77.1; P<.001) groups.

CONCLUSIONS: Extending previous research, the current study provides additional evidence for differences in objective sleep duration based on gender and race/ethnicity in daily life. These data suggest that risk associated with sleep duration is patterned in important ways across gender and race/ethnicity; such information can be used to tailor prevention efforts.

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Gene-by-environment interactions of the CLOCK, PEMT, and GHRELIN loci with average sleep duration in relation to obesity traits using a cohort of 643 New Zealand European children.

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OBJECTIVES: Modern technology may have desensitised the 'biological clock' to environmental cues, disrupting the appropriate co-ordination of metabolic processes. Susceptibility to misalignment of circadian rhythms may be partly genetically influenced and effects on sleep quality and duration could predispose to poorer health outcomes. Shorter sleep duration is associated with obesity traits, which are brought on by an increased opportunity to eat and/or a shift of hormonal profile promoting hunger. We hypothesised that increased sleep duration will offset susceptible genetic effects, resulting in reduced obesity risk.

METHODS: We recruited 643 (male: 338; female: 305) European children born to participants in the New Zealand centre of the International Screening for Pregnancy Endpoints sleep study. Ten genes directly involved in the
circadian rhythm machinery and a further 20 genes hypothesised to be driven by cyclic oscillations were evaluated by Sequenom assay. Multivariable regression was performed to test the interaction between gene variants and average sleep length (derived from actigraphy), in relation to obesity traits (body mass index (BMI) z-scores and percentage body fat (PBF)).

RESULTS: No association was found between average sleep length and BMI z-scores \( (p = 0.056) \) or PBF \( (p = 0.609) \). Uncorrected genotype associations were detected between STAT-rs8069645 \( (p = 0.0052) \) and ADIPOQ-rs266729 \( (p = 0.019) \) with differences in average sleep duration. Evidence for uncorrected gene-by-sleep interactions of the CLOCK-rs4864548 \( (p = 0.0039) \), PEMT-936108 \( (p = 0.016) \) and GHRELIN-rs696217 \( (p = 0.046) \) were found in relation to BMI z-scores but not for PBF.

CONCLUSION: Our results indicate that children may have different genetic susceptibility to the effects of sleep duration on obesity. Further confirmatory studies are required in other population cohorts of different age groups.

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Introduction: Biomathematical models of fatigue (BMMF) predict fatigue during a work-rest schedule on the basis of sleep-wake histories. In the absence of actual sleep-wake histories, sleep-wake histories are predicted directly from work-rest schedules. The predicted sleep-wake histories are then used to predict fatigue. It remains to be determined whether workers organize their sleep similarly across operations and thus whether sleep predictions generalize. Methods: Officers (n = 173) enrolled in the Buffalo Cardio-Metabolic Occupational Police Stress study were studied. Officers' sleep-wake behaviors were measured using wrist-actigraphy and predicted using a BMMF (FAID Quantum) parameterized in aviation and rail. Sleepiness (i.e. Karolinska Sleepiness Scale (KSS) ratings) was predicted using actual and predicted sleep-wake data. Data were analyzed using sensitivity analyses. Results: During officers' 16.0 ± 1.9 days of study participation, they worked 8.6 ± 3.1 shifts and primarily worked day shifts and afternoon shifts. Across shifts, 7.0 h ± 1.9 h of actual sleep were obtained in the prior 24 h and associated peak KSS ratings were 5.7 ± 1.3. Across shifts, 7.2 h ± 1.1 h of sleep were predicted in the prior 24 h and associated
peak KSS ratings were 5.5 ± 1.2. The minute-by-minute predicted and actual sleep-wake data demonstrated high sensitivity (80.4%). However, sleep was observed at all hours-of-the-day, but sleep was rarely predicted during the daytime hours. Discussion: The sleep-wake behaviors predicted by a BMMF parameterized in aviation and rail demonstrated high sensitivity with police officers' actual sleep-wake behaviors. Additional night shift data are needed to conclude whether BMMF sleep predictions generalize across operations.

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Genetic association of objective sleep phenotypes with a functional polymorphism in the neuropeptide S receptor gene.

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BACKGROUND: The neuropeptide S receptor (NPSR1) and its ligand neuropeptide S (NPS) have received increased attention in the last few years, as both
establish a previously unknown system of neuromodulation. Animal research studies have suggested that NPS may be involved in arousal/wakefulness and may also have a crucial role in sleep regulation. The single nucleotide polymorphism (SNP) rs324981 in NPSR1 has begun to shed light on a function of the NPS-system in human sleep regulation. Due to an amino acid exchange, the T-allele leads to an increased sensitivity of the NPSR1. In the only genome-wide association study to date on circadian sleep parameters in humans, an association was found between rs324981 and regular bedtime. However, the sleep parameters in this study were only measured by self-rating. Therefore, our study aimed to replicate these findings using an objective measure of sleep.

METHODS: The study included n = 393 white subjects (62-79 years) who participated in an actigraphic assessment for determining sleep duration, rest duration, sleep onset, rest onset and sleep onset latency. Genotyping of the SNP rs324981 was performed using the TaqMan OpenArray System.

RESULTS: The genotype at rs324981 was not significantly associated with rest onset (bedtime) or sleep onset (p = .146 and p = .199, respectively). However, the SNP showed a significant effect on sleep- and rest duration (p = .007 and p = .003, respectively). Subjects that were homozygous for the minor T-allele had a significantly decreased sleep- and rest duration compared to A-allele carriers.

CONCLUSION: The results of this study indicate that the sleep pattern in humans is influenced by the NPS-system. However, the previously reported association between bedtime and rs324981 could not be confirmed. The current finding of decreased sleep duration in T/T allele carriers is in accordance with studies in rodents reporting similar results after NPS application.

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Genetic contributions to circadian activity rhythm and sleep pattern phenotypes in pedigrees segregating for severe bipolar disorder.

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Abnormalities in sleep and circadian rhythms are central features of bipolar disorder (BP), often persisting between episodes. We report here, to our knowledge, the first systematic analysis of circadian rhythm activity in pedigrees segregating severe BP (BP-I). By analyzing actigraphy data obtained from members of 26 Costa Rican and Colombian pedigrees [136 euthymic (i.e., interepisode) BP-I individuals and 422 non-BP-I relatives], we delineated 73 phenotypes, of which 49 demonstrated significant heritability and 13 showed significant trait-like association with BP-I. All BP-I–associated traits related to activity level, with BP-I individuals consistently demonstrating lower activity levels than their non-BP-I relatives. We analyzed all 49 heritable phenotypes using genetic linkage analysis, with special emphasis on phenotypes judged to have the strongest impact on the biology underlying BP. We identified a locus for interdaily stability of activity, at a threshold exceeding genome-wide significance, on chromosome 12pter, a region that also showed pleiotropic linkage.
Genetic polymorphisms of DAT1 and COMT differentially associate with actigraphy-derived sleep-wake cycles in young adults.


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Accumulating evidence suggests that dopamine plays a key role in sleep-wake regulation. Cerebral dopamine levels are regulated primarily by the dopamine transporter (DAT) in the striatum and by catechol-O-methyl-transferase (COMT) in the prefrontal cortex. We hypothesized that the variable-number-tandem-repeat (VNTR) polymorphism in the 3'-untranslated region of the gene encoding DAT (DAT1, SLC6A3; rs28363170) and the Val158Met polymorphism of COMT (rs4680) differently affect actigraphy-derived rest-activity cycles and sleep estimates in healthy adults (65 men; 45 women; age range: 19–35 years). Daytime sleepiness, continuous rest-actigraphy and sleep diary data during roughly 4-weeks were analyzed. Nine-repeat (9R) allele carriers of DAT1 (n = 48) more often reported elevated sleepiness (Epworth sleepiness score ≥10) than 10-repeat (10R) allele homozygotes (n = 62, p < 0.02). Moreover, male 9R allele carriers showed higher wrist activity, whereas this difference was not present in women ("DAT1 genotype" × "gender" interaction: p < 0.005). Rest-activity patterns did not
differ among COMT genotypes. Nevertheless, a significant "COMT genotype" × "type of day" (workdays vs. rest days) interaction for sleep duration was observed (p = 0.04). The Val/Val (n = 36) and Met/Met (n = 24) homozygotes habitually prolonged sleep on rest days compared to workdays by more than 30 min, while Val/Met heterozygotes (n = 50) did not significantly extend their sleep (mean difference: 7 min). Moreover, whereas the proportion of women among the genotype groups did not differ, COMT genotype affected body-mass-index (BMI), such that Val/Met individuals had lower BMI than the homozygous genotypes (p < 0.04). While awaiting independent replication and confirmation, our data support an association of genetically-determined differences in cerebral dopaminergic neurotransmission with daytime sleepiness and individual rest-activity profiles, as well as other sleep-associated health characteristics such as the regulation of BMI. The differential associations of DAT1 and COMT polymorphisms may reflect the distinct local expression of the encoded proteins in the brain.

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Genome-wide association analysis of actigraphic sleep phenotypes in the LIFE Adult Study.


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The genetic basis of sleep is still poorly understood. Despite the moderate to high heritability of sleep-related phenotypes, known genetic variants explain only a small proportion of the phenotypical variance. However, most previous studies were based solely upon self-report measures. The present study aimed to conduct the first genome-wide association (GWA) of actigraphic sleep phenotypes. The analyses included 956 middle- to older-aged subjects (40–79 years) from the LIFE Adult Study. The SenseWear Pro 3 Armband was used to collect 11 actigraphic parameters of night- and daytime sleep and three parameters of rest (lying down). The parameters comprised measures of sleep timing, quantity and quality. A total of 7,141,204 single nucleotide polymorphisms (SNPs) were analysed after imputation and quality control. We identified several variants below the significance threshold of \( P \leq 5 \times 10^{-8} \) (not corrected for analysis of multiple traits). The most significant was a hit near UFL1 associated with sleep efficiency on weekdays \( (P = 1.39 \times 10^{-8}) \). Further SNPs were close to significance, including an association between sleep latency and a variant in CSNK2A1 \( (P = 8.20 \times 10^{-8}) \), a gene known to be involved in the regulation of circadian rhythm. In summary, our GWAS identified novel candidate genes with biological plausibility being promising candidates for replication and further follow-up studies.

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OBJECTIVES: To investigate the emergence of biological rhythms in the first months of life in human infants, by measuring age-related changes in core body temperature during night-time sleep, hormones (cortisol and 6-sulfatoxymelatonin) and the expression of a clock-controlled gene H3f3b in oral epithelial cells. 

DESIGN: Observational longitudinal study. 

SETTING: We measured overnight core body temperature, actigraphy, day-night urinary cortisol and 6-sulfatoxymelatonin, as well as circadian gene expression, in infants at home from March 2007 to July 2008 in Leicester. 

PARTICIPANTS: We recruited 35 healthy Caucasian infants who were born at term.
They were monitored from 6 to 18 weeks of age.

RESULTS: At 8 weeks of age the day-night rhythm of cortisol secretion was the first to appear followed by 6-sulfatoxymelatonin 1 week later; at the same time that night-time sleep was established. At 10 weeks, the maximum fall in deep body temperature occurred with the onset of night-time sleep, followed at 11 weeks by the rhythmical expression of the H3f3b gene.

CONCLUSIONS: In human infants, there is a clear sequential pattern for the emergence of diurnal biological rhythms between 6 and 18 weeks of postnatal age, led by the secretion of cortisol and linked with the establishment of consolidated night-time sleep. It is likely that this represents part of a maturation and adaption process as infants gain equilibrium with their external environment after birth.

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Gravitational artefact in frequency spectra of movement acceleration: implications for actigraphy in young and elderly subjects.

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Actigraphy, the long-term assessment of wrist movements by means of a small solid-state recorder, is widely used in a variety of human research fields, among which sheep, circadian rhythms and aging. Actigraphs assess movement with the use of accelerometers, which sense accelerations resulting from muscle force as well
as accelerations due to changes in the position of the sensor in the gravitational field. In the present paper a method is described to minimise gravitational artefact in movement assessment by calculating the instantaneous acceleration vector from 3 perpendicular acceleration signals. It is shown that the power spectra of single axis acceleration signals are dominated by low-frequency components (+/- 0.25 Hz) due to gravitational artefact. Spectra of the instantaneous acceleration vector indicate that 'true' movement accelerations resulting from muscle force are present in a much wider range: from 0.25 to 11 Hz. Wrist accelerations in elderly subjects were found to be of lower amplitude and frequency as compared to young subjects. It is furthermore shown that a bandpass filter of 0.25 to 2 or 3 Hz, as has been used in commercially available actigraphs, is far from optional, and may even result in a positive bias for movement detection in the elderly. This bias may underly contradictory findings in actigraphic studies on human aging. When a bandpass filter of 0.5-11 Hz is applied to a single-axis acceleration signal, the influence of gravitational artefact and bias are minimized, and the age-related decline in activity is properly detected.

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Group interventions for co-morbid insomnia and osteoarthritis pain in primary care: the lifestyles cluster randomized trial design.


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Six weekly sessions of group cognitive–behavioral therapy for insomnia and osteoarthritis pain (CBT-PI), and for osteoarthritis pain alone (CBT-P) were compared to an education only control (EOC). Basic education about pain and sleep was comparable, so EOC controlled for information and group participation. Active interventions differed from EOC in training pain coping skills (CBT-P and CBT-PI) and sleep enhancement techniques (CBT-PI). Persons with osteoarthritis age 60 or older were screened for osteoarthritis pain and insomnia severity via mailed survey. Primary outcomes were pain severity (pain intensity and interference ratings from the Graded Chronic Pain Scale) and insomnia severity (Insomnia Severity Index). Secondary outcomes were arthritis pain (AIMS-2 symptom scale) and sleep efficiency assessed by wrist actigraphy. Ancillary outcomes included: cognitive function, depression, and health care use. A clustered randomized design provided adequate power to identify moderate effects on primary outcomes (effect size>0.35). Modified intent to treat analyses, including all participants who attended the first session, assessed effects across CBT-PI, CBT-P, and EOC groups. Treatment effects were assessed post-intervention (2 months) and at 9 months, with durability of intervention effects evaluated at 18 months. The trial was executed in 6 primary clinics, randomizing 367 participants, with 93.2% of randomized patients attending at least 4 group sessions. Response rates for post-intervention and 9 month assessments were 96.7% and 92.9% respectively. This hybrid efficacy–effectiveness trial design evaluates whether interventions yield specific benefits for clinical and behavioral outcomes relative to an education only control when implemented in a primary care setting.

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Habitual sleep and kidney function in chronic kidney disease: the Chronic Renal Insufficiency Cohort study.

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Comment in
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Physiological evidence suggests that sleep modulates kidney function. Our objective was to examine the cross-sectional association between kidney function and objectively-estimated habitual sleep duration, quality and timing in a cohort of patients with mild to moderate chronic kidney disease. This study
involved two US clinical centers of the Chronic Renal Insufficiency Cohort (CRIC) study, including 432 participants in a CRIC ancillary sleep study. Habitual sleep duration, quality and timing were measured using wrist actigraphy for 5-7 days. Validated sleep questionnaires assessed subjective sleep quality, daytime sleepiness and risk of sleep apnea. Kidney function was assessed with the estimated glomerular filtration rate using the Chronic Kidney Disease Epidemiology Collaboration equation, and the urinary protein to creatinine ratio. Lower estimated glomerular filtration rate was associated with shorter sleep duration (-1.1 mL min⁻¹ 1.73 m⁻² per hour less sleep, P = 0.03), greater sleep fragmentation (-2.6 mL min⁻¹ 1.73 m⁻² per 10% higher fragmentation, P < 0.001) and later timing of sleep (-0.9 mL min⁻¹ 1.73 m⁻² per hour later, P = 0.05). Higher protein to creatinine ratio was also associated with greater sleep fragmentation (approximately 28% higher per 10% higher fragmentation, P < 0.001). Subjective sleep quality, sleepiness and persistent snoring were not associated with estimated glomerular filtration rate or protein to creatinine ratio. Thus, worse objective sleep quality was associated with lower estimated glomerular filtration rate and higher protein to creatinine ratio. Shorter sleep duration and later sleep timing were also associated with lower estimated glomerular filtration rate. Physicians treating patients with chronic kidney disease should consider inquiring about sleep and possibly sending for clinical sleep assessment. Longitudinal and interventional trials are needed to understand causal direction.

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The aim of this study was to explore habitual sleep, social jetlag, and day-to-day variations in sleep (measured as intra-individual standard deviation, ISD) in youths with delayed sleep–wake phase disorder (DSWPD), compared to healthy controls. We also aimed to investigate time of day effects in performance. The sample comprised 40 youths with DSWPD (70.0% female, mean age 20.7 ± 3.1 years) and 21 healthy controls (71.4% female, mean age 21.2 ± 2.2 years). Subjective and objective sleep were measured over 7 days on a
habitual sleep schedule by sleep diary and actigraphy recordings. Performance was tested twice with a 12-h interval (22:00 in the evening and 10:00 the following morning) using a simple, 10-min sustained reaction time test (RTT). The results showed later sleep timing in the DSWPD group compared to the controls, but sleep duration, social jetlag, and ISD in sleep timing did not differ between the groups. Still, participants with DSWPD reported longer sleep onset latency (SOL) and poorer sleep efficiency (SE), sleep quality, and daytime functioning, as well as larger ISD in SOL, sleep duration, and SE. The groups had similar evening performances on the RTT, but the DSWPD group performed poorer (slower with more lapses) than the controls in the morning. The poor morning performance in the DSWPD group likely reflects the combined impact of sleep curtailment and circadian variations in performance (synchrony effect), and importantly illustrates the challenges individuals with DSWPD face when trying to adhere to early morning obligations.

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Hadza sleep biology: Evidence for flexible sleep-wake patterns in hunter-gatherers.

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OBJECTIVES: Cross-cultural sleep research is critical to deciphering whether modern sleep expression is the product of recent selective pressures, or an example of evolutionary mismatch to ancestral sleep ecology. We worked with the Hadza, an equatorial, hunter-gatherer community in Tanzania, to better understand ancestral sleep patterns and to test hypotheses related to sleep segmentation.

METHODS: We used actigraphy to analyze sleep-wake patterns in thirty-three volunteers for a total of 393 days. Linear mixed effects modeling was performed to assess ecological predictors of sleep duration and quality. Additionally, functional linear modeling (FLM) was used to characterize 24-hr time averaged circadian patterns.

RESULTS: Compared with post-industrialized western populations, the Hadza were characterized by shorter (6.25 hr), poorer quality sleep (sleep efficiency = 68.9%), yet had stronger circadian rhythms. Sleep duration time was negatively influenced by greater activity, age, light (lux) exposure, and moon phase, and positively influenced by increased day length and mean nighttime temperature. The average daily nap ratio (i.e., the proportion of days where a nap was present) was 0.54 (SE = 0.05), with an average nap duration of 47.5 min (SE = 2.71; n = 139).

DISCUSSION: This study showed that circadian rhythms in small-scale foraging populations are more entrained to their ecological environments than Western populations. Additionally, Hadza sleep is characterized as flexible, with a consistent early morning sleep period yet reliance upon opportunistic daytime napping. We propose that plasticity in sleep-wake patterns has been a target of natural selection in human evolution.

Handedness and circadian motor asymmetries in humans: preliminary findings.

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Previous research studies indicate that a motor activity in the first half of nocturnal sleep is lateralized to the non-dominant hand. It was suggested that such phenomenon may be due to a more pronounced homeostatic deactivation of the dominant hemisphere (referring to the hypothesis of the use-dependent recovery function of sleep). If this were the case we should expect a reversed pattern of motor activity asymmetries between right- and left-handed subjects. We tested this hypothesis in an ecological study assessing the circadian motor activity in seventeen right- and seventeen left-handed subjects. All subjects wore actigraphs on both the left and right wrists for at least twelve consecutive days. In line with previous studies, right-handed subjects showed higher motor activity in the left vs. the right hand in late evening. We did not however find a reverse pattern of results in left-handed participants. On the whole the results do not seem to support the use-dependent recovery hypothesis, and are suggestive of a different circadian phase relationship between the two hemispheres regardless of handedness.
Healthier rhythm, healthier brain? Integrity of circadian melatonin and temperature rhythms relates to the clinical state of brain-injured patients.


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BACKGROUND: Healthy circadian rhythmicity has been suggested to relate to a better state of brain-injured patients and to support the emergence of consciousness in patient groups characterized by a relative instability thereof such as patients with disorders of consciousness (DOC).

METHODS: Going beyond earlier studies, a systems-level perspective was adopted and, using multilevel modelling, the joint predictive value of three indices of circadian rhythm integrity derived from skin temperature variations, melatonininsulfate secretion, and physical activity (wrist actigraphy) patterns was
evaluated for the behaviourally assessed state [Coma Recovery Scale – Revised (CRS-R) score] of DOC patients [13 unresponsive wakefulness syndrome; seven minimally conscious (exit) state]. Additionally, it was assessed in a subset of 16 patients whether patients' behavioural repertoire (CRS-R score) varied (i) with time of day or (ii) offset from the body temperature maximum \( (BT_{\text{max}}) \), i.e. when cognitive performance is expected to peak. RESULTS: The results reveal that better integrity of circadian melatonin and temperature rhythms relate to a richer behavioural repertoire. Moreover, higher CRS-R scores are, by trend, related to assessments taking place at a later daytime or deviating less from the pre-specified time of occurrence of \( BT_{\text{max}} \).

CONCLUSIONS: In conclusion, the results suggest that therapeutic approaches aimed at improving circadian rhythms in brain-injured patients are promising and should be implemented in hospitals or nursing homes. Beyond this, it might be helpful to schedule diagnostic procedures and therapies around the (pre-assessed) \( BT_{\text{max}} \) (≈4 pm in healthy individuals) as this is when patients should be most responsive.

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High-intensity environmental light in dementia: effect on sleep and activity.


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OBJECTIVES: To determine whether high-intensity ambient light in public areas of long-term care facilities will improve sleeping patterns and circadian rhythms of persons with dementia.

DESIGN: A cluster-unit crossover intervention trial involving four conditions: morning bright light, evening bright light, all-day bright light, and minimum standard light.

SETTING: The common areas of two geriatric units in a psychiatric hospital and a dementia-specific residential care facility.

PARTICIPANTS: Sixty-six older adults with dementia.

INTERVENTION: Ambient bright light of approximately 2,500 lux, delivered through a low-glare lighting system installed in the dining and activity areas. Participant exposure averaged 2.5 to 3.0 hours for the morning and evening interventions and 8.4 hours for the all-day intervention.

MEASUREMENTS: Nighttime sleep using wrist actigraphy and daytime activity using nonobtrusive daytime observations.

RESULTS: Night-time sleep increased significantly in participants exposed to morning and all-day light, with the increase most prominent in participants with severe or very severe dementia (mean increase 16 minutes (P=.008) for morning, and 14 minutes (P=.01) for all-day). Morning light produced a mean phase advance of 29 minutes (P=.02) and evening light a mean phase delay of 15 minutes (P=.06).

Effects on daytime sleepiness were inconsistent, and the number of sleep bouts, mesor, amplitude, intradaily variability, and interdaily stability were not significantly different, indicating that the overall strength of day and night activity rhythms did not change significantly under any treatment condition.

CONCLUSION: Bright light appears to have a modest but measurable effect on sleep in this population, and ambient light may be preferable to stationary.
The association of sleep apnea hypopnea syndrome (SAHS) with high leg activity in the same patient is a dilemma for the physician, as clonazepam, used to treat periodic leg movement syndrome (PLMS) can aggravate apneas, while nasal continuous positive airway pressure (nCPAP) can exacerbate PLMS. The present study aimed to compare nCPAP alone (n), nCPAP combined with clonazepam (n+c) and clonazepam alone (c) in patients with mild to moderate SAHS associated with high leg activity. Fourteen patients with an apnea hypopnea index (AHI) between 10 and 50 h⁻¹ and a leg movement index with regard to time in bed [LMI (TIB)] > 15 h⁻¹ on baseline polysomnography (b) were recorded on three consecutive nights with n, n+c and c, respectively. Leg movements were detected, using actigraphy, and were subsequently categorized into periodic, apnea- or hypopnea-related and nonperiodic movements (defined as neither periodic nor related to a respiratory event). The three treatments were successful in improving breathing [AHI b 26.1 (3.2) n 11.8 (2.4) n+c 5.0 (0.7) c 14.9 (1.8) h⁻¹], leg activity [LMI (TIB) b 391 (4.8) n 22.5 (4.4) n+c 23.9 (3.9) c 22.6 (3.7) h⁻¹] and sleep
All types of movements were reduced, the effect being significant for respiratory events related and nonperiodic movements. Combination therapy was more effective than nCPAP alone in reducing the AHI and in improving sleep efficiency. We conclude that in patients with mild to moderate SASH associated with high leg activity, nCPAP improves nocturnal breathing and clonazepam reduces leg activity. More unexpectedly nCPAP is beneficial on leg activity and clonazepam on breathing, probably through a decrease in sleep fragmentation. The best results are obtained with combination therapy.

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High prevalence of personality disorders among circadian rhythm sleep disorders (CRSD) patients.

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The purpose of this study was to examine systematically our previous clinical impression regarding the prevalence of personality disorders in patients suffering from circadian rhythm sleep disorders (CRSD). We hypothesized that, in a group of patients suffering from CRSD, there would be a higher frequency of personality disorders than in a group of healthy controls. The experimental group consisted of CRSD patients diagnosed according to a clinical interview and actigraphic recordings. The control group consisted of healthy volunteers in whom CRSD had been ruled out by means of a self-administered questionnaire.
Both groups were assessed for personality disorders using the MCMI, a diagnostic tool based on Millon's biopsychosocial theory of personality and the PRQ-R, a diagnostic tool based on the DMS-III-R. Both tests provided clear and significant support for the hypothesis that individuals suffering from CRSD are characterized to a greater extent by personality disorders than a control group. No specific characteristic pattern or profile of personality disorders was clearly detected. Correct early diagnosis and treatment of CRSD may improve afflicted individuals' adaptive capabilities and perhaps even prevent the development of a personality disorder. This suggests how important a greater awareness of CRSD on the part of the professional community may be.

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High prevalence of sleep disturbance in cirrhosis.

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Sleep disturbance is a classic sign of hepatic encephalopathy. However, there are limited data regarding its prevalence in cirrhotic patients without overt hepatic encephalopathy. We assessed the characteristics of sleep in cirrhosis using a sleep questionnaire (n = 44) and actigraphy (n = 20). The results were compared with those of subjects with chronic renal failure and those of healthy controls. Presence of subclinical hepatic encephalopathy, chronotopy profile, and
individual's affective state were also analyzed. The questionnaire indicated an elevated number of cirrhotic patients (47.7%) and patients with chronic renal failure (38.6%) who complained of unsatisfactory sleep compared with healthy controls (4.5%, \( P < .01 \)). Actigraphy corroborated the deterioration of sleep parameters in cirrhotic patients with unsatisfactory sleep. The sleep disturbance in cirrhosis was not associated with clinical parameters nor with cognitive impairment. Cirrhotic subjects and patients with chronic renal failure with unsatisfactory sleep showed higher scores for depression and anxiety, raising the possibility that the effects of chronic disease may underlie the pathogenesis of sleep disturbance. However, in contrast to chronic renal failure, unsatisfactory sleep in cirrhosis was associated with delayed bedtime, delayed wake-up time, and evening chronotopy. In conclusion, a sleep disturbance is frequent in cirrhotic patients without hepatic encephalopathy and may be related to abnormalities of the circadian timekeeping system.

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Higher sleep variability is associated with poorer glycaemic control in patients with type 1 diabetes.

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Sleep disturbances have been linked to insulin resistance and poor glycaemic control in patients with type 2 diabetes. However, the data are limited in type 1
diabetes. Recently, varying day-to-day sleep schedules, i.e. sleep variability, have been associated with adverse metabolic profile in healthy individuals. This study explored whether sleep variability affects glycaemic control and insulin requirement in type 1 diabetes. Forty-one adult patients with type 1 diabetes wore an actigraphy for 5 nights. Standard deviation of sleep duration, efficiency and mid-sleep time were sleep variability parameters. Sleep apnoea risk and self-reported sleep quality were assessed by the Berlin questionnaire and Pittsburgh Sleep Quality Index. Haemoglobin A1c, diabetes complications and insulin regimen were obtained from medical records. After adjusting for neuropathic symptoms, sleep apnoea risk and poor self-reported sleep quality, higher sleep variability was significantly associated with poorer glycaemic control (standard deviation of sleep duration, $B = 0.100$, $P = 0.004$; and standard deviation of mid-sleep time, $B = 0.068$, $P = 0.04$). In addition, standard deviations of sleep duration and mid-sleep time were highly correlated, suggesting that participants changed their sleep duration along with sleep timing. After adjusting for covariates, the standard deviation of sleep duration ($P = 0.009$) and standard deviation of mid-sleep time ($P = 0.012$) were associated with higher insulin requirement. In summary, higher sleep variability, which likely reflects sleep deprivation alternating with sleep compensation along with shifts in their circadian timing, was associated with poorer glycaemic control and higher insulin requirement in patients with type 1 diabetes. Increased sleep regularity may improve metabolic control in type 1 diabetes.

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Hippocampal activity mediates the relationship between circadian activity rhythms and memory in older adults.

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Older adults experience parallel changes in sleep, circadian rhythms, and episodic memory. These processes appear to be linked such that disruptions in sleep contribute to deficits in memory. Although more variability in circadian patterns is a common feature of aging and predicts pathology, little is known about how alterations in circadian activity rhythms within older adults influence new episodic learning. Following 10 days of recording sleep–wake patterns using actigraphy, healthy older adults underwent fMRI while performing an associative memory task. The results revealed better associative memory was related to more consistent circadian activity rhythms, independent of total sleep time, sleep efficiency, and level of physical activity. Moreover, hippocampal activity during successful memory retrieval events was positively correlated with associative memory accuracy and circadian activity rhythm (CAR) consistency. We demonstrated
that the link between consistent rhythms and associative memory performance was mediated by hippocampal activity. These findings provide novel insight into how the circadian rhythm of sleep–wake cycles are associated with memory in older adults and encourage further examination of circadian activity rhythms as a biomarker of cognitive functioning.

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Histamine H1 blocker hydroxyzine improves sleep in patients with cirrhosis and minimal hepatic encephalopathy: a randomized controlled pilot trial.

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OBJECTIVES: Sleep difficulty is common in minimal hepatic encephalopathy (HE) and the mechanisms are not fully elucidated. Dysregulated histamine neurotransmission is associated with an altered circadian rhythmicity that is partially restored following central histamine H1 receptor blockade in cirrhotic animals. We studied the effects of the histamine H1 blocker hydroxyzine in sleep alterations in patients with cirrhosis in a double-blind, randomized controlled fashion.

METHODS: A total of 35 patients (age 56 yr [36-69], Pugh's score 9 [7-12], portosystemic shunt: N = 7) with minimal HE and long-standing sleep difficulties (8 months [4-48]) and free from benzodiazepines were randomized to hydroxyzine 25 mg at bedtime (N = 17) or placebo (N = 18) for a 10-day period. Measurements of sleep behavior using visual analog scale and wrist actigraphy, neuropsychological
tests, and protein s100beta serum levels were performed at baseline and at day 10.

RESULTS: Subjective improvement in sleep was observed in 40% of hydroxyzine-treated patients but in none receiving placebo (P < 0.04). Objectively, 65% of hydroxyzine-treated patients versus 25% of patients under placebo had a >or=30% increase in sleep efficiency as measured by wrist actigraphy (P < 0.04). Neuropsychological tests (Z scores) and protein s100beta levels remained statistically unchanged in both groups. One patient developed an acute episode of encephalopathy reversible upon cessation of hydroxyzine.

CONCLUSIONS: In contrast to placebo, hydroxyzine 25 mg at bedtime improved sleep behavior (subjectively and using wrist actigraphy) in patients with cirrhosis and minimal HE. The risk of precipitating overt HE warrants some caution when prescribing this drug.

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This pilot study evaluated a home-based cognitive-behavioral intervention—the Sleep Enhancement Training System for Shift Workers (SETS-SW)—in a sample of 21 nurses working night shifts. Participants (20 women and 1 man) received 2 home-based cognitive-behavioral interventions: a 4-week active control intervention, followed by the 4-week SETS-SW intervention. Sleep and circadian rhythms were assessed at baseline and after each intervention using
questionnaires and 1 week of wrist actigraphy. After the SETS-SW intervention, participants reported better sleep quality, although no change in actigraphy outcomes was observed. Over the course of the study, participants also reported improved wellbeing and less appetite disturbance. A home-based cognitive-behavioral intervention may be useful for managing effects of shift work, but needs further evaluation in larger samples.

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Home lighting before usual bedtime impacts circadian timing: a field study.

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Laboratory studies suggest that evening light before bedtime can suppress melatonin. Here, we measured the range of evening light intensity people can generate with their household lights, and for the first time determined if varying home light before usual bedtime can shift circadian phase. This was a 3-week study with two counterbalanced conditions separated by a 5-day break. In a dim week, eight healthy subjects minimized their home light exposure from 4 h before habitual bedtime until a self-selected bedtime. In a bright week, the subjects maximized their home lighting for the same time. The dim light melatonin onset (DLMO) was assessed after each week. On average subjects maximized their lights to approximately 65 lux and minimized their lights to approximately 3 lux. Wrist actigraphy indicated that subjects went to bed slightly later when lights were maximized (average 14 min later, P = 0.05), but wake time did not change. Every subject had a later DLMO after the week of maximum versus minimum light exposure (average 1:03 h later, P < 0.001). These results demonstrate that the
light intensity people can generate at home in the few hours before habitual bedtime can alter circadian timing. People should reduce their evening light exposure to lessen circadian misalignment.

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The homeostatic and circadian sleep recovery responses after total sleep deprivation in mice.


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Many studies on sleep deprivation effects lack data regarding the recovery period. We investigated the 2-day homeostatic and circadian sleep recovery response to 24 h of total sleep deprivation (TSD) induced by brief rotation of an activity wheel. Eight mice were implanted with telemetry transmitters (DSI F40-EET) that recorded simultaneously their electroencephalography (EEG), locomotor activity and temperature during 24 h of baseline (BSL), TSD and 2 days of recovery (D1 and D2). In a second experiment, two groups of five non-implanted mice underwent TSD or ad libitum sleep, after which they were killed, adrenal glands were weighed and blood was collected for analysis of corticosterone concentration. During TSD mice were awake at least 97% of the time, with a
consecutive sleep rebound during D1 that persisted during D2. This was characterized by increases of non-rapid eye movement (NREM) sleep (44.2 ± 6.9% for D1 and 43.0 ± 7.7% for D2 versus 33.8 ± 9.2% for BSL) and the relative delta band power (179.2 ± 34.4% for D1 and 81.9 ± 11.2% for D2). Greater NREM and REM sleep amounts were observed during the 'light' periods. Temperature and locomotor activity characteristics were unchanged during D1 and D2 versus BSL. In non-implanted mice, corticosterone levels as well as adrenal gland and overall body weights did not differ between TSD and ad libitum sleep groups. In conclusion, 24 h of TSD in an activity wheel without stress responses influence homeostatic sleep regulation with no effect on the circadian regulation over at least 2 days of recovery in mice.

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Hospital lighting and its association with sleep, mood and pain in medical inpatients.

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AIMS: To describe light exposure, sleep–wake patterns, mood, pain and their relationships in adult medical inpatients.

BACKGROUND: The hospital environment may contribute to patient discomfort by providing a lighting structure that interferes with circadian rhythmicity, sleep, mood and pain.

DESIGN: A descriptive correlational design was used in this
preliminary study.
METHODS: Between May 2011–April 2012, data were collected from a convenience sample of 23 women and 17 men admitted to a large academically affiliated hospital in the United States. Over 72 hours, light exposure and sleep-wake patterns were continuously measured with wrist actigraph/light meters for each participant. Mood was measured daily using the Profile Of Mood States Brief™ Form. Subjective pain scores were abstracted from medical records.
RESULTS: Light exposure levels were low: mean daytime light intensity was 104·80 lux. Sleep time was fragmented and low: mean 236·35 minutes of sleep/night. Intra-daily stability scores indicated little sleep-wake synchronization with light. Fatigue and total mood disturbance scores were high and inversely associated with light. Pain levels were also high and positively associated with fatigue, but not directly with light exposure. Low light exposure significantly predicted fatigue and total mood disturbance.
CONCLUSION: Medical inpatients were exposed to light levels insufficient for circadian entrainment. Nevertheless, higher light exposure was associated with less fatigue and lower total mood disturbance in participants with pain, suggesting the need for further investigation to determine if manipulating light exposure for medical inpatients would be beneficial in affecting sleep-wake disturbances, mood and pain.

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Hospitalization-induced exacerbation of the ill effects of chemotherapy on rest-activity rhythm and quality of life of breast cancer patients: a
prospective
and comparative cross-sectional follow-up study.

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Chemotherapy administration may result in the disruption of circadian rhythms and impairment of quality of life (QoL) of cancer patients. Nevertheless, we have little knowledge on the long-term consequences of chemotherapy and the effects of hospitalization. In the present study, we employed the two-factor repeated-measure cross-sectional design to determine the effects of chemotherapy and hospitalization on rest-activity (RA) rhythm and QoL of breast cancer patients. Initially, we randomly selected 39 inpatients and 42 outpatients, scheduled to receive six cycles of chemotherapy, from the Regional Cancer Center (RCC), Raipur, India. Finally, 30 patients in each group were included in the current study. We monitored circadian RA rhythm and QoL using wrist actigraphy and QLQ-C30 and QLQ-BR23, respectively, during the 1st (C1), 3rd (C3) and 6th (C6) chemotherapy cycles. Results revealed that with the progression of chemotherapy cycles (from C1 to C6), all rhythm parameters, namely mesor, amplitude, acrophase, rhythm quotient (RQ), circadian quotient (CQ), peak activity (PA), dichotomy index and autocorrelation coefficient, significantly decreased in both cancer in- and outpatients. In both groups of patients and during C1–C6, all functional and global QoL measures of QLQ-C30 and
QLQ-BR23 significantly decreased and the symptoms significantly increased, except constipation, body image, sexual functioning and future perspectives in outpatients. The hospitalization exacerbated the problems associated with the RA rhythm and the QoL of the patients. In conclusion, the current study highlighted the negative consequences of hospitalization among inpatients, irrespective of the stage of cancer. We, therefore, recommend that cancer patients should be administered with chemotherapy as outpatients. The proposed protocol might have a covert bearing on the expression of better physiological state leading to satisfactory treatment outcomes.

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An hour of bright white light in the early morning improves performance and advances sleep and circadian phase during the Antarctic winter.

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Previous work has demonstrated that exposure to an hour of bright light in the morning and the evening during the Polar winter has beneficial effects on circadian phase. This study investigated the effect of a single hour of bright white morning light on circadian phase, sleep, alertness and cognitive performance. Nine individuals (eight male, one female, median age 30 years), wintering at Halley Research Station (75°S), Antarctica from 7th May until 6th August 2007, were exposed to bright white light for a fortnight from
08:30 to 09:30 h, with two fortnight control periods on either side. This sequence was performed twice, before and following Midwinter. Light exposure, sleep and alertness were assessed daily by actigraphy, sleep diaries and subjective visual analogue scales. Circadian phase (assessed by urinary 6-sulphatoxymelatonin rhythm) and cognitive performance were evaluated at the end of each fortnight. During light exposure circadian phase was advanced from 4.97 ± 0.96 decimal hours (dh) (mean ± SD) to 4.08 ± 0.68 dh (p = 0.003). Wake-up time was shifted by a similar margin from 8.45 ± 1.83 dh to 7.59 ± 0.78 dh (p < 0.001). Sleep start time was also advanced (p = 0.047) but by a lesser amount, consequently, actual sleep time was slightly reduced. There was no change in objective or subjective measures of sleep quality or subjective measures of alertness. An improvement in cognitive performance was found with both the Single Letter Cancellation Test (p < 0.001) and the Digit Symbol Substitution Test (p = 0.026) with preserved circadian variation. These beneficial effects of a single short duration light treatment may have implications not only for the Antarctic but other remote environments where access to natural light and delayed circadian phase, is problematic. These results require validation in larger studies at varying locations.

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How accurately does wrist actigraphy identify the states of sleep and wakefulness?

Pollak CP(1), Tryon WW, Nagaraja H, Dzwonczyk R.
STUDY OBJECTIVES: Because sleep and wakefulness differ from each other by the amount of body movement, it has been claimed that the two states can be accurately distinguished by wrist actigraphy. Our objective was to test this claim in lengthy polysomnographic (psg) and actigraphic (acf) samples that included night and day components.

DESIGN: Fourteen healthy young (21-35 years) and old (70-72 years) men and women lived in a laboratory without temporal cues for 7 days. Each subject continuously wore sleep-recording electrodes as well as 2 wrist-movement recorders. Act measurements were converted to predictions of sleep and wakefulness by simple-threshold and multiple-regression methods. Psg served as the gold standard for calculation of predictive values (PV, the probability that an act prediction is correct by psg criteria).

SETTING: N/A.

PARTICIPANTS: N/A.

INTERVENTIONS: N/A.

MEASUREMENTS AND RESULTS: The 7-day act recordings showed clear circadian cycles of high and low activity that respectively corresponded to subjective days, when subjects were wakeful, and subjective nights when they slept. Lower act levels corresponded to deeper states of psg sleep. Logistic regression on a 20-minute moving average of act gave the highest overall PV's. Nevertheless, the mean PV for sleep (PVS) was only 62.2% in complete, day + night samples. PVS was 86.6% in night samples. Act successfully predicted wakefulness during subjective nights (PVW = 89.6) and accurately measured circadian period length and the extent of sleep-wake consolidation, but it overestimated sleep rate and sleep efficiency.
Act systematically decreased before sleep onset and increased before awakening, but reliable transitions among joint psg/act states (the Markov-1 property) were not demonstrated.

CONCLUSIONS: Low PV's and overestimation of sleep currently disqualify actigraphy as an accurate sleep-wake indicator. Actigraphy may, however, be useful for measuring circadian period and sleep-wake consolidation and has face validity as a measure of rest/activity.

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How mindfulness changed my sleep: focus groups with chronic insomnia patients.


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BACKGROUND: Chronic insomnia is a major public health problem affecting approximately 10% of adults. Use of meditation and yoga to develop mindful awareness ('mindfulness training') may be an effective approach to treat chronic insomnia, with sleep outcomes comparable to nightly use of prescription sedatives, but more durable and with minimal or no side effects. The purpose of this study was to understand mindfulness training as experienced by patients with chronic insomnia, and suggest procedures that may be useful in optimizing sleep benefits.

METHODS: Adults (N = 18) who completed an 8-week mindfulness-based stress reduction (MBSR) program as part of a randomized, controlled clinical trial to evaluate MBSR as a treatment for chronic insomnia were invited to
participate in post-trial focus groups. Two groups were held. Participants (n = 9) described how their sleep routine, thoughts and emotions were affected by MBSR and about utility (or not) of various mindfulness techniques. Groups were audio-recorded, transcribed and analyzed using content analysis.

RESULTS: Four themes were identified: the impact of mindfulness on sleep and motivation to adopt a healthy sleep lifestyle; benefits of mindfulness on aspects of life beyond sleep; challenges and successes in adopting mindfulness-based practices; and the importance of group sharing and support. Participants said they were not sleeping more, but sleeping better, waking more refreshed, feeling less distressed about insomnia, and better able to cope when it occurred. Some participants experienced the course as a call to action, and for them, practicing meditation and following sleep hygiene guidelines became priorities. Motivation to sustain behavioral changes was reinforced by feeling physically better and more emotionally stable, and seeing others in the MBSR class improve. The body scan was identified as an effective tool to enable falling asleep faster. Participants described needing to continue practicing mindfulness to maintain benefits.

CONCLUSIONS: First-person accounts are consistent with published trial results of positive impacts of MBSR on sleep measured by sleep diary, actigraphy, and self-report sleep scales. Findings indicate that mindfulness training in a group format, combined with sleep hygiene education, is important for effective application of MBSR as a treatment for chronic insomnia.

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How should we measure delayed sleep phase shift in severe, refractory obsessive-compulsive disorder?

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OBJECTIVE: A previous study, based upon direct nursing observations, showed almost half of a cohort of inpatients with severe, enduring OCD also suffered from delayed sleep phase shift. Males, younger patients and those with more severe symptoms were most likely to be affected. However, the ward environment may have had a direct effect on sleeping patterns. In this study we compared the accuracy of actigraphic measurements with that of the "gold standard" of direct nursing observation, and other clinical sleep scales. We postulated that actigraphy would prove a reliable, acceptable, and valid alternative.

METHODS: All patients admitted over 29 months to a specialized treatment unit for severe, chronic refractory OCD were invited to participate. We collected demographic data, clinical measures of OCD and depressive symptom severity, self-rated measures of social and occupational disability and sleep, nursing records based upon direct observation of sleep onset and duration, and actigraphy records.

RESULTS: Evaluable data was obtained from 36 patients (22 males) with an average age of 37 years and profound OCD symptoms measured by the Yale-Brown Obsessive-Compulsive Scale. According to direct nursing observation, 12 patients (33%) showed delayed sleep phase shift. Actigraphic recordings demonstrated good agreement (kappa = 0.63) with nursing observation as did the St George's Insomnia Questionnaire (kappa = 0.66).

CONCLUSION: This study demonstrates that actigraphy is a reliable
method of recording sleep/activity cycles in severe, enduring OCD.

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Human circadian phase in 12:12 h, 200: <8 lux and 1000: <8 lux light-dark cycles, without scheduled sleep or activity.

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The light levels required to maintain human circadian phase in the absence of other strong time cues are not defined. We investigated circadian phase in two groups of men, living in partial temporal isolation, exposed to 12 h:12 h light:dark cycles of: (A) 200: <8 lux, broad spectrum white light for 14 days; and (B) 1000: <8lux for 14 days. The rhythm variables measured were urinary 6-sulphatoxymelatonin, rectal temperature, activity and rest (actigraphy and sleep logs). In 200: <8 lux four/six individuals showed phase delays. Exposure to 1000: <8 lux appeared to maintain synchronisation of rest-activity to 24 h, but with a significant overall phase advance of 0.81 h in temperature. These observations suggest that domestic intensity light does not maintain phase without scheduled sleep/activity, possibly due to indirect effects on behaviour influencing light exposure.

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In our continuously developing 'around the clock' society, there is a need to increase our understanding of how changes in biology, physiology and psychology influence our health and performance. Embedded within this challenge, is the increasing need to account for individual differences in sleep and circadian rhythms, as well as to explore the impact of time of day on performance in the real world. There are a number of ways to measure sleep and circadian rhythms from subjective questionnaire-based methods to objective sleep/wake monitoring, actigraphy and analysis of biological samples. This paper proposes a protocol that combines multiple techniques to categorize individuals into Early, Intermediate or Late circadian phenotype groups (ECPs/ICPs/LCPs) and recommends how to conduct diurnal performance testing in the field. Representative results show large differences in rest-activity patterns derived from actigraphy, circadian phase (dim light melatonin onset and peak time of cortisol awakening response) between circadian phenotypes. In addition, significant differences in diurnal performance rhythms between ECPs and LCPs emphasizes the need to account for circadian phenotype. In summary, despite the difficulties in
controlling influencing factors, this protocol allows a real-world assessment of the impact of circadian phenotype on performance. This paper presents a simple method to assess circadian phenotype in the field and supports the need to consider time of day when designing performance studies.

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PMID: 32338646


Human circadian rhythms in constant dim light (8 lux) with knowledge of clock time.

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The light/dark (L/D) cycle is a major synchronizer of human circadian rhythms. In the absence of a strong L/D cycle, synchrony with 24 hours can nevertheless be maintained in a socially structured environment, as shown in Polar regions (Broadway et al. 1987) and by some blind subjects (Czeisler et al. 1995a). The relative contribution of other time cues to entrainment in dim light has not been fully explored. The present study investigated the behaviour of melatonin (assessed as 6-sulphatoxymelatonin); rectal temperature; activity and sleep (actigraphy and logs) in constant dim light (L/ L) with access to a digital clock. 6 normal healthy males were maintained as a group in partial temporal isolation with attenuated sound and ambient temperature for 21 days. All 6 subjects showed free-running periodicity for 6-sulphatoxymelatonin and 5/6 subjects for temperature, activity and sleep offset. The average period (tau) was
24.26 +/- 0.049, substantially shorter than in previous experiments with a self selected L/D cycle but similar to a recent study conducted in very dim light. One subject maintained a rigid sleep/wake cycle throughout whilst his 6-sulphatoxymelatonin rhythm free-ran. Total sleep time, from actigraph data, did not change but sleep efficiency decreased during the experiment. The subjects did not show group synchronization. These results confirm previous data indicating the importance of the L/D cycle in human entrainment and underline the lesser role of social cues and knowledge of clock time. This particular approach will permit the administration of timed medication to sighted humans under free-running conditions.

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Human seasonal and circadian studies in Antarctica (Halley, 75°S).

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Living for extended periods in Antarctica exposes base personnel to extremes of daylength (photoperiod) and temperature. At the British Antarctic Survey base of Halley, 75°S, the sun does not rise for 110 d in the winter and does not set for 100 d in summer. Photoperiod is the major time cue governing the timing of seasonal events such as reproduction in many species. The neuroendocrine signal
providing photoperiodic information to body physiology is the duration of melatonin secretion which reflects the length of the night: longer in the short days of winter and shorter in summer. Light of sufficient intensity and spectral composition serves to suppress production of melatonin and to set the circadian timing and the duration of the rhythm. In humans early observations suggested that bright (>2000 lux) white light was needed to suppress melatonin completely. Shortly thereafter winter depression (Seasonal Affective Disorder or SAD) was described, and its successful treatment by an artificial summer photoperiod of bright white light, sufficient to shorten melatonin production. At Halley dim artificial light intensity during winter was measured, until 2003, at a maximum of approximately 500 lux in winter. Thus a strong seasonal and circadian time cue was absent. It seemed likely that winter depression would be common in the extended period of winter darkness and could be treated with an artificial summer photoperiod. These observations, and predictions, inspired a long series of studies regarding human seasonal and circadian status, and the effects of light treatment, in a small overwintering, isolated community, living in the same conditions for many months at Halley. We found little evidence of SAD, or change in duration of melatonin production with season. However the timing of the melatonin rhythm itself, and/or that of its metabolite 6-sulphatoxymelatonin (aMT6s), was used as a primary marker of seasonal, circadian and treatment changes. A substantial phase delay of melatonin in winter was advanced to summer phase by a two pulse 'skeleton' bright white light treatment. Subsequently a single morning pulse of bright white light was effective with regard to circadian phase and improved daytime performance. The circadian delay evidenced by melatonin was accompanied by delayed sleep (logs and actigraphy): poor sleep is a
common complaint in Polar regions. Appropriate extra artificial light, both standard white, and blue enriched, present throughout the day, effectively countered delay in sleep timing and the aMT6s rhythm. The most important factor appeared to be the maximum light experienced. Another manifestation of the winter was a decline in self-rated libido (men only on base at this time). Women on the base showed lower aspects of physical and mental health compared to men. Free-running rhythms were seen in some subjects following night shift, but were rarely found at other times, probably because this base has strongly scheduled activity and leisure time. Complete circadian adaptation during a week of night shift, also seen in a similar situation on North Sea oil rigs, led to problems readapting back to day shift in winter, compared to summer. Here again timed light treatment was used to address the problem. Sleep, alertness and waking performance are critically dependent on optimum circadian phase. Circadian desynchrony is associated with increased risk of major disease in shift workers. These studies provide some groundwork for countering/avoiding circadian desynchrony in rather extreme conditions.

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Hunger hormone and sleep responses to the built-in blue-light filter on an electronic device: a pilot study.

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The aim of the current study was to investigate the effect of the blue-light filtering 'Night Shift' function on the Apple iPad at night and leptin production, perceived hunger levels and markers of sleep quality and quantity in healthy young adults. In a randomised, crossover design, 13 young adults (6 male/7 female) performed three experimental trials. Two of the interventions included one hour of night-time electronic device use; reading on an iPad ~30 cm from eyes, either with (iPad+NS) or without (iPad) the 'Night Shift' blue-light filtering feature turned on. The control trial involved reading a hard-copy book for one hour (CON). Leptin and perceived hunger and tiredness levels were assessed at various time points for the three experimental conditions. Objective sleep indices (actigraphy) and subjective ratings of sleep were recorded. There were no significant interactions for any of the measured variables (p > 0.05). Small to moderate effect sizes were found for perceived sleep quality, with CON (7.3 ± 1.7) having the highest value when compared to iPad+NS (6.6 ± 1.8, d = 0.29) and iPad (5.6 ± 2.3, d = 0.66). Moderate effects were associated with iPad+NS when compared to iPad (d = 0.77) and for iPad compared to CON (d = 0.90) for pre-post change in leptin concentration. Use of electronic devices at night may result in moderate suppression of leptin levels and impaired sleep quality, with negligible differences associated with whether or not the 'Night Shift' feature is turned on.

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PMID: 31890092

Hyperactive night and day? Actigraphy studies in adult ADHD: a baseline comparison and the effect of methylphenidate.

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STUDY OBJECTIVES: To investigate parameters of sleep, activity, and circadian rhythm, as well as the effects of methylphenidate on these variables, in adults with ADHD.

DESIGN: 1) Baseline group comparison; 2) Double blind, placebo-controlled, cross-over medication trial.

SETTING: Data collection took place during daily lives of participants.

PARTICIPANTS: 39 normal controls and 33 adults with ADHD for baseline comparisons; 31 adults with ADHD in medication trial.

INTERVENTIONS: Treatment with placebo and methylphenidate during medication trial.

MEASUREMENTS AND RESULTS: Actigraphy and sleep log data were collected for 7 consecutive nights and days to obtain baseline values for ADHD and normal controls. Repeated measurements during placebo and methylphenidate treatment were conducted for the ADHD group. Actigraphic sleep estimates showed that ADHD subjects took longer to fall asleep, had lower sleep efficiency, and had shorter within-night periods of uninterrupted sleep. These findings were consistent with subjective complaints. Actigraphic measures of ADHD subjects showed continuously elevated daytime activity levels, resulting in a 24-hour pattern that was more stable and less variable than in controls. Methylphenidate led to a later bedtime, later sleep onset, and reduction in sleep duration. However, number and total duration of nocturnal awakenings decreased, while mean duration
of within-night periods of uninterrupted sleep increased, indicating more consolidated sleep.

CONCLUSIONS: Our data suggest that sleep problems are inherent in adults with ADHD and that methylphenidate reduced total sleep time but improved sleep quality by consolidating sleep.

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PMID: 17520787 [Indexed for MEDLINE]


Hypersomnia after head-neck trauma: a medicolegal dilemma.

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OBJECTIVES: To evaluate the severity of daytime sleepiness in patients with a history of head trauma who complain of daytime somnolence, to investigate polygraphic abnormalities during nocturnal sleep, and to determine whether daytime sleepiness was the cause or consequence of the head trauma.

METHODS: The authors performed a systematic evaluation of 184 patients comprised of clinical interviews, sleep disorders questionnaires, sleepiness and depression scales, medical and neurologic evaluations, sleep logs with actigraphy, nocturnal polysomnography, and the Multiple Sleep Latency Test (MSLT). Assessments of sleepiness before the accident were based on bed partner interviews, coworker and employer reports, health reports, driving records, and employment history that included absenteeism.

RESULTS: Post-traumatic complaint of somnolence was associated with variable degrees of impaired daytime functioning in more than 98% of patients. Patients who were in a coma for 24 hours, who had a head fracture, or who had immediate neurosurgical interventions were likely to have scores > 16 points on
the Epworth Sleepiness Scale (ESS) and < or = 5 minutes on the MSLT. Pain at night was an important factor in nocturnal sleep disruption and daytime sleepiness. Sleep-disordered breathing was a common finding and was the only finding in whiplash patients with daytime sleepiness. Extensive evaluation of pretrauma behavior supported the conclusion that the onset of symptomatic sleep-disordered breathing was associated with the trauma. The patients who showed a "compulsive presleep behavior" were severely impaired in performing their daily activities.

CONCLUSIONS: A systematic approach is required when dealing with patients complaining of hypersomnia following a head-neck trauma.

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Hypocretin-1 Levels Associate with Fragmented Sleep in Patients with Narcolepsy Type 1.


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STUDY OBJECTIVES: We aimed to analyze nocturnal sleep characteristics of patients with narcolepsy type 1 (narcolepsy with cataplexy) measured by actigraphy in respect to cerebrospinal fluid hypocretin-1 levels of the same patients.

METHODS: Actigraphy recording of 1-2 w and hypocretin-1 concentration analysis
were done to thirty-six unmedicated patients, aged 7 to 63 y, 50% female. Twenty-six of them had hypocretin-1 levels under 30 pg/mL and the rest had levels of 31-79 pg/mL.

RESULTS: According to actigraphy, patients with very low hypocretin levels had statistically significantly longer sleep latency ($P = 0.033$) and more fragmented sleep, indicated by both the number of immobile phases of 1 min ($P = 0.020$) and movement + fragmentation index ($P = 0.049$). There were no statistically significant differences in the actual sleep time or circadian rhythm parameters measured by actigraphy.

CONCLUSIONS: Actigraphy gives additional information about the stabilization of sleep in patients with narcolepsy type 1. Very low hypocretin levels associate with more wake intruding into sleep.

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Identifying Insomnia in Early Pregnancy: Validation of the Insomnia Symptoms Questionnaire (ISQ) in Pregnant Women.

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Comment in
STUDY OBJECTIVES: Although a substantial number of pregnant women report symptoms of insomnia, few studies have used a validated instrument to determine the prevalence in early gestation. Identification of insomnia in pregnancy is vital given the strong connection between insomnia and the incidence of depression, cardiovascular disease, or immune dysregulation. The goal of this paper is to provide additional psychometric evaluation and validation of the Insomnia Symptom Questionnaire (ISQ) and to establish prevalence rates of insomnia among a cohort of pregnant women during early gestation.

METHODS: The ISQ was evaluated in 143 pregnant women at 12 weeks gestation. The internal consistency and criterion validity of the dichotomized ISQ were compared to traditional measures of sleep from sleep diaries, actigraphy, and the Pittsburgh Sleep Quality Index using indices of sensitivity, specificity, positive and negative predictive value (PPV, NPV), and likelihood ratio (LR) tests.

RESULTS: The ISQ identified 12.6% of the sample as meeting a case definition of insomnia, consistent with established diagnostic criteria. Good reliability was established with Cronbach $\alpha = 0.86$. The ISQ had high specificity (most $> 85$%), but sensitivity, PPV, NPV, and LRs varied according to which sleep measure was used as the validating criterion.

CONCLUSIONS: Insomnia is a health problem for many pregnant women at all stages in pregnancy. These data support the validity and reliability of the ISQ to identify insomnia in pregnant women. The ISQ is a short and cost-effective tool that can be quickly employed in large observational studies or in clinical practice where perinatal women are seen.

COMMENTARY: A commentary on this article appears in this issue on page 593.

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Idiopathic chronic sleep onset insomnia in attention-deficit/hyperactivity disorder: a circadian rhythm sleep disorder.

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To investigate whether ADHD-related sleep-onset insomnia (SOI) is a circadian rhythm disorder, we compared actigraphic sleep estimates, the circadian rest-activity rhythm, and dim light melatonin onset (DLMO) in ADHD children having chronic idiopathic SOI with that in ADHD children without sleep problems. Participants were 87 psychotropic-medication-naïve children, aged 6 to 12 yrs, with rigorously diagnosed ADHD and SOI (ADHD-SOI) and 33 children with ADHD without SOI (ADHD-noSOI) referred from community mental health institutions and pediatric departments of non-academic hospitals in The Netherlands. Measurements were 1 wk, 24 h actigraphy recordings and salivary DLMO. The mean (±SD) sleep onset time was 21:38 ± 0:54 h in ADHD-SOI, which was significantly later than that of 20:49 ± 0:49 h in ADHD-noSOI. DLMO was significantly later in ADHD-SOI (20:32 ± 0:55 h), compared with ADHD-noSOI (19:47 ± 0:49 h; p < 0.001). Wake-up time in ADHD-SOI was later than in ADHD-noSOI (p = 0.002). There were no significant between-group differences in sleep maintenance, as estimated by number of wake bouts and activity level in the least active 5 h period, or inter- and intradaily rhythm variability. We conclude that children with ADHD and chronic idiopathic sleep-onset insomnia show a delayed sleep phase and
delayed DLMO, compared with ADHD children without SOI.

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PMID: 16076654  [Indexed for MEDLINE]

Illegitimate tasks and sleep quality: an ambulatory study.
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The current study investigated the short-term effect of illegitimate tasks on sleep quality, assessed by actigraphy. Seventy-six employees of different service jobs participated in a 2-week data collection. Data were analysed by way of multilevel analyses. As predicted, illegitimate tasks were positively related to sleep fragmentation and sleep-onset latency, but not to sleep efficiency and not to sleep duration. Time pressure, social stressors at work and at home, and the value of the dependent variable from the previous day were controlled. Results confirm the predictive power of illegitimate tasks for a variable that can be considered crucial in the development of long-term outcomes of daily experiences.

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Imbalance of nonparametric rest-activity rhythm and the evening-type of chronotype according to frailty indicators in elderly community dwellers.
Background: Sleep health-related issues, such as poor subjective sleep quality during the night and nocturnal wakefulness, have been a focus of recent research on frailty. However, current trends regarding the chronotypes of older individuals with frailty have not been well documented, and information on the impact of frailty on circadian rest–activity patterns is limited. The aim of this research was to clarify the relationship among frailty, nonparametric rest–activity patterns, and chronotype in older community-dwelling subjects.

Method: A survey was conducted between June and December 2018, and the participants of this study were recruited from among community-dwellers aged 60 years or older living in Akita prefecture, Japan. The frailty phenotype defined by the National Center for Geriatrics and Gerontology Study of Geriatric Syndromes (NCGG-SGS) was used to evaluate the frailty status of each participant. To evaluate nonparametric rest–activity rhythm (RAR) parameters (e.g., interdaily stability [IS], intradaily variability [IV], and relative amplitude [RA]), each participant wore an Actiwatch Spectrum Plus device on his or her non-dominant wrist for seven continuous days without removal. The Munich chronotype questionnaire-Japanese version (MCTQ-J) was also used to measure the midpoint of sleep in free days (MSF).

Results: The final study cohort was composed of 105 participants (85.7% women) and was divided into 58 non-frail subjects, 45 pre-frail subjects, and 2 frail subjects. According to a binomial logistic regression analysis, the pre-frail individuals had a weaker grip strength (coefficient [beta], -0.18; odds ratio, 0.84; 95% confidence interval [CI],...
0.76–0.93; p = 0.001) and a lower RA (beta, −8.78; odds ratio, 0.0002; 95% CI, 0.00–0.15; p = 0.01). In addition, correlation analyses also showed that the MSF was negatively associated with the RA in the pre-frail group (r = −0.30, p < 0.05) and positively correlated with the RA in the non-frail group (r = 0.26, p < 0.05); furthermore, the MSF of the pre-frail group occurred at a later time than that of the non-frail one (p = 0.03). Conclusion: The present study provides grounds for our proposal that pre-frailty is significantly associated with a low grip power and relative imbalance between rest and active statuses as indexed using nonparametric RAR parameters. Furthermore, elderly individuals with pre-frailty or frailty may have a later MSF time. However, these potential findings need to be validated in future research.

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Impact of adult attention deficit hyperactivity disorder and medication status on sleep/wake behavior and molecular circadian rhythms.


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Attention deficit hyperactivity disorder (ADHD) is a common neuropsychiatric condition that has been strongly associated with changes in sleep and circadian rhythms. Circadian rhythms are near 24-h cycles that are primarily generated by an endogenous circadian timekeeping system, encoded at the molecular level by a panel of clock genes. Stimulant and non-stimulant medication used in the management of ADHD has been shown to potentially impact on circadian processes and their behavioral outputs. In the current study, we have analyzed circadian rhythms in daily activity and sleep, and the circadian gene expression in a cohort of healthy controls (N = 22), ADHD participants not using ADHD-medication (N = 17), and participants with ADHD and current use of ADHD medication (N = 17).

Rhythms of sleep/wake behavior were assessed via wrist-worn actigraphy, whilst rhythms of circadian gene expression were assessed ex-vivo in primary human-derived dermal fibroblast cultures. Behavioral data indicate that patients with ADHD using ADHD-medication have lower relative amplitudes of diurnal activity rhythms, lower sleep efficiency, more nocturnal activity but not more nocturnal wakenings than both controls and ADHD participants without medication. At the molecular level, there were alterations in the expression of PER2 and CRY1 between ADHD individuals with no medication compared to medicated ADHD patients or controls, whilst CLOCK expression was altered in patients with ADHD and current medication. Analysis of fibroblasts transfected with a BMAL1:luc reporter showed changes in the timing of the peak expression across the three groups.

Taken together, these data support the contention that both ADHD and medication status impact on circadian processes.

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BACKGROUND: Noise in the vicinity of airports is a public health issue. Exposure to aircraft noise has been shown to have adverse effects on health and particularly on sleep. Many studies support the hypothesis that noise at night can affect subjective sleep quality. Fewer studies, however, have performed objective measurements of sleep.

OBJECTIVES: This study aimed to investigate by actigraphy the relationship between aircraft noise exposure and objective parameters of sleep quality in the population living near two French airports.

METHODS: This study includes 112 participants living in the vicinity of Paris–Charles de Gaulle and Toulouse–Blagnac airports. Wrist actigraphy measurements were performed during eight nights to evaluate objective parameters of sleep quality such as sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST), time in bed (TB) and sleep efficiency (SE).
Acoustic measurements were made simultaneously both inside the participants' bedrooms and outside (at the exterior frontage) to estimate aircraft noise levels. Energy indicators related to the sound energetic average for a given period of time, as well as indicators related to noise events (eg, the number of events that exceed a given threshold), were estimated. Logistic and linear regression models were used, taking into account potential confounders: age; gender; marital status; education; and body mass index (BMI).

RESULTS: Energy indicators, in particular, indicators related to noise events were significantly associated with objective parameters of sleep quality. Increased levels of aircraft noise and increased numbers of aircraft noise events increased the time required for sleep onset (SOL) and the total wake time after sleep onset (WASO) and decreased sleep efficiency (SE). An association was also observed between aircraft noise exposure and an increase in total sleep time (TST) and time in bed (TB).

CONCLUSION: The findings of the present study contribute to the overall evidence suggesting that nocturnal aircraft noise exposure may decrease the objective quality of sleep. Aircraft noise exposure affects objective parameters of sleep quality, not only regarding noise levels but also regarding the number of events. Mechanisms for adapting to sleep deprivation could be observed.

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Impact of breast cancer on prospective memory functioning assessed by virtual reality and influence of sleep quality and hormonal therapy: PROSOM–K study.

BACKGROUND: Breast cancer (BC) is the most frequent cancer in women with more than 70% of BC patients being treated with hormonal therapy (HT). Among these patients, some report difficulties in remembering what they are supposed to do at the right moment, referring to prospective memory (PM). PM is essential for autonomy and medical adherence of patients, and requires an ecological assessment. Virtual reality, that recreates naturalistic environment, seems to be a promising method to evaluate PM. Several BC patients also report sleep disturbances. Given the role of sleep on memory consolidation, it is
imperative
to explore the influence of sleep quality on PM in BC patients treated
with HT.
The purpose of PROSOM-K study is to assess PM functioning using
virtual reality
and sleep quality in BC treated or not with HT.
METHODS: PROSOM-K is a prospective study including post-menopausal BC
patients
≤70 years old treated with radiotherapy (n = 25) or with radiotherapy
and HT
(n = 25), and healthy post-menopausal women (n = 25) matched for age
and education. PM will be assessed using a virtual reality based task.
Other
cognitive functions and psychosocial factors will be assessed with
validated
questionnaires and neuropsychological tests. The study is divided in 3
sessions:
a session of familiarisation with the virtual environment and the PM
task: a
day-time session during which participants learn intentions during the
morning
and recall them in the evening; and a night-time session during which
participants learn intentions in the evening and recall them the
following
morning. Women will be monitored by wrist actigraphy; during the
night-time
session, objective sleep quality and quantity will be measured by
polysomnography.
DISCUSSION: This is a novel study aiming to assess PM using virtual
reality,
coupled with the evaluation of other cognitive functions.
Polysomnographic study
of sleep will provide further information about architectural sleep
disturbances
in BC. Association between sleep architecture parameters and PM
mechanism in BC
women treated with HT will be described in detail. We expect our
results will
provide knowledge for patients and clinicians and further help to
improve patient
care and cognitive therapy.
TRIAL REGISTRATION: NCT03420105 , registered: January 10, 2018.

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The impact of bright artificial white and 'blue-enriched' light on sleep and circadian phase during the polar winter.

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Delayed sleep phase (and sometimes free-run) is common in the Antarctic winter (no natural sunlight) and optimizing the artificial light conditions is desirable. This project evaluated sleep when using 17,000 K blue-enriched lamps compared with standard white lamps (5000 K) for personal and communal illumination. Base personnel, 10 males, five females, 32.5±8 years took part in the study. From 24 March to 21 September 2006 light exposure alternated between 4-5-week periods of standard white (5000 K) and blue-enriched lamps (17,000 K), with a 3-week control before and after extra light. Sleep and light exposure were assessed by actigraphy and sleep diaries. General health (RAND 36-item questionnaire) and circadian phase (urinary 6-sulphatoxymelatonin rhythm) were evaluated at the end of each light condition. Direct comparison (rmanova) of blue-enriched light with white light showed that sleep onset was earlier by 19 min (P=0.022), and sleep latency tended to be shorter by 4 min (P=0.065) with blue-enriched light. Analysing all light conditions, control, blue and white, again provided evidence for greater efficiency of blue-enriched light compared with white (P<0.05), but with the best sleep timing, duration, efficiency and quality in control natural light conditions. Circadian phase was earlier on average in midwinter blue compared with midwinter white light by 45 min (P<0.05). Light condition had no influence on general health. We conclude that the use of blue-enriched light had some beneficial effects, notably earlier
sleep, compared
with standard white light during the polar winter.

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Impact of Common Diabetes Risk Variant in MTNR1B on Sleep, Circadian, and Melatonin Physiology.

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The risk of type 2 diabetes (T2D) is increased by abnormalities in sleep quantity and quality, circadian alignment, and melatonin regulation. A common genetic
variant in a receptor for the circadian-regulated hormone melatonin (MTNR1B) is associated with increased fasting blood glucose and risk of T2D, but whether sleep or circadian disruption mediates this risk is unknown. We aimed to test if MTNR1B diabetes risk variant rs10830963 associates with measures of sleep or circadian physiology in intensive in-laboratory protocols (n = 58–96) or cross-sectional studies with sleep quantity and quality and timing measures from self-report (n = 4,307–10,332), actigraphy (n = 1,513), or polysomnography (n = 3,021). In the in-laboratory studies, we found a significant association with a substantially longer duration of elevated melatonin levels (41 min) and delayed circadian phase of dim-light melatonin offset (1.37 h), partially mediated through delayed offset of melatonin synthesis. Furthermore, increased T2D risk in MTNR1B risk allele carriers was more pronounced in early risers versus late risers as determined by 7 days of actigraphy. Our results provide the surprising insight that the MTNR1B risk allele influences dynamics of melatonin secretion, generating a novel hypothesis that the MTNR1B risk allele may extend the duration of endogenous melatonin production later into the morning and that early waking may magnify the diabetes risk conferred by the risk allele.

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The Impact of Early Bedtimes on Adolescent Caloric Intake Varies by
PURPOSE: Adolescent sleep restriction is common and can lead to overeating. Here, we test whether lengthening sleep via early bedtimes affects dietary intake differently for adolescents accustomed to a later sleep phase ("night owls") versus an earlier sleep phase ("morning larks").

METHODS: Using a randomized cross-over design, 67 adolescents changed bedtimes to create five-night periods of sleep restriction (6.5 hours in bed) versus healthy sleep (10 hours in bed). Caloric intake was measured via validated interviews. Phase preference was based on participants' premanipulation sleep.

RESULTS: Actigraphy verified that the manipulation altered sleep regardless of phase preference. Phase preference moderated the effect of the manipulation on cumulative caloric intake (p = .01-.03). Night owls showed little effect, but morning larks reduced their evening intake during healthy sleep.

CONCLUSIONS: An "early to bed" approach confers little dietary benefit for night owls but may have a protective effect for adolescents who gravitate toward earlier bedtimes.
Impact of Media Use on Adolescent Sleep Efficiency.

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OBJECTIVE: In 2010, American youth aged 8 to 18 spent an average of 7.5 hours daily using entertainment media, an increase of more than an hour compared with 2005. Increase in media use is associated with multiple negative outcomes, including decreased sleep time and increased tiredness, but little research has examined whether media use is associated with poorer sleep efficiency when the individual is actually asleep.

METHODS: This study assessed relations between adolescent media use and sleep efficiency. Fifty-five adolescents (mean age = 14.89 years; SD = 0.62; 53% African-American and 47% white) completed self-report measures concerning their media use. Sleep quality was measured by actigraphy for 1 week, and both sleep offset and sleep efficiency were extracted from actigraphy data.

RESULTS: Sleep efficiency was negatively correlated to daily time spent text messaging (r(52) = -0.29; p < .05), media use after bed (r(52) = -0.32; p < .05), and number of nighttime awakenings by mobile phones (r(52) = -0.33; p < .05). Decreased sleep efficiency was related to sleeping later in the morning,
presumably to make up for lost sleep at night (r(52) = -0.33; p < .05). In a regression model, media use accounted for 30% of the variance in sleep efficiency (adjusted R = 0.30; F(6,44) = 3.74; p < .01).

CONCLUSION: Media use after bed, awakenings by a mobile phone at night, and sleep offset associated with adolescents' sleep efficiency. Results support the incorporation of media use habits into adolescent sleep health education and sleep dysfunction interventions. Parental education about the effects of media use on sleep could also mitigate negative effects.

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The Impact of Objective and Subjective Sleep Parameters on Depressive Symptoms during Pregnancy in Women with a Mental Disorder: An Explorative Study.

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Poor sleep quality during pregnancy is associated with both antepartum and postpartum depression and adverse birth outcomes. This study evaluated both objective and subjective sleep quality and the effects on the subsequent course of antepartum depressive symptoms in psychiatric patients. This observational explorative study was embedded in an ongoing study focusing on pregnant women with a mental disorder and was performed in 18 patients (24–29 weeks pregnant). Depressive symptoms were assessed throughout pregnancy using the Edinburgh Postnatal Depression Scale (EPDS) with 5-week intervals. Sleep was assessed with actigraphy, the Pittsburgh Sleep Quality Index (PSQI) and sleep diaries at the start of the study. We studied correlations between sleep parameters and EPDS scores cross-sectionally using Spearman correlation. Next, we studied the course of antepartum EPDS scores over time per sleep parameter using generalized linear mixed modelling analysis. Objectively measured fragmentation index, total PSQI score and 4 PSQI subscales (sleep quality, sleep duration, sleep disturbances and daytime dysfunctions) were significantly correlated with EPDS scores when measured cross-sectionally at the start. Six objectively and subjectively measured sleep parameters had moderate to large effects on the course of depressive symptoms through the third trimester, but these effects were not...
statistically significant. More research is necessary to explore the causality of
the direction between sleep problems and antepartum depressive
symptoms we found
in psychiatric patients.

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The Impact of Optimized Daylight and Views on the Sleep Duration and
Cognitive Performance of Office Workers.

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A growing awareness has recently emerged on the health benefits of
exposure to
daylight and views. Daylight exposure is linked to circadian rhythm
regulation,
which can have significant impacts on sleep quality and cognitive
function. Views
of nature have also been shown to impact emotional affect and
performance. This
study explores the impact of optimized daylight and views on the sleep
and
cognitive performance of office workers. Thirty knowledge workers
spent one week
working in each of two office environments with identical layouts,
furnishings,
and orientations; however, one was outfitted with electrochromic glass
and the other with traditional blinds, producing lighting conditions of 40.6 and 316 equivalent melanopic lux, respectively. Participants in the optimized daylight and views condition slept 37 min longer as measured by wrist-worn actigraphs and scored 42% higher on cognitive simulations designed to test their higher order decision-making performance. Both sleep and cognitive function were impacted after one day in the space, yet the impacts became more significant over the course of the week. The positive effect of optimized daylight and views on cognitive function was comparable for almost all participants, while increases in sleep duration were significantly greater for those with the lowest baseline sleep duration. This study stresses the significance of designing with daylight in order to optimize the sleep quality and performance of office workers.

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The Impact of Shift Work on Sleep, Alertness and Performance in Healthcare Workers.


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Shift work is associated with impaired alertness and performance due to sleep loss and circadian misalignment. This study examined sleep between shift types (day, evening, night), and alertness and performance during day and night shifts in 52 intensive care workers. Sleep and wake duration between shifts were evaluated using wrist actigraphs and diaries. Subjective sleepiness (Karolinska Sleepiness Scale, KSS) and Psychomotor Vigilance Test (PVT) performance were examined during day shift, and on the first and subsequent night shifts (3rd, 4th or 5th). Circadian phase was assessed using urinary 6-sulphatoxymelatonin rhythms. Sleep was most restricted between consecutive night shifts (5.74 ± 1.30 h), consecutive day shifts (5.83 ± 0.92 h) and between evening and day shifts (5.20 ± 0.90 h). KSS and PVT mean reaction times were higher at the end of the first and subsequent night shift compared to day shift, with KSS highest at the end of the first night. On nights, working during the circadian acrophase of the urinary melatonin rhythm led to poorer outcomes on the KSS and PVT. In rotating shift workers, early day shifts can be associated with similar sleep restriction to night shifts, particularly when scheduled immediately following an evening shift. Alertness and performance remain most impaired during night shifts given the lack of circadian adaptation to night work. Although
healthcare workers perceive themselves to be less alert on the first night shift
compared to subsequent night shifts, objective performance is equally impaired on
subsequent nights.

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Impact of shift work schedules on actigraphy-based measures of sleep in Hispanic workers: results from the Hispanic Community Health Study/Study of Latinos ancillary Sueño study.

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Study Objectives: To describe sleep characteristics of shift workers compared with day workers from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) Sueño ancillary study and test the hypothesis that shift work is associated with shorter sleep duration, worse sleep quality, greater sleep
variability, and other sleep/health-related factors.
Methods: Employed adults (N = 1253, mean age 46.3 years, 36.3% male) from the
Sueño study were included. Measures of sleep duration, timing, regularity, and
continuity were calculated from 7 days of wrist-activity monitoring. Participants
provided information on demographics, employment, work schedule (day, afternoon,
night, split, irregular, and rotating), sleepiness, depressive symptoms,
medications, caffeine, and alcohol use. Survey linear regression
adjusting for
age, sex, background, site, number of jobs, and work hours was used.
Results: In age and sex-adjusted models, all shift work schedules were
associated
with delayed sleep timing. Night and irregular schedules were
associated with
shorter sleep duration, greater napping, and greater variability of
sleep.
Afternoon and rotating shifts were associated with lower sleep
regularity. In
fully adjusted models, night and irregular schedules remained
associated with
shorter sleep duration, later sleep midpoint, and greater variability in sleep
measures compared with day schedules. Split schedules were associated
with, less
time in bed, less sleep fragmentation, and less wake during the sleep
period than
day schedules.
Conclusions: Work schedule significantly affects sleep-wake with
substantial
differences between day work and other types of schedule. Detailed
assessment of
work schedule type not just night shift should be considered as an
important
covariate when examining the association between sleep and health
outcomes.
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Impact of sleep and circadian disturbances in urinary 6-
sulphatoxymelatonin
levels, on cognitive function after major surgery.
Sleep and circadian disturbances may underlie cognitive dysfunction after major surgery. The aim of this study was to examine the association between sleep and circadian disturbances (as assessed by changes in the melatonin rhythm) and postoperative cognitive dysfunction (POCD). We measured subjective and objective sleep quality, excretion of the major metabolite of melatonin, 6-sulphatoxymelatonin (aMT6s) in urine and cognitive function before and 4 days after major abdominal surgery in 36 patients. Subjective sleep quality was measured by visual analogue scale, objective sleep quality was measured by actigraphy, and cognitive function was assessed by neuropsychological testing.

Eighteen patients (50%) had POCD on day 4 after surgery. At that time, the excretion of aMT6s was disturbed with significantly higher daytime excretion and a reduced night/day ratio compared with the preoperative measure (P = 0.05). Patients with POCD had significantly worse sleep quality and more night awakenings (P < 0.05) but we found no significant differences in day time (06:00–22:00 hr), night-time (22:00–06:00 hr) or total aMT6s excretion (μg/24 hr). A significant correlation was found between the total excretion of aMT6s and actigraphically measured sleep efficiency (r(s) = 0.45, P = 0.03) and wakefulness after sleep onset (r(s) = −0.44, P = 0.04). In conclusion, POCD was associated with worse subjective sleep quality and more awakenings. Circadian rhythmicity as assessed by aMT6s excretion was disturbed after surgery but we were unable to show an association with POCD. Strategies to improve postoperative sleep quality
Impact of sleep behavior on glycemic control in type 1 diabetes: the role of social jetlag.

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BACKGROUND: Sleep behavior is changing toward shorter sleep duration and a later chronotype. It results in a sleep debt that is acquitted on work-free days, inducing a small but recurrent sleep misalignment each week, referred to as "social jetlag". These sleep habits could affect health through misalignment with circadian rhythms.
OBJECTIVES: The primary objective is to address the impact of sleep behavior on glycemic control, assessed by HbA1c, in patients with type 1 diabetes, independently of other lifestyle or sleep-related factors. The secondary objective is to address whether circadian phase affects glycemic control.

DESIGN: In total, 80 adult patients with type 1 diabetes (46% female) were included in a clinical cohort study.

METHODS: Sleep behavior was addressed objectively by a 7-day actimetry, lifestyle by questionnaires, sleep breathing disorders by nocturnal oximetry and circadian phase by dim light melatonin onset (DLMO).

RESULTS: Univariate analyses showed that chronotype \((r = 0.23, P = 0.042)\) and social jetlag \((r = 0.30, P = 0.008)\) were significantly associated with HbA1c. In multivariable analysis, social jetlag was the only sleep habit independently associated with HbA1c \((\beta = 0.012 (0.006; 0.017), P < 0.001)\). HbA1c was lower in patients with a social jetlag below versus above the median \((7.7\% (7.1-8.7) and 8.7\% (7.6-9.8), P = 0.011)\). DLMO was not associated with HbA1c. However, the later the DLMO, the worse the sleep efficiency \((r = -0.41, P < 0.001)\) and fragmentation index \((r = 0.35, P = 0.005)\).

CONCLUSIONS: Social jetlag, a small but recurrent circadian misalignment, is associated with worse glycemic control in type 1 diabetes, whereas circadian phase is not. Further intervention studies should address the potential improvement of glycemic control by correcting social jetlag.

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The Impact of Subthalamic Deep Brain Stimulation on Sleep-Wake Behavior: A Prospective Electrophysiological Study in 50 Parkinson Patients.
Study Objectives: This prospective observational study was designed to systematically examine the effect of subthalamic deep brain stimulation (DBS) on subjective and objective sleep-wake parameters in Parkinson patients.

Methods: In 50 consecutive Parkinson patients undergoing subthalamic DBS, we assessed motor symptoms, medication, the position of DBS electrodes within the subthalamic nucleus (STN), subjective sleep-wake parameters, 2-week actigraphy, video-polysomnography studies, and sleep electroencephalogram frequency and dynamics analyses before and 6 months after surgery.

Results: Subthalamic DBS improved not only motor symptoms and reduced daily intake of dopaminergic agents but also enhanced subjective sleep quality and reduced sleepiness (Epworth Sleepiness Scale: -2.1 ± 3.8, p < .001). Actigraphy recordings revealed longer bedtimes (+1:06 ± 0:51 hours, p < .001) without shifting of circadian timing. Upon polysomnography, we observed an increase in sleep efficiency (+5.2 ± 17.6%, p = .005) and deep sleep (+11.2 ± 32.2 min, p = .017) and increased accumulation of slow-wave activity over the night (+41.0 ± 80.0%, p = .005). Rapid eye movement sleep features were refractory to subthalamic DBS, and the dynamics of sleep as assessed by state space analyses did not normalize. Increased sleep efficiency was associated with active electrode contact localization more distant from the ventral margin of the left subthalamic nucleus.

Conclusion: Subthalamic DBS deepens and consolidates nocturnal sleep and improves daytime wakefulness in Parkinson patients, but several outcomes...
suggest that it does not normalize sleep. It remains elusive whether modulated activity in the STN directly contributes to changes in sleep-wake behavior, but dorsal positioning of electrodes within the STN is linked to improved sleep-wake outcomes.

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Impact of transcutaneous electrical nerve stimulation on sleep in chronic low back pain: a real-world retrospective cohort study.

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Objective: The purpose of this study was to determine if transcutaneous electrical nerve stimulation (TENS) improves sleep in chronic low back pain (CLBP).

Background: There is uncertainty over the effectiveness of TENS in CLBP. In most studies, pain intensity has been the primary outcome measure. Although sleep abnormalities are common in CLBP, sleep outcomes have not been evaluated in most studies of TENS effectiveness. Subjective and objective sleep measures are often inconsistent in CLBP, suggesting that perception of sleep and actual sleep may differ.

Methods: This retrospective cohort study evaluated TENS for CLBP over 10 weeks. The source database included demographics, pain characteristics, pain intensity
and interference on an 11-point numerical rating scale, adherence and actigraphic sleep data from real-world TENS users. Key inclusion criteria were CLBP with self-reported history of back injury and baseline pain interference with sleep ≥4. Study participants were stratified into improved and unimproved groups based on changes in pain interference with sleep (improved ≥1-point decrease). Actigraphic sleep metrics were compared between the two groups for weeks 1–2 and weeks 9–10. Results: The inclusion criteria were met by 554 TENS users. There were 282 (50.9%) participants in the improved group and 272 (49.1%) in the unimproved group. The two groups had similar baseline characteristics and high TENS adherence. At the weeks 1–2 assessment, there were no differences among actigraphic sleep. At the weeks 9–10 assessment, there was a difference in total sleep time, with the improved group sleeping 29 minutes longer. In addition, the periodic leg movement (PLM) index was lower in the improved group. Conclusion: Regular TENS improved self-reported and objective sleep measures in individuals with CLBP. When compared to the unimproved group, the improved group had longer total sleep time and fewer PLMs. Sleep may be an important outcome for TENS effectiveness in CLBP.

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Conflict of interest statement: Disclosure SNG, TCF, MM, and XK are employees and shareholders of NeuroMetrix, Inc. The authors report no other conflicts of interest in this work.


Impaired quality and efficiency of sleep impairs cognitive functioning in
Addison's disease.

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BACKGROUND: Standard replacement therapy for Addison's disease (AD) does not restore a normal circadian rhythm. Periods of sub- and supra-physiological cortisol levels experienced by patients with AD likely induce disrupted sleep. Given that healthy sleep plays an important role in memory consolidation, the novelty of the current study was to characterise, using objective measures, the relationship between sleep and memory in patients with AD, and to examine the hypothesis that poor sleep is a biological mechanism underlying memory impairment in those patients.

METHODS: We used a within-subjects design. Ten patients with AD and 10 matched healthy controls completed standardised neuropsychological tests assessing declarative memory (Rey Auditory Verbal Learning Test) and procedural memory (Finger Tapping Task) before and after a period of actigraphy-measured sleep, and before and after a period of waking.

RESULTS: Relative to healthy controls, patients with AD experienced disrupted sleep characterised by poorer sleep efficiency and more time spent awake. Patients also showed impaired verbal learning and memory relative to healthy controls (p=0.007). Furthermore, whereas healthy controls' declarative memory performance benefited from a period of sleep compared to waking
patients with AD derived no such benefit from sleep (p=0.448). Regarding the procedural memory task, analyses detected no significant between-group differences (all p's<0.065), and neither group showed significant sleep-enhanced performance. CONCLUSIONS: We demonstrated, using actigraphy and standardized measures of memory performance, an association between sleep disturbances and cognitive deficits in patients with AD. These results suggest that, in patients with AD, the source of memory deficits is, at least to some extent, disrupted sleep patterns that interfere with optimal consolidation of previously-learned declarative information. Hence, treating the sleep disturbances that are frequently experienced by patients with AD may improve their cognitive functioning.

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Impaired sleep and well-being in mothers with low-birth-weight infants.

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OBJECTIVE: To explore relationships between impaired sleep and well-being in mothers with low-birth-weight infants in the neonatal intensive care unit.
DESIGN: Cross-sectional descriptive exploratory design.
SETTING: Neonatal intensive care unit in metropolitan Atlanta, GA.
PARTICIPANTS: Twenty second-week postpartum, first-time mothers who had a low-birth-weight infant hospitalized in the neonatal intensive care unit.

METHODS: Self-report data were collected for sleep, fatigue, depression, and well-being. Total sleep time, wake after sleep onset, circadian activity rhythms, and light exposure were measured using a wrist actigraph.

RESULTS: Mothers reported clinically significant sleep disturbance and fatigue severity. Actigraphy showed the average nighttime total sleep time was less than 7 hours with 19% +/- 2.2% wake after sleep onset, and the total daytime sleep was more than an hour. Mothers also experienced moderate depressive symptoms. Maternal well-being as measured by the Medical Outcomes Short Form-36, version 2 was approximately 1 SD below the mean scores of age-matched women in the general U.S. population.

CONCLUSION: Mothers of hospitalized low-birth-weight infants are vulnerable. The presence of sleep disturbances and negative physical and mental health indicators warrants further study. Intervention is needed to promote sleep for new mothers during postpartum recovery, especially mothers who are dealing with a medically ill infant.

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Impairment in circadian activity rhythms occurs during dexamethasone therapy in children with leukemia.

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BACKGROUND: Circadian rhythm disturbances in adults with cancer are associated with fatigue, time to relapse, and death. This study of circadian activity rhythms (CAR) of children with acute lymphoblastic leukemia (ALL) on continuation chemotherapy aimed to describe CAR before and after starting dexamethasone, and to determine whether fatigue was associated with less robust CAR.

PROCEDURE: This was a secondary analysis of data from a multi-institutional study in which children with ALL aged 5–18 years wore an actigraph for 10 consecutive 24-hour periods, five before and five during dexamethasone therapy. CAR parameters measured by actigraphy were calculated for each 5-day period, including peak activity, MESOR, amplitude, acrophase, and circadian quotient. Fatigue was measured on study days 2, 5, 7, and 10 by parent-report and self-report for children ≥ 7 years.

RESULTS: Eighty-two children qualified for CAR analysis, and 87 for analysis of daily peak activity patterns and fatigue. Mean age was 8.8 ± 3.3 years. Peak activity, MESOR, and amplitude significantly decreased during dexamethasone therapy. Children on high-dose dexamethasone (8 or 12 mg/m(2)/d) had significantly higher (better, or more robust) values of several CAR parameters than those on low-dose (6 mg/m(2)/d). There was a significant trend of decreasing daily pattern of peak activity during dexamethasone therapy only. Fatigue increased across the study and was associated with decreasing CAR peak activity, MESOR, and amplitude.

CONCLUSIONS: Dexamethasone initiation was associated with a decrease in several CAR parameters, and a significant decrease in the trend of daily peak activity. Fatigue was associated with less robust CAR.

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Improved Mental Acuity Forecasting with an Individualized Quantitative Sleep Model.

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Sleep impairment significantly alters human brain structure and cognitive function, but available evidence suggests that adults in developed nations are sleeping less. A growing body of research has sought to use sleep to forecast cognitive performance by modeling the relationship between the two, but has generally focused on vigilance rather than other cognitive constructs affected by sleep, such as reaction time, executive function, and working memory. Previous modeling efforts have also utilized subjective, self-reported sleep durations and were restricted to laboratory environments. In the current effort, we addressed these limitations by employing wearable systems and mobile applications to gather objective sleep information, assess multi-construct cognitive performance, and model/predict changes to mental acuity. Thirty participants were recruited for participation in the study, which lasted 1 week. Using the Fitbit Charge HR and a mobile version of the automated neuropsychological assessment metric called CogGauge, we gathered a series of features and utilized the unified model of performance to predict mental acuity based on sleep records. Our results suggest that individuals poorly rate their sleep duration, supporting the need for objective sleep metrics to model circadian changes to mental acuity. Participant compliance in using the wearable throughout the week and responding to the CogGauge assessments was 80%. Specific biases were identified in temporal metrics.
across mobile devices and operating systems and were excluded from the mental acuity metric development. Individualized prediction of mental acuity consistently outperformed group modeling. This effort indicates the feasibility of creating an individualized, mobile assessment and prediction of mental acuity, compatible with the majority of current mobile devices.

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PMID: 28487671


Improving adaptation to simulated night shift: timed exposure to bright light versus daytime melatonin administration.

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Chronic circadian disturbance is thought to cause many of the health and social problems reported by shift workers. In recent years, appropriately timed exposure to bright light and exogenous melatonin have been used to accelerate adaptation to phase shifts of the circadian system. In this study we compared adaptation to night shift in three groups of subjects. The first treatment group received timed exposure to bright light (4–7,000 lux between 2400 and 0400 hours on each of three night shifts). The second treatment group received exogenous melatonin by capsule (2 mg at 0800 hours then 1 mg at 1100 and 1400 hours). The placebo control groups received either dim red light at less than 50 lux or placebo (sucrose) in identical capsules at the same time. Results indicated that all groups shifted significantly from baseline. Using the dim-light melatonin onset as a circadian marker, the bright-light group shifted the furthest,
whereas there was no significant difference between the melatonin and placebo groups. Sleep quality as determined by wrist actigraphy was most improved in the light-treatment group, although the melatonin group also showed significant improvements. Cognitive psychomotor performance was most improved in the light-treatment group and the melatonin group again showed little difference from the control group. Although melatonin was unable to increase the amount of the phase shift following transition to night shift, it is likely that the intermediate levels of improvement in sleep reflect the hypothermic effects of melatonin. By lowering core temperature across the sleep period, sleep may be enhanced. This improvement in sleep quality did not produce concomitant improvements in shift performance for the melatonin group. This suggests that the enhanced performance in the light-treatment group may reflect more direct "energizing" effects. On the basis of these results, bright light is clearly superior in its ability to phase shift the circadian system and thereby improve sleep and performance. However, melatonin may permit shift workers to override the circadian system for short periods and avoid the potential toxicity due to overzealous manipulations of the circadian pacemaker. In rapidly rotating shift schedules, melatonin may be preferable because it would not require workers to reverse the large phase shift induced by light.

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PMID: 7761738 [Indexed for MEDLINE]


In vitro circadian period is associated with circadian/sleep preference.

Evaluation of circadian phenotypes is crucial for understanding the pathophysiology of diseases associated with disturbed biological rhythms such as circadian rhythm sleep disorders (CRSDs). We measured clock gene expression in fibroblasts from individual subjects and observed circadian rhythms in the cells (in vitro rhythms). Period length of the in vitro rhythm (in vitro period) was compared with the intrinsic circadian period, $\tau$, measured under a forced desynchrony protocol (in vivo period) and circadian/sleep parameters evaluated by questionnaires, sleep log, and actigraphy. Although no significant correlation was observed between the in vitro and in vivo periods, the in vitro period was correlated with chronotype, habitual sleep time, and preferred sleep time. Our data demonstrate that the in vitro period is significantly correlated with circadian/sleep preference. The findings suggest that fibroblasts from individual patients can be utilized for in vitro screening of therapeutic agents to provide personalized therapeutic regimens for CRSD patients.

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PMID: 23797865 [Indexed for MEDLINE]
Toward identifying variables that may protect children against sleep problems otherwise associated with ethnic minority status and economic adversity, support coping was examined as a moderator. Participants were 235 children (113 boys, 122 girls; M age = 11.33 years, SD = 8.03 months), 64% European American and 36% African American. Children's sleep duration (minutes) and continuity (efficiency) were assessed through actigraphs worn for 1 week. Mothers reported on the family's monetary resources (income-to-needs ratio) and children reported on their support coping strategies. For children from lower income homes and African Americans, a higher level of support coping was a protective factor against fewer sleep minutes and reduced sleep efficiency, otherwise associated with economic adversity. Children from more economically advantaged homes had good sleep parameters regardless of their coping. The results build on the existing small body of work by demonstrating that children's support coping strategies have a protective role against sleep problems otherwise associated with ethnic minority status and economic adversity and present potential targets for intervention that may help reduce health disparities in an important health domain.

DOI: 10.1037/a0036699
PMCID: PMC4105988
PMID: 25045954 [Indexed for MEDLINE]


[Increased daytime tiredness, nocturnal hypertension and sleep apnea: studies in rural general practice].
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Studies in a Rural General Practice: Sleep-Related Breathing Disorders (SRBD) and altered circadian blood pressure profile are related to increased cardiovascular risk. We investigated the prevalence and coincidence of both diseases in male patients from a general practice in a small community of 2500 people. Out of 409 selected patients (using a questionnaire regarding symptoms and findings of SRBD), 185 were monitored in an outpatient setting with an apnoea-screening system Mesam IV. Ambulatory blood pressure monitoring (Spacelabs 90207). Holter-ECG and actigraphy were also measured. Sixty patients had a Respiratory Disturbance Index (RDI) > 10. An indication for further sleep studies was seen in 40 patients; 36.5% of daytime hypertensives were "Non-Dipper", and 47.6% of normotensives were also "Non-Dipper". Excessive daytime sleepiness (EDS) is an important symptom of SRBD, and in this investigation we noticed a large number of patients without this symptom suffering from relevant SRBD. Therefore, absence of EDS alone is not indicative for the use of ambulatory monitoring.

PMID: 9340632 [Indexed for MEDLINE]


Increased light exposure consolidates sleep and strengthens circadian rhythms in severe Alzheimer's disease patients.


Author information:
Sleep in the nursing home environment is extremely fragmented, possibly in part as a result of decreased light exposure. This study examined the effect of light on sleep and circadian activity rhythms in patients with probable or possible Alzheimer's disease. Results showed that both morning and evening bright light resulted in more consolidated sleep at night, as measured with wrist actigraphy. Evening light also increased the quality of the circadian activity rhythm, as measured by a 5-parameter extended cosine model (amplitude, acrophase, nadir, slope of the curve, and relative width of the peak and trough). Increasing light exposure throughout the day and evening is likely to have the most beneficial effect on sleep and on circadian rhythms in patients with dementia. It would behoove nursing homes to consider increasing ambient light in multipurpose rooms where patients often spend much of their days.

DOI: 10.1207/S15402010BSM0101_4
PMID: 15600135  [Indexed for MEDLINE]


Increasing walking and bright light exposure to improve sleep in community-dwelling persons with Alzheimer's disease: results of a randomized, controlled trial.

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OBJECTIVES: To test the effects of walking, light exposure, and a combination intervention (walking, light, and sleep education) on the sleep of persons with Alzheimer's disease (AD).

DESIGN: Randomized, controlled trial with blinded assessors.

SETTING: Independent community living.

PARTICIPANTS: One hundred thirty-two people with AD and their in-home caregivers.

INTERVENTIONS: Participants were randomly assigned to one of three active treatments (walking, light, combination treatment) or contact control and received three or six in-home visits.

MEASUREMENTS: Primary outcomes were participant total wake time based on wrist actigraphy and caregiver ratings of participant sleep quality on the Sleep Disorders Inventory (SDI). Secondary sleep outcomes included additional actigraphic measurements of sleep percentage, number of awakenings, and total sleep time.

RESULTS: Participants in walking (P=.05), light (P=.04), and combination treatment (P=.01) had significantly greater improvements in total wake time at posttest (effect size 0.51-0.63) than controls but no significant improvement on the SDI. Moderate effect size improvements in actigraphic sleep percentage were also observed in active treatment participants. There were no significant differences between the active treatment groups and no group differences for any sleep outcomes at 6 months. Participants with better adherence (4 d/wk) to walking and light exposure recommendations had significantly less total wake time (P=.006) and better sleep efficiency (P=.005) at posttest than those with poorer adherence.

CONCLUSION: Walking, light exposure, and their combination are potentially effective treatments for improving sleep in community-dwelling persons with AD, but consistent adherence to treatment recommendations is required.

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Indirect bright light improves circadian rest-activity rhythm disturbances in demented patients.

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Light is known to be an important modulator of circadian rhythms. We tested the hypothesis than an enduring increase in the daytime environmental illumination level improves rest-activity rhythm disturbances in demented patients. Actigraphy was performed before, during, and after 4 weeks of increased illumination in the living rooms of 22 patients with dementia clinically diagnosed as probable Alzheimer's disease, multi-infarct dementia, dementia associated with alcoholism, or normal pressure hydrocephalus. The results indicated that during increased illumination, the stability of the rest-activity rhythm increased in patients with intact vision, but not in visually impaired patients.

van Nassau F(1), Mackenbach JD(2), Compernolle S(3), de Bourdeaudhuij I(3),
As the detrimental health effects of sedentary behaviour are well established, insight into the individual and environmental factors that influence adults' sedentary behaviour is needed. Most studies to date rely on self-reported measures of sedentary time. Therefore, the aim of the current study was to examine individual and environmental correlates of objectively measured sedentary time in Dutch and Belgian adults. Between March and August 2014, Belgian (n = 133) and Dutch (n = 223) adults, recruited as sub-sample of the SPOTLIGHT survey, wore an ActiGraph accelerometer to provide objectively measured sedentary and moderate to vigorous physical activity time. Participants completed a questionnaire assessing sociodemographic (country of residence, age, gender and educational level), lifestyle (sleep, smoking, sugar-containing beverage consumption, alcohol intake), health (body mass index, self-rated health), work (employment status and type of work), happiness, physical environmental (owning a car, number of screens, socioeconomic status and residential density) and social environmental factors (social network, social cohesion). Univariate and multivariable regression analyses showed that Belgian participants had a lower odds of being sedentary for at least 9 hours per day compared to Dutch participants. Women, older participants and those meeting the WHO recommendation for physical activity were also less likely to sit for 9 hours or more per day. Participants doing (heavy) manual work or being in education, homemaker,
unemployed had lower odds of being sedentary for at least 9 hours per day compared to participants with a sitting job. Those with a higher self-reported social network also had lower odds for sedentary time. No associations between physical and other social environmental characteristics and sedentary time were found. Our findings add to the growing evidence of factors associated with prolonged sedentary time in adults. These findings may be used to inform the development of strategies and interventions aimed at reducing sedentary time, and to identify high risk groups.

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Individual Differences in Sleep Timing Relate to Melanopsin-Based Phototransduction in Healthy Adolescents and Young Adults.


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STUDY OBJECTIVES: Individual differences in sleep timing have been widely recognized and are of particular relevance in adolescents and young adults who often show mild to severely delayed sleep. The biological mechanisms underlying the between-subject variance remain to be determined. Recent human genetics studies showed an association between sleep timing and melanopsin gene variation, but support for functional effects on downstream pathways and behavior was not demonstrated before. We therefore investigated the association between the autonomic (i.e., pupil diameter) and behavioral (i.e., sleep timing) readouts of two different downstream brain areas, both affected by the same melanopsin-dependent retinal phototransduction: the olivary pretectal nucleus (OPN) and the suprachiasmatic nucleus (SCN).

METHODS: Our study population included 71 healthy individuals within an age range with known vulnerability to a delayed sleep phase (16.8-35.7 y, 37 males, 34 females). Pupillometry was performed to estimate functionality of the intrinsic melanopsin-signaling circuitry based on the OPN-mediated post-illumination pupil response (PIPR) to blue light. Sleep timing was quantified by estimating the SCN-mediated mid-sleep timing in three different ways in parallel: using a chronotype questionnaire, a sleep diary, and actigraphy.

RESULTS: All three measures consistently showed that those individuals with a later mid-sleep timing had a more pronounced PIPR (0.03 < P < 0.05), indicating a stronger blue-light responsiveness of the intrinsic melanopsin-based phototransduction circuitry.

CONCLUSIONS: Trait-like individual differences in the melanopsin phototransduction circuitry contribute to individual differences in sleep timing. Blue light-sensitive young individuals are more prone to delayed
Individualized sleep education improves subjective and objective sleep indices in elite cricket athletes: A pilot study.

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The aim of the current study was to evaluate the effect of personalized sleep hygiene education on sleep indices in elite athletes. Nine elite male cricket players performed 3 weeks of baseline sleep monitoring (PRE), followed by group and individualized sleep hygiene education and a further 3 weeks of sleep monitoring (POST). Subjective sleep questionnaires included the Athlete Sleep Behaviour Questionnaire (ASBQ), the Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Quality Index (PSQI). Objective sleep indices were monitored via wrist actigraphy. There were significant improvements ($p < 0.05$) in two of the sleep questionnaires (ESS and PSQI) and in sleep efficiency (+5%), sleep latency ($-29$ min) and sleep onset variance ($-28$ min) following the
intervention, all associated with large or very large effect sizes (d= 1.38, -0.85 and -0.88, respectively). The current study reports that personalized sleep hygiene education using the ASBQ to target maladaptive sleep behaviours may be effective in acutely improving sleep indices in elite male athletes.

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Individually tailored light intervention through closed eyelids to promote circadian alignment and sleep health.

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BACKGROUND: Light is most effective at changing the timing of the circadian clock when applied close to the core body temperature minimum. The present study investigated, in a home setting, if individually tailored light treatment using flashing blue light delivered through closed eyelids during the early part of the sleep period delayed circadian phase and sleep in a population of healthy older adults and in those suffering from early awakening insomnia.

METHODS: Twenty-eight participants (9 early awakening insomniacs) completed an 8-week, within-subjects study. Twice, participants collected data during two baseline weeks and one intervention week. During the intervention week, participants wore a flashing blue (active) or a flashing red (control) light mask during sleep. Light was expected to delay circadian phase. Saliva samples for dim light melatonin onset (DLMO) were collected at the end of each baseline and intervention week. Wrist actigraphy and Daysimeter, a calibrated light and
activity meter, data were collected during the entire study.

RESULTS: Compared to baseline, flashing blue light, but not flashing red light, significantly (p<0.05) delayed DLMO. The mean ± standard deviation phase shift (minutes) was 0:06 ± 0:30 for the flashing red light and 0:34 ± 0:30 for the flashing blue light. Compared to Day 1, sleep start times were significantly delayed (by approximately 46 minutes) at Day 7 after the flashing blue light. The light intervention did not affect sleep efficiency.

CONCLUSIONS: The present study demonstrated the feasibility of using light through closed eyelids during sleep for promoting circadian alignment and sleep health.

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PMID: 26985450


Inducing more sleep on school nights reduces sedentary behavior without affecting physical activity in short-sleeping adolescents.

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OBJECTIVES/BACKGROUND: Short sleep duration during adolescence is associated with increased dietary intake and greater risk for overweight/obesity. However, findings are mixed on the relationship between sleep and physical activity (PA) during the school year, when short sleep duration is most common. Furthermore, there is concern that increasing sleep duration may interfere with opportunities for PA, yet this has not been directly tested. This study examined the impact of an at-home experimental sleep extension protocol on PA during the school year among short-sleeping adolescents.

PARTICIPANTS/METHODS: Participants included 18 adolescents (67% female, 78% white) who reported regularly sleeping between 5–7 h on school nights. Adolescents completed a five-week, at-home sleep manipulation protocol with an initial baseline week followed in a randomized, counterbalanced order by two experimental conditions, each lasting two weeks. During prescribed habitual sleep (HAB), bedtimes and rise times were set to match the baseline sleep pattern, and during sleep extension (EXT), adolescents were instructed to increase time in bed on school nights by 1.5 h per night relative to baseline. Wrist-mounted actigraphy was employed to monitor sleep and waist-mounted accelerometers were used to measure daytime PA.

RESULTS: Adolescents slept for an average duration of 71 min longer on school nights during EXT than during HAB (p < 0.001). During HAB, adolescents spent more time in sedentary behavior (p = 0.002) than during EXT, but there were no cross-condition differences in light activity (p = 0.184) or moderate-to-vigorous PA (p = 0.102).

CONCLUSIONS: Extending sleep duration on school nights in short-sleeping adolescents reduces time spent in sedentary behavior, without having a
Motor asymmetry during the first hours of sleep documented in adults found higher activity in the non-dominant limb. The stage of development at which such asymmetries first appear is unknown. Twenty healthy infants were followed from 7 to 12 months of age, at 3-week intervals, comparing motor activity of the right and left legs during sleep using twin actigraphs (AMI). Hour-by-hour analysis of the first seven hours of nocturnal sleep found no consistent difference in activity levels between the right and left legs. Using the standard
algorithm for infants, which provides an overall estimate of sleep quality, revealed discrepancies in night waking episodes (Right versus Left) in 33% of the nights. Results pertaining to leg movement suggest that motor asymmetry is not yet present during the first year of life. However, given the large discrepancies in the detection of night waking, further investigation of the developmental course of circadian motor asymmetry is warranted.

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Infant sleep hygiene counseling (sleep trial): protocol of a randomized controlled trial.

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BACKGROUND: Sleep problems in childhood have been found to be associated with memory and learning impairments, irritability, difficulties in mood modulation, attention and behavioral problems, hyperactivity and impulsivity. Short sleep duration has been found to be associated with overweight and obesity in childhood. This paper describes the protocol of a behavioral intervention planned to promote healthier sleep in infants.

METHODS: The study is a 1:1 parallel group single-blinded randomized controlled trial enrolling a total of 552 infants at 3 months of age. The main eligibility criterion is maternal report of the infant's sleep lasting on average less than 15 h per 24 h (daytime and nighttime sleep). Following block randomization, trained fieldworkers conduct home visits of the intervention group mothers and provide standardized advice on general practices that promote infant's self-regulated sleep. A booklet with the intervention content to aid the mother in implementing the intervention was developed and is given to the mothers in the intervention arm. In the two days following the home visit the intervention mothers receive daily telephone calls for intervention reinforcement and at day 3 the fieldworkers conduct a reinforcement visit to support mothers' compliance with the intervention. The main outcome assessed is the between group difference in average nighttime self-regulated sleep duration (the maximum amount of time the child stays asleep or awake without awakening the parents), at ages 6, 12 and 24 months, evaluated by means of actigraphy, activity diary records and questionnaires. The secondary outcomes are conditional linear growth
between age 3-12 and 12-24 months and neurocognitive development at ages 12 and 24 months.

DISCUSSION: The negative impact of inadequate and insufficient sleep on children's physical and mental health are unquestionable, as well as its impact on cognitive function, academic performance and behavior, all of these being factors to which children in low- and middle-income countries are at higher risk.

Behavioral interventions targeting mothers and young children that can be delivered inexpensively and not requiring specialized training can help prevent future issues by reducing the risk to which these children are exposed.

TRIAL REGISTRATION: ClinicalTrial.gov NCT02788630 registered on 14 June 2016 (retrospectively registered).

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PMCID: PMC5010682
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Infant wake after sleep onset serves as a marker for different trajectories in cognitive development.

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BACKGROUND: Sleep variables have been linked to improved functioning of learning and memory throughout life, with most studies focusing on older children and adults. Since infancy is a time of outstanding plasticity, sleep variables could be particularly important for cognitive development in that age group.
METHODS: This is a longitudinal study collecting data from 40 infants at four different time points of 4, 6, 8 and 10 months. Sleep variables were assessed using actigraphy for a week, as well as a sleep questionnaire. Eye-tracking was employed to examine developmental cognitive trajectories. Infants had to remember the location of a toy that had previously been linked to a sound and an eye-tracker recorded whether they were searching the correct location upon hearing the sound.

RESULTS: Based on their trajectories between 4 and 10 months, infants were divided into two groups who shifted their response strategies at different time points. Those two groups also differed in other aspects of their looking patterns and scored increasingly differently in the Ages & Stages Questionnaire over time. Time spent awake in the night early in life was reduced in the group who changed their strategy earlier.

CONCLUSIONS: While previous research examined the relation of infant sleep and cognitive functioning measured once, this paper provides first evidence that night wake time can serve as a marker for different cognitive trajectories.

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Influence of acoustic stimulation on the circadian and ultradian rhythm of premature infants.

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The aim of the present study was to evaluate the development of the circadian rhythm of the salivary cortisol in premature infants and its correlation with the onset of the sleep-activity behavior pattern during the first 3 weeks of life under controlled light:dark conditions. Furthermore, we investigated the influence of acoustic stimulation by audiotaped lullabies or the maternal voice on the cortisol values and long-term sleep-activity patterns. The study was a block-randomized, prospective clinical trial with a study population of 62 preterm neonates (30<37 gestational age). We compared two study groups who listened either to music or to the maternal voice (music: N=20; maternal voice: N=20) with a matched control group (N=22). The acoustic stimulation took place every evening between 20:00 and 21:00 h for 30 min over a period of 2 weeks. The cortisol values and activity-rest behavior of the neonates were determined during the first 3 weeks of life on the 1st, 7th and 14th day. Actigraphic monitoring was used to record the activity pattern continuously over 24 h and a validated algorithm for neonates was used to estimate sleep and wakefulness. The saliva samples were obtained 10 min before and 10 min after the acoustic interventions for the study groups. Additionally, saliva samples were obtained from the control group seven times over a 24-h period (20:00, 21:00, 01:00, 05:00, 08:00, 13:00 and 17:00 h). The cortisol data were analyzed by fast Fourier transformation to assess periodic characteristics and frequencies. Hierarchical linear modeling was further performed for the statistical analysis. RESULTS: The cortisol rhythm analysis indicated a circadian rhythm pattern for only one premature infant, all others of the neonates showed no circadian or ultradian rhythm in cortisol. Cortisol level of the premature neonates was significantly higher during the first day of the study period at night-time (median: 17.1 nmol/L,
IQR=9.7–24.4 nmol/L) than on days 7 (median: 9.6 nmol/L, IQR=4.7–14.6 nmol/L; Tukey-HSD, z=4.12, p<0.001) and 14 (IQR=5.8–13.7 nmol/L; Tukey-HSD, z=2.89, p<0.05). No significant effect of acoustic stimulation was observed on the cortisol concentration and sleep-wake behavior. The activity-sleep rhythm of preterm neonates was dominated by ultradian rhythm patterns with a prominent period length of 4 h (30.5%). Activity frequencies of neonates were also significantly higher overnight on the first study day (mean: 329±185.1 U) than of night seven (mean: 260.2±132.4 U; Tukey-HSD, z=2.50, p<0.05). Quiet-activity patterns increased, whereas high-activity patterns decreased during the observation period. Average sleep time increased significantly during the study time from day 1 to day 7 (Tukey-HSD, z=2.51, p<0.05). In conclusion, premature infants showed higher cortisol levels – without a circadian rhythmicity – and higher activity frequencies in the first days after birth which may reflect an adaptation process of neonates after birth. Cortisol concentrations and the activity patterns were not influenced by music interventions.

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The influence of break timing on the sleep quantity and quality of fly-in, fly-out shiftworkers.

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Although shift and break timing is known to affect the sleep of shiftworkers, this has not been demonstrated in Fly-in, Fly-out (FIFO) settings which, compared
to residential based settings, may be favourable for sleep. This study investigated the sleep quantity and quality of shiftworkers working a FIFO operation comprising of shifts, and therefore breaks, across the 24-h day. The sleep of 24 males (50.43 ± 8.57 yr) was measured using actigraphy and sleep diaries. Morning breaks were associated with less sleep (09:00-12:00 h; 4.4 ± 1.3 h) and a poorer sleep quality (06:00-09:00 h; 3.1 ± 1.0, "average") compared to breaks beginning between 00:00 h and 03:00 h (6.8 ± 1.7 h; 2.2 ± 0.9, "good"). Sleep efficiency remained constant regardless of break timing (85.9 ± 5.0% to 89.9 ± 3.5%). Results indicate that even in operations such as FIFO where sleeping conditions are near-optimal and the break duration is held constant, the influence of the endogenous circadian pacemaker on sleep duration is evident.

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PMCID: PMC4273020
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Influence of chronotype and social zeitgebers on sleep/wake patterns.

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Inter-individual differences in the phase of the endogenous circadian rhythms have been established. Individuals with early circadian phase are called morning types; those with late circadian phase are evening types. The Horne and Ostberg Morningness-Eveningness Questionnaire (MEQ) is the most frequently used to assess individual chronotype. The distribution of MEQ scores is likely to be biased by several factors, such as gender, age, genetic background, latitude, and social
habits. The objective of the present study was to determine the effect of different social synchronizers on the sleep/wake cycle of persons with different chronotypes. Volunteers were selected from a total of 1232 UFPR undergraduate students who completed the MEQ. Thirty-two subjects completed the study, including 8 morning types, 8 evening types and 16 intermediate types. Sleep schedules were recorded by actigraphy for 1 week on two occasions: during the school term and during vacation. Sleep onset and offset times, sleep duration, and mid-sleep time for each chronotype group were compared by the Mann-Whitney U-test separately for school term and vacation. School term and vacation data were compared by the Wilcoxon matched-pair test. Morning types showed earlier sleep times and longer sleep duration compared with evening types (23:00 +/- 44 and 508.9 +/- 50.27 vs 01:08 +/- 61.95 and 456.44 +/- 59.08, for the weekdays during vacation). During vacation, the subjects showed later sleep times, except for the morning types, who did not exhibit differences for sleep onset times. The results support the idea that social schedules have an impact on the expression of circadian rhythmicity but this impact depends on the individual chronotype.

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Influence of circadian time of hypertension treatment on cardiovascular risk: results of the MAPEC study.

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Clinical studies have documented morning-evening, administration-time differences of several different classes of hypertension medications in blood pressure (BP)-lowering efficacy, duration of action, safety profile, and/or effects on the circadian BP pattern. In spite of these published findings, most hypertensive subjects, including those under combination therapy, are instructed by their physicians and pharmacists to ingest all of their BP-lowering medications in the morning. The potential differential reduction of cardiovascular (CVD) morbidity and mortality risk by a bedtime versus upon-awakening treatment schedule has never been evaluated prospectively. The prospective MAPEC study was specifically designed to test the hypothesis that bedtime chronotherapy with ≥1 hypertension medications exerts better BP control and CVD risk reduction than conventional therapy, i.e., all medications ingested in the morning. A total of 2156 hypertensive subjects, 1044 men/1112 women, 55.6 ± 13.6 (mean ± SD) yrs of age, were randomized to ingest all their prescribed hypertension medications upon awakening or ≥1 of them at bedtime. At baseline, BP was measured at 20-min intervals from 07:00 to 23:00 h and at 30-min intervals at night for 48 h. Physical activity was simultaneously monitored every min by wrist actigraphy to accurately determine the beginning and end of daytime activity and nocturnal sleep. Identical assessment was scheduled annually and more frequently (quarterly) if treatment adjustment was required. Despite lack of differences in ambulatory BP between groups at baseline, subjects ingesting medication at bedtime showed at their last available evaluation significantly lower mean sleep-time BP, higher sleep-time relative BP decline, reduced prevalence of non-dipping (34% versus 62%; p < .001), and higher prevalence of
controlled ambulatory BP (62% versus 53%; p < .001). After a median follow-up of 5.6 yrs, subjects ingesting ≥1 BP-lowering medications at bedtime exhibited a significantly lower relative risk of total CVD events than those ingesting all medications upon awakening (0.39 [0.29–0.51]; number of events 187 versus 68; p < .001). The difference between the treatment-time groups in the relative risk of major events (including CVD death, myocardial infarction, ischemic stroke, and hemorrhagic stroke) was also highly statistically significant (0.33 [0.19–0.55]; number of events: 55 versus 18; p < .001). The progressive decrease in asleep BP and increase in sleep-time relative BP decline towards a more normal dipping pattern, two novel therapeutic targets requiring proper patient evaluation by ambulatory BP, were best achieved with bedtime therapy, and they were the most significant predictors of event-free survival. Bedtime chronotherapy with ≥1 BP-lowering medications, compared to conventional upon-waking treatment with all medications, more effectively improved BP control, better decreased the prevalence of non-dipping, and, most importantly, significantly reduced CVD morbidity and mortality.

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The influence of daytime inactivity and nighttime restlessness on cancer-related fatigue.

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PURPOSE/OBJECTIVES: To identify indicators involving circadian
activity/rest cycles associated with higher levels of cancer-related fatigue (CRF) during the first three chemotherapy cycles after surgery for stage I/II breast cancer.

DESIGN: Prospective, descriptive, repeated measures.

SETTING: Midwestern oncology clinics and subjects' homes.

SAMPLE: 72 women, ages 33–69 and free of unstable chronic illnesses, entered the study. Complete data were obtained from 30–47 subjects at each time.

METHODS: CRF was measured using the Piper Fatigue Scale at the start and midpoint of each chemotherapy cycle. Circadian activity/rest indicators were obtained using Mini-Motionlogger wrist actigraphs for 96 hours at the start of each treatment and for 72 hours at the midpoint of each chemotherapy cycle.

MAIN RESEARCH VARIABLES: Fatigue and circadian activity/rest indicators.

FINDINGS: Women who were less active and had increased night awakenings reported higher CRF levels at all three cycle midpoints, with the strongest association being number of night awakenings. During the third chemotherapy cycle, women who were less active during the day, took more naps, and spent more time resting during a 24-hour period experienced higher CRF.

CONCLUSIONS: Women whose sleep is disrupted at cycle midpoints are at risk for CRF. The cumulative effects of less daytime activity, more daytime sleep, and night awakenings are associated with higher CRF levels.

IMPLICATIONS FOR NURSING PRACTICE: Assessment of CRF and night awakenings at the midpoints of each chemotherapy cycle and development of nursing interventions to promote daytime activity and nighttime rest are key to managing fatigue and preventing loss of biologic rhythmicity.

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Sleep is an essential biological phenomenon, being a physiological and behavioral process necessary for quality of life. Melatonin is a circadian hormone produced at night by the pineal gland, regulated by the light/dark cycle, under the control of the suprachiasmatic nucleus. Melatonin is an indoleamine, synthesized from the essential amino acid tryptophan via serotonin. Melatonin is also found in plants, where it helps fight oxidative stress. To present a systematic review on the ability of food sources of melatonin to promote healthy sleep. A literature search was performed on the PubMed, Scopus, and ScienceDirect databases, including only randomized, placebo-controlled trials published in English between 2005 and 2019. The methodological quality of the trials was assessed by the Jadad scale. Of the 25 eligible articles, eight met the inclusion criteria. They addressed the intake of milk or cherry juice in children, adults, and elderly subjects and evaluated sleep quality by questionnaires, sleep diary, actigraphy, or polysomnography. The analysis of the studies presented limitations, including lack of homogeneity of treatment dosage and duration. Nonetheless, the results indicated that the consumption of milk and sour cherries, sources of melatonin, may improve sleep quality in humans. These results pointed out to the potential suitability of food sources of melatonin as adjuvants in the prevention and treatment of sleep disorders. Further studies are necessary to better ascertain the aspects relevant to their use.

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OBJECTIVE: To examine the independent and interactive effects of race and socioeconomic status (SES) on objective indices and self-reports of sleep.

METHODS: The sleep of 187 adults (41% black; mean age = 59.5 +/- 7.2 years) was examined. Nine nights of actigraphy and two nights of inhome polysomnography (PSG) were used to assess average sleep duration, continuity, and architecture; self-report was used to assess sleep quality. Psychosocial factors, health behaviors, and environmental factors were also measured.

RESULTS: Blacks had shorter sleep duration and lower sleep efficiency, as measured by actigraphy and PSG, and they spent less time proportionately in Stage 3-4 sleep, compared with others (p < .01). Lower SES was associated with longer actigraphy-measured latency, more wake after sleep onset as measured by PSG, and poorer sleep quality on the Pittsburgh Sleep Quality Index (p < .05).

CONCLUSIONS: Blacks and perhaps individuals in lower SES groups may be at risk for sleep disturbances and associated health consequences.

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PMID: 18480189 [Indexed for MEDLINE]
The influence of sleep hygiene education on sleep in professional rugby league athletes.

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OBJECTIVE: To examine the usefulness of sleep hygiene education on the sleep of professional rugby league athletes during a 10–week period of the competitive season.

DESIGN: Case study.

PARTICIPANTS: Twenty-four professional rugby league athletes.

MEASUREMENTS: Initially, participants were monitored for a 2-week period using wrist activity monitors allowing baseline estimation of sleep. Following this, 12 athletes attended two 30-minute sleep hygiene education seminars delivered over successive weeks, whereas the remaining 12 athletes received no education. Sleep was monitored in all athletes across the 2-week education period and for a 2-week period 1 month following the end of education. Split-plot analysis of variance and paired t tests were used to examine differences in sleep across the duration of the investigation.

RESULTS: An initial sleep hygiene education seminar resulted in an
earlier bedtime (effect size [ES] = 0.53 ± 0.48), more time in bed (ES = 0.53 ± 0.49),
and increased sleep duration (ES = 0.47 ± 0.44). A second sleep hygiene education
seminar resulted in more time in bed (ES = 0.84 ± 0.50) but a reduction in sleep
efficiency (ES = 1.15 ± 0.48). One month following sleep hygiene education, sleep
behavior was comparable to that observed at baseline.
CONCLUSION: This study shows that sleep hygiene education can lead to positive
changes in sleep behavior. However, changes in sleep from education may not be
sustained following the initial intervention.

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Insomnia and physical activity in adults with prediabetes.

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This secondary analysis study examines the relationship between physical activity
and symptoms of insomnia among adults with prediabetes (N = 958) from the
2005-2006 National Health and Nutrition Examination Survey (NHANES). The sample
of participants were generally obese, middle-aged, and racially diverse. NHANES
questions included symptoms of insomnia, sleep duration, and sleep latency. Body
mass index (BMI) was calculated from measured height and weight; at least 2 days
of ActiGraph activity monitor data determined mean steps walked. Men
walked more steps than women; however, women had more insomnia symptoms. There were significant associations between insomnia symptoms and increased sleep latency and decreased sleep duration. Multiple regression analysis showed that younger age, lower BMI, higher self-rated health, high school education, and fewer insomnia symptoms were significantly related to increased steps walked. The findings indicate that insomnia in adults with prediabetes may be a barrier to their adapting an active lifestyle.

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Insomnia symptoms and actigraph-estimated sleep characteristics in a nationally representative sample of older adults.

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BACKGROUND: Reports of insomnia symptoms are common among the elderly. However, little is known about the relationship between insomnia symptoms and objective assessments of sleep in the general population of older adults. We assessed
concordance between insomnia symptoms and actigraphic sleep characteristics in a nationally representative sample of older Americans.

METHODS: In a national probability sample of 727 adults aged 62-91 years in 2010-2011 from the National Social Life, Health, and Aging Project, respondents were asked how often they (a) feel rested when they wake up, (b) have trouble falling asleep, (c) have trouble with waking up during the night, and (d) have trouble waking up too early and not being able to fall asleep again. Responses to these questions were compared to sleep characteristics estimated from three nights of actigraphy for the same individuals. Statistical analyses were adjusted for age, gender, race and ethnicity, income, assets, and education.

RESULTS: Feeling rested (Question (a), above) was not correlated with any actigraphy-estimated sleep characteristics. Questions (b)-(d) each had several significant correlations with the actigraphy metrics, but generally not with the specific objective sleep characteristics that each question intended to reference. In some cases, the associations were not in the expected direction.

CONCLUSIONS: Although three of four questions about insomnia symptoms were significantly associated with objectively estimated sleep characteristics, responses seem to be general indicators of sleep quality rather than reports of specific sleep characteristics.

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Inter-individual differences in habitual sleep timing and entrained
phase of endogenous circadian rhythms of BMAL1, PER2 and PER3 mRNA in human leukocytes.

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STUDY OBJECTIVES: Individual sleep timing differs and is governed partly by circadian oscillators, which may be assessed by hormonal markers, or by clock gene expression. Clock gene expression oscillates in peripheral tissues, including leukocytes. The study objective was to determine whether the endogenous phase of these rhythms, assessed in the absence of the sleep-wake and light-dark cycle, correlates with habitual sleep-wake timing.

DESIGN: Observational, cross-sectional.

SETTING: Home environment and Clinical Research Center.

PARTICIPANTS: 24 healthy subjects aged 25.0 +/- 3.5 (SD) years.

MEASUREMENTS: Actigraphy and sleep diaries were used to characterize sleep timing. Circadian rhythm phase and amplitude of plasma melatonin, cortisol, and BMAL1, PER2, and PER3 expression were assessed during a constant routine.

RESULTS: Circadian oscillations were more robust for PER3 than for BMAL1 or PER2. Average peak timings were 6:05 for PER3, 8:06 for PER2, 15:06 for BMAL1, 4:20 for melatonin, and 10:49 for cortisol. Individual sleep-wake timing correlated with the phases of melatonin and cortisol. Individual PER3 rhythms correlated significantly with sleep-wake timing and the timing of melatonin and cortisol, but those of PER2 and BMAL1 did not reach significance. The correlation between sleep timing and PER3 expression was stronger in individuals homozygous for the variant of the PER3 polymorphism that is associated with morningness.

CONCLUSIONS: Individual phase differences in PER3 expression during a constant routine correlate with sleep timing during entrainment. PER3 expression in
leukocytes represents a useful molecular marker of the circadian processes governing sleep-wake timing.

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The interaction between subclinical psychotic experiences, insomnia and objective measures of sleep.


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Investigations into schizophrenia have revealed a high incidence of comorbidity with disturbed sleep and circadian timing. Acknowledging this comorbidity on a dimensional level, we tested prospectively whether subclinical psychotic symptoms are more prevalent in individuals with insomnia. An insomnia group (n=21) and controls (n=22) were recruited on their subjective sleep quality, recorded actigraphically for 3 weeks and assessed for psychotic-like experiences.
with The Prodromal Questionnaire-16. Using multivariate Poisson regression analyses, we found that objective and subjective sleep measures interact to predict the highest risk for psychotic experiences. Objective measures of sleep and statistical modelling are rarely used in either clinical trials or practice for schizophrenia, yet this study highlights their value in these areas.

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Interactions between sleep duration and quality as predictors of adolescents' adjustment.

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OBJECTIVES: We examined interactions between adolescents' sleep duration and quality as predictors of their internalizing symptoms and externalizing behaviors. As a secondary aim, we assessed adolescent sex, race/ethnicity, and socioeconomic status (SES) as additional moderators of risk (ie, 3-way interactions among sleep duration; quality; and sex, race, or SES).

DESIGN: The study used a cross-sectional design.

SETTING: Participants were from small towns and semirural communities in Alabama.

PARTICIPANTS: The sample consisted of 235 adolescents (Mage = 15.78 years, SD = 9.60 months) and was diverse with respect to sex (54% female), race/ethnicity (32% Black/African American, 67% White), and SES.
MEASUREMENTS: Sleep duration (actual sleep minutes) was examined with actigraphs for 1 week. Adolescents reported on their subjective sleep quality, internalizing symptoms, and externalizing behavior with psychometrically sound measures.

RESULTS: Findings revealed interactions between sleep duration and sleep quality as predictors of adolescents' adjustment. Adolescents with both short sleep duration in conjunction with poor sleep quality had the highest levels of internalizing symptoms and aggressive and rule-breaking behavior. SES interacted with sleep duration and sleep quality to predict rule-breaking behavior, and the highest level of problems was observed for adolescents from lower-SES homes who had short sleep duration accompanied by poor sleep quality.

CONCLUSIONS: Findings identify the conjoint role of sleep duration and quality as predictors of adolescents' socioemotional adjustment and emphasize the importance of examining multiple sleep parameters simultaneously toward a better understanding of adaptation in adolescence.

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Internet and In-Person Cognitive Behavioral Therapy for Insomnia in Military Personnel: A Randomized Clinical Trial.


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Study Objectives: Compare in-person and unguided Internet-delivered cognitive behavioral therapy for insomnia (CBTi) with a minimal contact control condition in military personnel.

Methods: A three-arm parallel randomized clinical trial of 100 active duty US Army personnel at Fort Hood, Texas. Internet and in-person CBTi were comparable, except for the delivery format. The control condition consisted of phone call assessments.

Results: Internet and in-person CBTi performed significantly better than the control condition on diary-assessed sleep efficiency (d = 0.89 and 0.53, respectively), sleep onset latency (d = -0.68 and -0.53), number of awakenings (d = -0.42 and -0.54), wake time after sleep onset (d = -0.88 and -0.50), the Insomnia Severity Index (d = -0.98 and -0.51), and the Dysfunctional Beliefs and Attitudes About Sleep Scale (d = -1.12 and -0.54). In-person treatment was better than Internet treatment on self-reported sleep quality (d = 0.80) and dysfunctional beliefs and attitudes about sleep (d = -0.58). There were no differences on self-reported daytime sleepiness or actigraphy-assessed sleep parameters (except total sleep time; d = -0.55 to -0.60). There were technical difficulties with the Internet treatment which prevented tailored sleep restriction upward titration for some participants.

Conclusions: Despite the unique, sleep-disrupting occupational demands of...
military personnel, in-person and Internet CBTi are efficacious treatments for this population. The effect sizes for in-person were consistently better than Internet and both were similar to those found in civilians. Dissemination of CBTi should be considered for maximum individual and population benefits, possibly in a stepped-care model.

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Internight sleep variability: its clinical significance and responsiveness to treatment in primary and comorbid insomnia.

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Although sleep diary and actigraphy data are usually collected daily for 1 or 2 weeks, traditional analytical approaches aggregate these data into mean values. Internight variability of sleep often accompanies insomnia. However, few studies have explored the relevance of this 'construct' in the context of diagnosis, clinical impact, treatment effects and/or whether having 'variable sleep' carries any prognostic significance. We explored these questions by conducting secondary analyses of data from a randomized clinical trial. The sample included primary (PI: n = 40) and comorbid insomnia (CMI: n = 41) sufferers receiving four
biweekly sessions of cognitive-behavioural therapy (CBT) or sleep hygiene education. Using the within-subject standard deviations of diary- and actigraphy-derived measures collected for 2-week periods [sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST) and sleep efficiency (SE)], we found that CMI sufferers displayed more variable self-reported SOLs and SEs than PI sufferers. However, higher variability in diary and actigraphy-derived measures was related to poorer sleep quality only within the PI group, as measured by the Pittsburgh Sleep Quality Index (PSQI). Within both groups, the variability of diary-derived measures was reduced after CBT, but the variability of actigraphy-derived measures remained unchanged. Interestingly, the variability of actigraphy measures at baseline was correlated with PSQI scores at 6-month follow-up. Higher SOL variability was associated with worse treatment outcomes within the PI group, whereas higher WASO variability was correlated with better treatment outcomes within the CMI group. Sleep variability differences across insomnia diagnoses, along with their distinctive correlates, suggest that mechanisms underlying the sleep disruption/complaint and treatment response in both patient groups are distinct. Further studies are warranted to support variability as a useful metric in insomnia studies.

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Intraindividual variability in sleep and perceived stress in young adults.

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OBJECTIVES: Research suggests strong associations between habitual sleep parameters (eg, mean duration, timing, efficiency), perceived stress, and insomnia symptoms. The associations between intraindividual variability (IIV; night-to-night within-person variation) in sleep, perceived stress, and insomnia have not been explored. This study examined associations between IIV in subjectively and objectively determined sleep parameters and to perceived stress in young adults with and without insomnia.

DESIGN: Prospective longitudinal.

SETTING AND PARTICIPANTS: Participants were 149 college students (mean age = 20.2 [SD = 2.4], 59% female) either with insomnia (n = 81; 54%) or without insomnia (n = 68; 46%).

MEASUREMENTS: Participants completed 1 week of daily sleep diaries and actigraphy (to assess total sleep time [TST], sleep efficiency [SE], and circadian midpoint [CM]), the Perceived Stress Scale, and a diagnostic interview for determination of insomnia as part of a parent study.

RESULTS: Greater IIV in actigraphy–determined TST (but not SE or CM) was independently associated with greater perceived stress, regardless of insomnia status. Greater IIV in sleep diary–determined TST, SE, or CM was not
associated with perceived stress. Insomnia status was the most robust predictor of elevated perceived stress. There was a significant interaction between IIV in sleep diary-determined TST and insomnia status on perceived stress: Only in those without insomnia was greater IIV in sleep diary-determined TST associated with higher perceived stress.

CONCLUSION: Maintaining a more consistent sleep duration may be associated with lower stress in college students. Future research is needed to clarify the directionality and implications of this association for treatment.

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Inversion of the circadian rhythm of melatonin in the Smith-Magenis syndrome.


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OBJECTIVE: The objective was to determine the circadian rhythm of melatonin in the Smith-Magenis syndrome (SMS), which causes behavioral problems and sleep disturbance.

STUDY DESIGN: Questionnaires, sleep consultations, and sleep diaries were obtained in 20 children with SMS (9 girls, 11 boys aged 4 to 17 years). Actigraphy, electroencephalography, and the circadian variations of plasma
melatonin, cortisol, and growth hormone were recorded in 8 patients. Early sleep
onset, early sleep offset, and sleep attack indicated sleep disturbance.

RESULTS: All children with SMS had a phase shift of their circadian rhythm of
melatonin. Time at onset of melatonin secretion was 6 AM +/- 2 (control group: 9
P.M. +/- 2). Peak time was 12 PM +/- 1 (control group: 3:30 AM +/- 1:30), and
melatonin offset was at 8 PM +/- 1 (control group: 6 AM +/- 1).

Behavioral problems correlated with the inverted circadian rhythm of melatonin.

CONCLUSION: Considering that clock genes mediate the generation of circadian
rhythms, we suggest that haploinsufficiency for a circadian system gene mapping
to chromosome 17p11.2 may cause the inversion of the circadian rhythm of
melatonin in SMS.

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Investigating the relationships between hypothalamic volume and
measures of circadian rhythm and habitual sleep in premanifest Huntington's
disease.

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Objective: Pathological changes within the hypothalamus have been proposed to mediate circadian rhythm and habitual sleep disturbances in individuals with Huntington's disease (HD). However, investigations examining the relationships between hypothalamic volume and circadian rhythm and habitual sleep in individuals with HD are sparse. This study aimed to comprehensively evaluate the relationships between hypothalamic pathology and circadian rhythm and habitual sleep disturbances in individuals with premanifest HD.

Methods: Thirty-two individuals with premanifest HD and twenty-nine healthy age- and gender-matched controls participated in this dual-site, cross-sectional study. Magnetic resonance imaging scans were performed to evaluate hypothalamic volume. Circadian rhythm and habitual sleep were assessed via measurement of morning and evening cortisol and melatonin levels, wrist-worn actigraphy, the Consensus Sleep Diary and sleep questionnaires. Information on mood, physical activity levels and body composition were also collected.
Results: Compared to healthy controls, individuals with premanifest HD displayed significantly reduced grey matter volume in the hypothalamus, decreased habitual sleep efficiency and increased awakenings; however, no alterations in morning cortisol or evening melatonin release were noted in individuals with premanifest HD. While differences in the associations between hypothalamic volume and cortisol and melatonin output existed in individuals with premanifest HD compared to healthy controls, no consistent associations were observed between hypothalamic volume and circadian rhythm or habitual sleep outcomes. Conclusion: While significant differences in associations between hypothalamic volume and cortisol and melatonin existed between individuals with premanifest HD and healthy controls, no differences in circadian markers were observed between the groups. This suggests that circadian regulation is maintained despite hypothalamic pathology, perhaps via neural compensation. Longitudinal studies are required to further understand the relationships between the hypothalamus and circadian rhythm and habitual sleep disturbances in HD as the disease course lengthens.

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An investigation into the strength of the association and agreement levels between subjective and objective sleep duration in adolescents.

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STUDY OBJECTIVES: The majority of adolescent sleep research has utilized self-reported sleep duration and some have based information on a solitary question. Whilst some have claimed to have validated sleep survey data with objective actigraphy measures in adolescents, the statistical approach applied only demonstrates the strength of the association between subjective and objective sleep duration data and does not reflect if these different methods actually agree.

METHODS: Data were collected as part of the Midlands Adolescents Schools Sleep Education Study (MASSSES). Adolescents (n=225) aged 11–13 years provided estimates for weekday, weekend and combined sleep duration based on self-reported survey data, a 7-day sleep diary, and wrist-worn actigraphy.

RESULTS: We assessed the strength of the relationship as well as agreement levels between subjective and objectively determined sleep duration (weekday, weekend and combined). Subjective diary sleep duration was significantly correlated with actigraphy estimates for weekday and weekend sleep duration $r=0.30$, $p \leq 0.001$ and $r=0.31$, $p \leq 0.001$ respectively. Pitman's test demonstrated no significant difference in the variance between weekend sleep duration ($r=0.09$, $p=0.16$) and combined sleep duration ($r=0.12$, $p=0.08$) indicating acceptable agreement between actigraphy and sleep diary sleep duration only. Self-reported sleep duration estimates (weekday, weekend and combined) did not agree with actigraphy determined sleep duration.

CONCLUSIONS: Sleep diaries are a cost-effective alternative to survey/questionnaire data. Self-reported measures of sleep duration in adolescents do not agree with actigraphy measures and should be avoided where possible. Previous adolescent sleep studies that have utilized self-reported survey data may not provide a complete representation of sleep on the outcome measure of interest.

DOI: 10.1371/journal.pone.0072406
PURPOSE: The intrinsically photosensitive retinal ganglion cells (ipRGCs) signal environmental light, control pupil size and entrain circadian rhythm. There is speculation that ipRGCs may be involved in the protective effects of light exposure in myopia. Here, the ipRGC-driven pupil response was evaluated in children and examined with light exposure and refractive error.

METHODS: Children ages 5–15 years participated. Subjects wore an actigraph device prior to the lab visit for objective measures of light exposure and sleep. For pupillometry, the left eye was dilated and presented with stimuli, and the consensual pupil response was measured in the right eye. Pupil measurements were preceded by 5 min dark adaptation. In Experiment 1 (n = 14), 1 s long wavelength light (‘red,’ 651 nm, 167 cd m⁻²) and 10 increasing intensities of 1 s short wavelength light (‘blue,’ 456 nm, 0.167–167 cd m⁻²) were presented with a 60 s interstimulus interval. A piecewise two-segment regression was fit to the stimulus response function to determine the functional melanopsin threshold. Pupil responses were analysed with light exposure over the previous 24 h. For Experiment 2 (n = 42), three 1 s red and three 1 s blue alternating stimuli were presented with a 60 s interstimulus interval. Following an additional 5-min dark
adaption, the experiment was repeated. Pupil metrics included peak constriction, the 6 s and 30 s post-illumination response (PIPR), early and late area under the curve (AUC). Following pupil measurements, cycloplegic refractive error and axial length were measured.

RESULTS: For Experiment 1, PIPR metrics demonstrated a graded response to increasing intensity blue stimuli, with a mean functional melanopsin threshold of $6.2 \pm 4.5$ cd m$^{-2}$ (range: 0.84–16.7 cd m$^{-2}$). The 6 s PIPR and early AUC were associated with 24-h light exposure for high intensity stimuli (33.3 and 83.3 cd m$^{-2}$, $p < 0.005$ for both). For Experiment 2, there were no associations between pupil metrics and refractive error. The 6 s PIPR and early AUC to blue stimuli were significantly increased for Trial 2 compared to Trial 1.

CONCLUSIONS: The ipRGC-driven pupil responses in children were robust and similar to responses previously measured in an adult population. The 6 s PIPR and early AUC to high intensity blue stimuli were associated with previous light exposure. There were no associations between the ipRGC-driven pupil response and refractive status in this cohort.

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Irregular 24-hour activity rhythms and the metabolic syndrome in older adults.

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Circadian rhythms – near 24 h intrinsic biological rhythms – modulate many aspects of human physiology and hence disruption of circadian rhythms may have an important impact on human health. Experimental work supports a potential link between irregular circadian rhythms and several key risk factors for cardiovascular disease including hypertension, obesity, diabetes and dyslipidemia, collectively termed the metabolic syndrome. While several epidemiological studies have demonstrated an association between shift-work and the components of the metabolic syndrome in working-age adults, there is a relative paucity of data concerning the impact of non-occupational circadian irregularity in older women and men. To address this question, we studied 7 days of actigraphic data from 1137 older woman and men participating in the Rush Memory and Aging Project, a community-based cohort study of the chronic conditions of aging. The regularity of activity rhythms was quantified using the nonparametric interdaily stability metric, and was related to the metabolic syndrome and its components obesity, hypertension, diabetes and dyslipidemia. More regular activity rhythms were associated with a lower odds of having the metabolic syndrome (OR = 0.69, 95% CI = 0.60–0.80, p = 5.8 × 10(-7)), being obese (OR = 0.73, 95% CI = 0.63–0.85, p = 2.5 × 10(-5)), diabetic (OR = 0.76, 95% CI = 0.65–0.90, p = 9.3 × 10(-4)), hypertensive (OR = 0.78, 95% CI = 0.66–0.91, p = 2.0 × 10(-3)) or dyslipidemic (OR = 0.82, 95% CI = 0.72–0.92, p = 1.2 × 10(-3)). These associations were independent of differences in objectively measured total daily physical activity or rest, and were not accounted for by prevalent coronary artery disease, stroke or peripheral artery disease. Moreover, more regular activity rhythms were associated with lower odds of having cardiovascular disease (OR = 0.83; 95% CI = 0.73–0.95, p = 5.7 × 10(-3)), an effect that was statistically mediated by the
metabolic syndrome. We conclude that irregular activity rhythms are associated with several key components of the metabolic syndrome in older community-dwelling adults, and that the metabolic syndrome statistically partially mediates the association between activity rhythms and prevalent cardiovascular disease. Although additional longitudinal and experimental studies are needed to conclusively delineate the causal relationships underlying these associations, these findings are consistent with preclinical data, and add further support for investigations of the irregularity of activity rhythms as a potential therapeutic target to decrease the burden of cardiovascular disease in older adults.

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Is it possible to study sleep-wake patterns in adolescent borderline personality disorder? An actigraphic feasibility study.

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Borderline Personality Disorder (BPD) is characterized by severe instability in mood, impulse control, relationships and sleep patterns, alongside with mild cognitive disturbances in some patients. Although research on adolescent BPD has developed over the last decade, little is known about circadian sleep-wake patterns in this population. Low compliance and cooperation frequently reported in these patients impede data collection. Therefore, research had to introduce non-invasive objective measurements such as actigraphy while minimizing attrition.
and resurgence of suicidal ideation. This article examined the feasibility of an actigraphic study with BPD adolescents. Eighteen BPD adolescents (13-17 years old) were recruited from a specialized outpatient mood disorders clinic and asked to wear an actigraph for nine days including two weekends. Twelve (66.7%) of the 18 BPD patients who consented kept the actigraph for an average of 11.00 days (SD: 2.04), thus completing the required 9-day period. The reasons surrounding difficulties during the experiment, such as aversive emotions during interviews, dermal irritation, fragile alliance with the research assistant, are described. The factors that contributed the most to our satisfactory compliance rate included stabilized mood before inclusion, close ties between the research and the clinical teams, rapid access to an emergency psychiatric assessment if needed.

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It is time for chronotherapy!

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The EORTC Chronotherapy Group (CTG) stemmed from the International Organisation for Cancer Chronotherapy (IOCC) in 1996. The IOCC was the first to initiate large scale multicentre international chronotherapy trials, for the purpose of investigating the relevance of chronomodulated or timed administration of cancer therapy based on biological rhythms. Programmable pumps for cytotoxic chronodelivery and actigraph devices to monitor circadian rhythm alterations
linked to cancer were also developed. The unique expertise of the IOCC with regard to cancer chronotherapy furthered its development within the EORTC. EORTC offers broad expertise in clinical cancer research and opportunities for scientific recognition, inter-group collaborations and translational research. Over the past 5 years, EORTC CTG has grown from 16 to 48 centres in 12 different countries. It is currently conducting seven multicentre chronotherapy trials, which test the relevance of adapting cancer treatment delivery to circadian rhythms. The group aims at developing multiple collaborations to establish a chronotherapy network involving institutions with expertise ranging from experimental chronobiology to new drug testing, disease-specific management and quality of life or survival issues.

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It's time for chronotherapy!

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The EORTC Chronotherapy Group (CTG) stemmed from the International Organisation for Cancer Chronotherapy (IOCC) in 1996. The IOCC was first to initiate large scale multicentre international chronotherapy trials, for the purpose of investigating the relevance of chronomodulated or timed administration of cancer therapy based on biological rhythms. Programmable pumps for cytotoxic chronodelivery and actigraph devices to monitor circadian rhythm alterations linked to cancer were also developed. The unique expertise of the IOCC
with regard to cancer chronotherapy furthered its development within the EORTC. The EORTC offers broad expertise in clinical cancer research and opportunities for scientific recognition, intergroup collaborations and translational research. Over the past 5 years, the EORTC CTG has grown from 16 to 48 centres in 12 different countries. It is currently conducting seven multicentre chronotherapy trials which test the relevance of adapting cancer treatment delivery to circadian rhythms. The group aims at developing multiple collaborations to establish a chronotherapy network involving institutions with expertise ranging from experimental chronobiology to new drug testing, disease-specific management and quality of life or survival issues.

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Job strain and vagal recovery during sleep in shift working health care professionals.

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Within sample female nurses/nurse assistants in three shift work, we explored the association of job strain with heart rate variability before and during sleep. The participants (n = 95) were recruited from the Finnish Public Sector Study, from hospital wards that belonged either to the top (high job strain [HJS],
n = 42) or bottom quartiles on job strain (low job strain [LJS], n = 53) as rated by Job Content Questionnaire responses. A further inclusion criterion was that participants' own job strain was at least as high (HJS group) or low (LJS group) as their ward's average estimation. Three-week field measurements included sleep diary and actigraphy to study the participants' sleep patterns and sleep-wake rhythm. A subset of three pre-selected, circadian rhythm and recovery controlled measurement days, one morning shift, one night shift and a day off, included 24-h heart rate variability (HRV) measurements. The bootstrapped HRV parameters (HR, HF, LF, LF-to-HF-ratio and RMSSD) 30 min before and during 30 min of sleep with lowest average heart rate showed no statistically significant job strain group differences. No association of exposure to stressful work environment and HRV before and during sleep was found.

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Ketogenic diet treatment abolishes seizure periodicity and improves diurnal rhythmicity in epileptic Kcna1-null mice.

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INTRODUCTION: Seizures are known to perturb circadian rhythms in humans as well as in animal models of epilepsy. However, it is unknown whether treatment of the underlying epilepsy restores normal biologic rhythms. We asked whether: (1)
seizure activity is characterized by diurnal rhythmicity, (2) chronically epileptic mice exhibit impaired rest-activity rhythms, and (3) treatment with the anticonvulsant ketogenic diet (KD) improves such perturbations. METHODS: Chronically epileptic Kcna1-null mice were fed either a standard diet (SD) or KD for 4 weeks and subjected to continuous video-EEG (electroencephalography) and actigraphy monitoring for 3–5 days to assess seizure activity and rest-activity cycles. RESULTS: Seizure activity in Kcna1-null mice demonstrated diurnal rhythmicity, peaking at zeitgeber (ZT)2.30 +/- 1.52. Rest-activity rhythms of epileptic mice were significantly disrupted. Whereas locomotor activity for wild-type mice peaked at ZT15.45 +/- 0.28 (ZT14:26–ZT16:51), peak activity of epileptic mice was more unpredictable, occurring over a 12.4 h range (ZT06:33–ZT18:57). In six of nine epileptic mice, peak activity was delayed to ZT17.42 +/- 0.38, whereas peak activity was advanced to ZT10.00 +/- 1.26 in the remaining mice. Treatment with the KD abolished seizure periodicity and restored the rest-activity rhythm to values resembling those of wild-type mice (i.e., activity peaking at ZT16.73 +/- 0.67). CONCLUSIONS: Kcna1-null mice experience seizures with 24-h periodicity and impaired circadian behavior. KD reduces the number and periodicity of seizures and restores normal behavioral rhythms, suggesting that this nonpharmacologic therapy may benefit biologic rhythm disturbances in epileptic patients.

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Kindergarten children's failure to qualify for first grade could result from
sleep disturbances.

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Every year, 7% to 15% of preschool children are found to be underqualified for first grade. We examined whether sleep disturbances are factors in school readiness and their association with neurocognitive skills and behavior. The population included 148 kindergarten students. The study group consisted of 50 students who were assessed by the educational authority as unready for first grade. Children who were scheduled to attend first grade (n = 98) were in the control group. All children/parents filled in a sleep questionnaire and underwent a week of actigraphic sleep/wake study as well as cognitive and behavioral assessments. Children in the study group had significantly shorter total sleep time, reduced sleep efficiency, and increased number of nighttime awakenings. There were significant correlations between sleep variables, and cognitive and behavioral scores. In conclusion, children who fail to qualify for first grade have significantly inferior sleep patterns. Sleep disturbances were associated with cognitive and emotional immaturity.

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Klokwerk + study protocol: An observational study to the effects of night-shift work on body weight and infection susceptibility and the mechanisms underlying these health effects.
BACKGROUND: Night-shift work may cause severe disturbances in the worker's circadian rhythm, which has been associated with the onset of health problems and diseases. As a substantial part of the workforce is exposed to night-shift work, harmful aspects of night-shift work should not be overlooked. The aim of the Klokwerk + study is to study the effects of night-shift work on body weight and infection susceptibility and the mechanisms underlying these health effects. First, we will study the relation between night-shift work exposure and body weight and between night-shift work exposure and infection susceptibility. Second, we will examine the mechanisms linking night-shift work exposure to body weight and infection susceptibility, with a specific focus on sleep,
physical activity, diet, light exposure, vitamin D level, and immunological factors.
Lastly, we will focus on the identification of biomarkers for chronic circadian disturbance associated with night-shift work.
METHODS/DESIGN: The design of this study is a prospective observational cohort study consisting of 1,960 health care workers aged 18–65 years. The study population will consist of a group of night-shift workers and an equally sized group of non-night-shift workers. During the study, there will be two measurement periods. As one of the main outcomes of this study is infection susceptibility, the measurement periods will take place at approximately the first (September/October) (T0) and the last month (April/May) (T1, after 6 months) of the flu season. The measurements will consist of questionnaires, anthropometric measurements, a smartphone application to determine infection susceptibility, food diaries, actigraphy, light sensors, and blood sample analyses.
DISCUSSION: The Klokwerk + study will contribute to the current need for high-quality data on the health effects of night-shift work and its underlying behavioral and physiological mechanisms. The findings can be the starting point for the development of interventions that prevent negative health effects caused by night-shift work. In addition, the identification of biomarkers indicative of loss of homeostasis due to circadian disturbance may be an important asset in monitoring the effects of such interventions.

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PMID: 27484676  [Indexed for MEDLINE]

Lack of exposure to natural light in the workspace is associated with physiological, sleep and depressive symptoms.
The diurnal light cycle has a crucial influence on all life on earth. Unfortunately, modern society has modified this life-governing cycle by stressing maximum production and by giving insufficient attention to the ecological balance and homeostasis of the human metabolism. The aim of this study is to evaluate the effects of exposure or lack of exposure to natural light in a rest/activity rhythm on cortisol and melatonin levels, as well as on psychological variables in humans under natural conditions. This is a cross-sectional study. The subjects were allocated split into two groups according to their workspace (10 employees in the "with window" group and 10 in the "without window" group). All participants were women and wore an actigraph (Actiwatch 2, Philips Respironics), which measures activity and ambient light exposure, for seven days. Concentrations of melatonin and cortisol were measured from the saliva samples. Participants were instructed to collect saliva during the last day of use of the actigraph at 08:00 am, 4:00 pm and 10:00 pm. The subjects answered the Self-Reporting Questionnaire-20 (SRQ-20) to measure the presence of minor psychiatric disorders; the Montgomery-Asberg (MA) scale was used to measure depression symptoms, and the Pittsburgh Sleep Quality Index questionnaire (PSQI) was used to evaluate the quality of sleep. The Rayleigh analysis indicates that the two groups, "with window" and "without window", exhibited similar activities and light acrophases. In relation to light exposure, the mesor was significantly higher (t = -2.651, p = 0.023) in the "with window" group (191.04 ± 133.36) than in the "without window" group (73.8 ± 42.05). Additionally, the "with window" group presented the highest amplitude of light exposure (298.07 ± 222.97). Cortisol levels were significantly different between the groups at 10:00 pm (t = 3.009, p = 0.008; "without window" (4.01 ± 0.91) "with window"
In terms of the melatonin levels, the groups differed at two different times of day: 08:00 am ($t = 2.593$, $p = 0.018$) and 10:00 pm ($t = -2.939$, $p = 0.009$). The "with window" group had a lower melatonin level at 08:00 am (3.54 ± 0.60) but a higher level at 10:00 pm (24.74 ± 4.22) than the "without window" group. Higher cortisol levels were positively correlated with minor psychiatric disorders and depressive symptoms (MA) at 10:00 pm. Lower melatonin levels at 10:00 pm were correlated with depressive symptoms and poor quality of sleep (PSQI). Our study demonstrated that not only may light pollution affect human physiology but also lack of exposure to natural light is related to high levels of cortisol and lower levels of melatonin at night, and these, in turn, are related to depressive symptoms and poor quality of sleep.

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Larger phase angle between sleep propensity and melatonin rhythms in sighted humans with non-24-hour sleep-wake syndrome.

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STUDY OBJECTIVES: This study was aimed to clarify phase angle between sleep propensity and the circadian pacemaker in patients with non-24-hour sleep-wake syndrome (Non-24).
DESIGN AND SETTING: A case-control study was undertaken.
PARTICIPANTS: Sighted patient with Non-24 (4 males and 1 female, aged 16 to 39
y), and sex- and age-matched healthy controls (12 males and 3 females, aged 19 to 35 y) participated the study. MEASUREMENT AND INTERVENTION: Following an actigraphic assessment of the sleep-wake cycle in their homes, the participants entered an ultra-short sleep-wake schedule together with simultaneous measurement of dim light melatonin rhythm after 24-hour sleep deprivation. RESULTS: The period of the sleep-wake cycle observed at home was longer in the Non-24 patients (25.12 hours) than in the controls (24.02 hours, p<0.0001). The interval from sleep propensity (SP) onset to the melatonin midpoint (MLmid) was significantly shorter in the Non-24 patients than in the controls. The interval from the MLmid to the SP offset was significantly longer in the Non-24 patients than in the controls. CONCLUSIONS: It was postulated that Non-24 sufferers' delayed SP onset relative to the circadian pacemaker may accelerate the light-induced phase-delay, leading to sleep-wake cycle that is longer than 24 hours.

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Late and Instable Sleep Phasing is Associated With Irregular Eating Patterns in Eating Disorders.

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BACKGROUND: Sleep problems are common in eating disorders (EDs). PURPOSE: We evaluated whether sleep-phasing regularity associates with the regularity of daily eating events.

METHODS: ED patients (n = 29) completed hourly charts of mood and eating occasions for 2 weeks. Locomotor activity was recorded continuously by wrist actigraphy for a minimum of 10 days, and sleep was calculated based on periods of inactivity. We computed the center of daily inactivity (CenDI) as a measure of sleep phasing and consolidation of the daily inactivity (ConDI) as a measure of daily sleep rhythm strength. We assessed interday irregularities in the temporal structure of food intake using the standard deviation (SD) of frequency (IFRQ), timing (ITIM), and interval (IINT) of food intake. A self-evaluation of other characteristics included mood, anxiety, and early trauma.

RESULTS: A later phasing of sleep associated with a lower frequency of eating (eating frequency with the CenDI rho = -0.49, p = .007). The phasing and rhythmic strength of sleep correlated with the degree of eating irregularity (CenDI with ITIM rho = 0.48, p = .008 and with IINT rho = 0.56, p = .002; SD of CenDI with ITIM rho = 0.47, p = .010, and SD of ConDI with IINT rho = 0.37, p = .048).

Childhood Trauma Questionnaire showed associations with variation of sleep onset (rho = -0.51, p = .005) and with IFRQ (rho = 0.43, p = .023).

CONCLUSIONS: Late and variable phasing of sleep associated robustly with irregular pattern of eating. Larger data sets are warranted to enable the analysis of diagnostic subgroups, current medication, and current symptomatology and to confirm the likely bidirectional association between eating pattern stability and the timing of sleep.
Latent activity rhythm disturbance sub-groups and longitudinal change in depression symptoms among older men.

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Activity rhythm disturbances and depression often co-occur among older adults. However, little is known about how activity rhythm disturbances themselves co-occur, or how disturbances to multiple aspects of the activity...
rhythm relate
to depression over time. In this study, we performed a Latent Class
Analysis to
derive sub-groups of older men [total n = 2933, mean age = 76.28,
standard
deviation (SD) = 5.48] who shared similar patterns of activity rhythm
disturbances (defined as extreme values of modeled activity rhythm
parameters).
We found eight sub-groups with distinct combinations of activity
rhythm
disturbances: one had all normative activity rhythm parameters
(32.09%), one had
only lower activity (10.06%), three had earlier activity (totaling
26.96%) and
three had later activity (totaling 30.89%). Groups with similar timing
were
distinguished depending on whether the relative length of the active
period was
shorter and/or if the activity rhythm had lesser amplitude/robustness.
We next
examined whether the derived activity rhythm sub-groups were
associated with
different rates of change in depression symptom levels over an average
of 5.5
(0.52 SD) follow-up years. The sub-group with lower activity only had
faster
increases in depressive symptoms over time (compared with the group
with
normative rhythm parameters), but this association was accounted for
by
adjustments for concurrently assessed health status covariates. Independent
of
these covariates, we found that four activity rhythm disturbance sub-
groups
experienced faster depressive symptom increases (compared with the
normative
sub-group): These included all three sub-groups that had later
activity timing
and one sub-group that had earlier activity timing plus a shorter
active period
and a dampened rhythm. Low activity rhythm height/robustness with
normal timing
therefore may mark depression risk that is attributable to co-
occuring disease
processes; in contrast, having late or combined early/compressed/
dampened
activity rhythms may independently contribute to depression symptom
development.
Our findings suggest that activity rhythm-related depression risk is
heterogeneous, and may be detected when multiple aspects of rhythm
timing are
delayed or when early timing is accompanied by compressed/dampened activity
rhythms. Future studies should consider how distinct combinations of altered activity rhythm timing and height/robustness develop and conjointly determine health risks. Further research is also needed to determine whether/how activity rhythms can be modified to improve depression outcomes.

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Later high school start times associated with longer actigraphic sleep duration in adolescents.

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Comment in
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Study Objectives: High school start times (SSTs) directly impact adolescents' sleep timing and duration. This study investigated the associations between SSTs and actigraphically-measured 24-hour sleep duration, sleep onset, sleep offset
and sleep quality.

Methods: This study included 383 adolescents (Mage = 15.5, SDage = 0.6 years) participating in the age 15 wave of the Fragile Families & Child Wellbeing Study, a national birth cohort study sampling from 20 large US cities. Multilevel models used daily observations (N = 1116 school days, Mdays = 2.9, SDdays = 1.4 per adolescent) of sleep and SSTs from concordant daily diary and actigraphy.

Results: A diverse range of SSTs were included in our analyses (MSST = 08:08, SDSST = 39 minutes, RangeSST = 06:00-11:05), and are presented in the following categories for ease of interpretation: before 07:30, 07:30-07:59, 08:00-08:29, and 08:30 or later. Adolescents starting school at 08:30 or later exhibited significantly longer actigraphically-assessed 24-hour sleep duration (by 21-34 minutes, p < .05) and later sleep offset (by 32-64 minutes, p < .001) when compared with the adolescents grouped by earlier SSTs. SSTs were also analyzed continuously for comparison with existing literature, and results indicated that every 1-hour delay in SST was significantly associated with 21 minutes longer 24-hour sleep duration (p < .001), 16 minutes later sleep onset (p < .01), and 39 minutes later sleep offset (p < .001). All models controlled for covariates including socioeconomic status.

Conclusion: These findings support pediatric and public health expert recommendations for SSTs after 08:30. In our diverse national urban sample, adolescents with SSTs at 08:30 or later, compared with adolescents with earlier SSTs, had significantly longer actigraphy-measured sleep.

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Latino adolescents' cultural values associated with diurnal cortisol
Activity.

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Hypothalamic-pituitary-adrenal (HPA) axis activity has been identified as a mechanism through which daily life stress contributes to health problems and racial/ethnic health disparities. Stress-related changes in neuroendocrine function are evident as early as adolescence, but the ways in which promotive cultural factors may also contribute to variation in diurnal HPA activity have received little empirical attention. Grounded in cultural models of resilience, dual dimensions of Latino adolescents' cultural values (ethnic heritage and U.S. mainstream) were examined as promotive and protective factors in relation to their diurnal salivary cortisol patterns using ecological momentary assessment (N = 209; Mage = 18.10; 64.4% female). Participants provided 5 daily saliva samples for 3 days while completing corresponding electronic diary reports and using time-sensitive compliance devices (track caps, actigraphs). Results from 3-level growth curve models indicated that higher U.S. mainstream cultural values (e.g., self-reliance, competition, material success) were associated with higher average waking cortisol levels and a more rapid rate of diurnal
cortisol decline (i.e., "steeper" slope). Regarding situational deviations from the diurnal rhythm (within-person differences), cortisol levels were higher in relation to diary-reported ongoing stress (vs. completed). Accounting for these situational differences in stress timing, a cross-level interaction (i.e., between-person difference in within-person process) indicated that higher perceived stress than usual was associated with lower cortisol levels for adolescents with stronger alignment to Latino ethnic heritage values (e.g., familism, respect, religiosity), compared to relatively higher cortisol levels for those with less alignment to these values. Results were consistent adjusting for participants' sex, immigrant generation, parents' education level, depressive symptoms, medication use, sleep duration, and other self-reported health behaviors. These findings join the growing science of cultural neurobiology by demonstrating the promotive and potentially regulating influence of cultural values in the daily HPA functioning of Latino adolescents.

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Latino adolescents' daily bicultural stress and sleep: Gender and school context moderation.

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OBJECTIVE: Bicultural stress (i.e., challenge arising from navigating 2 cultural contexts) has significant consequences for Latino youth's health, but
researchers have yet to examine the implications of bicultural stress for adolescents' sleep. The goals of this study were to examine whether individual and day-to-day (within-person) differences in bicultural stress were associated with Latino adolescents' sleep onset latency (i.e., time to fall asleep), sleep midpoint (i.e., sleep schedule), sleep duration (i.e., time asleep), and subjective sleep quality.

METHOD: Participants were 209 Latino late adolescents (Mage = 18.10 years; 64.4% female) attending over 90 different high schools who completed 7 daily diary surveys while wearing actigraph wristwatches (N = 1,320 daily observations). Participants also reported sleep problems in a standard survey. Statistical interactions were tested to assess moderation by gender and coethnic school composition.

RESULTS: On average, more bicultural stressors across the week were associated with lower average sleep duration and more sleep problems for male (compared to female) adolescents and youth attending schools with higher (compared to lower) Latino student enrollment. Regarding day-to-day differences, more daily bicultural stressors than usual predicted longer sleep onset latency that night for male adolescents, earlier sleep midpoint that night, and less sleep duration that night for youth attending higher Latino-enrollment schools.

CONCLUSIONS: Latino adolescents' everyday experiences of bicultural stress relate to differences in sleep duration, timing, and quality, with important variation by gender and school context. Results advance existing theory regarding social position factors that differentiate the health implications of bicultural stress for Latino youth. (PsycINFO Database Record (c) 2020 APA, all rights reserved).

DOI: 10.1037/hea0000824
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INTRODUCTION: Current models of fatigue and alertness use a combination of biological (circadian) and homeostatic factors to predict sleep and wake. Such models do not include social factors in their calculations. The aim of our analysis was to compare the relative contributions of social and biological factors in models designed to predict the total sleep time (TST) during layover periods between transmeridian flights.

METHOD: The study actigraphically collected sleep information from 86 cockpit crew (mean age 46.7 yr, SD 4.3 yr) during round-trip patterns from Australia to Los Angeles (n=15), Europe (n=42), New York (n=10), and Hong Kong (n=19). Linear regression models were constructed to predict TST using data from airline schedules. This schedule information included layover length, flight duration, the number of night hours at the destination (social hours), the number of night hours in Australian Eastern Standard time (biological hours), and time zone displacement. These models were then validated using independent data.

RESULTS: Analysis indicated that the schedule data was highly correlated. Linear regression analyses indicated that social night hours account for more variance than biological night hours ($r = 0.8$ vs. $0.7$). Additionally, the layover length achieved a correlation coefficient of $0.9$. These results were strengthened when the model parameters were applied to the cross-validation dataset.

DISCUSSION: Social night hours significantly influence sleep during international
layovers and may be a better predictor than biological night hours. More research must be carried out to determine the validity of these findings in a larger, randomly collected flight sample.

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Learning to live on a Mars day: fatigue countermeasures during the Phoenix Mars Lander mission.


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STUDY OBJECTIVES: To interact with the robotic Phoenix Mars Lander (PML) spacecraft, mission personnel were required to work on a Mars day (24.65 h) for 78 days. This alien schedule presents a challenge to Earth-bound circadian physiology and a potential risk to workplace performance and safety. We evaluated the acceptability, feasibility, and effectiveness of a fatigue management program to facilitate synchronization with the Mars day and alleviate circadian misalignment, sleep loss, and fatigue.

DESIGN: Operational field study.

SETTING: PML Science Operations Center.

PARTICIPANTS: Scientific and technical personnel supporting PML mission.

INTERVENTIONS: Sleep and fatigue education was offered to all support personnel. A subset (n = 19) were offered a short-wavelength (blue) light panel to aid alertness and mitigate/reduce circadian desynchrony. They were assessed using a daily sleep/work diary, continuous wrist actigraphy, and regular performance
tests. Subjects also completed 48-h urine collections biweekly for assessment of the circadian 6-sulphatoxymelatonin rhythm.

MEASUREMENTS AND RESULTS: Most participants (87%) exhibited a circadian period consistent with adaptation to a Mars day. When synchronized, main sleep duration was 5.98 ± 0.94 h, but fell to 4.91 ± 1.22 h when misaligned (P < 0.001). Self-reported levels of fatigue and sleepiness also significantly increased when work was scheduled at an inappropriate circadian phase (P < 0.001). Prolonged wakefulness (≥ 21 h) was associated with a decline in performance and alertness (P < 0.03 and P < 0.0001, respectively).

CONCLUSIONS: The ability of the participants to adapt successfully to the Mars day suggests that future missions should utilize a similar circadian rhythm and fatigue management program to reduce the risk of sleepiness-related errors that jeopardize personnel safety and health during critical missions.

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Light and maternal influence in the entrainment of activity circadian rhythm in infants 4-12 weeks of age.

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The influence of light and maternal activity on early infant activity rhythm were
studied in 43 healthy, maternal-infant pairs. Aims included description of infant and maternal circadian rhythm of environmental light, assessing relations among of activity and light circadian rhythm parameters, and exploring the influence of light on infant activity independent of maternal activity. Three-day light and activity records were obtained using actigraphy monitors at infant ages 4, 8, and 12 weeks. Circadian rhythm timing, amplitude, 24-hour fit, rhythm center, and regularity were determined using cosinor and nonparametric circadian rhythm analyses (NPCRA). All maternal and infant circadian parameters for light were highly correlated. When maternal activity was controlled, the partial correlations between infant activity and light rhythm timing, amplitude, 24-hour fit, and rhythm center demonstrated significant relation (r = .338 to .662) at infant age 12 weeks, suggesting entrainment. In contrast, when maternal light was controlled there was significant relation between maternal and infant activity rhythm (r = 0.470, 0.500, and 0.638 at 4, 8 and 12 weeks, respectively) suggesting the influence of maternal-infant interaction independent of photoentrainment of cycle timing over the first 12 weeks of life. Both light and maternal activity may offer avenues for shaping infant activity rhythm during early infancy.

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Light exposure at night and sleep quality in bipolar disorder: The APPLE cohort study.

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BACKGROUND: Sleep disturbance in bipolar disorder (BD) is common and is associated with a risk for mood episode recurrence. Thus, it is important to identify factors that are related to sleep disturbance in BD. This cross-sectional study investigated the association between exposure to light at night (LAN) and sleep parameters in patients with BD.

METHODS: The sleep parameters of 175 outpatients with BD were recorded using actigraphy at their homes for seven consecutive nights and were evaluated using the Insomnia Severity Index (ISI). The average LAN intensity in the bedroom during bedtime and rising time was measured using a portable photometer, and the participants were divided into two groups: "Light" (≥5 lx) and "Dark" (<5 lx).

The association between LAN and sleep parameters was tested with multivariable analysis by adjusting for potential confounder such as age, gender, current smoker, mood state, day length, daytime light exposure, and sedative medications.

RESULTS: After adjusting for potential confounder, the actigraphy sleep parameters showed significantly lower sleep efficiency (mean, 80.1% vs. 83.4%; p = 0.01), longer log-transformed sleep onset latency (2.9 vs. 2.6 min; p = 0.01), and greater wake after sleep onset (51.4 vs. 41.6 min; p = 0.02) in the Light group than in the Dark group. Whereas, there were no
significant differences in the ISI scores between the groups. LIMITATIONS: This was a cross-sectional study; therefore, the results do not necessarily imply that LAN causes sleep disturbance. CONCLUSIONS: Reducing LAN exposure may contribute to improved sleep quality in patients with BD.

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Light exposure is related to social and emotional functioning and to quality of life in older women.

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While there are data supporting the use of light in clinical populations, there has been less investigation of relationships among light and psychological variables in non-clinical samples. Subjects were 459 ethnically diverse women (mean age 67.68) recruited as part of the Women's Health Initiative. Light exposure and sleep were measured with an Actillume wrist actigraph. Subjects completed questionnaires, investigating Social Support, Social Functioning, Social Strain, Quality of Life, Satisfaction with Life, Emotional Well-being, Optimism, Negative Emotional Expressiveness, and Role Limitation Due to Emotional Problems. Significant partial correlations (controlling for age, education and ethnicity) were found between mesor light exposure and Social Functioning, Quality of Life, Satisfaction with Life, and Emotional Well-Being.
Quality of Life and Satisfaction with Life were also found to be significantly correlated with morning light. The most parsimonious model to account for the variance shared between mesor light and the predictors included only Quality of Life. The variance shared between mesor light exposure and social and emotional functioning could be subsumed under the variance shared between mesor light exposure and Quality of Life. Increased light exposure is related to improved quality of life and social and emotional functioning.

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Light is beneficial for infant circadian entrainment: an actigraphic study.

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AIM: This article is a report of an exploratory study of the relation between light exposure and circadian rest-activity patterns in infants.

BACKGROUND: Ambient light is a major environmental stimulus for regulation of circadian rhythm of sleep and wake in adults, but few studies have been conducted to examine environmental light exposure in relation to rest-activity circadian rhythm parameters of infants.

METHODS: An intensive within-subject design was used with a convenience sample of 22 infants (mean postnatal age 49.8 days) who wore a combined light and activity monitoring device for seven consecutive days at home. For each infant, light data (lux) were aggregated over the 7 days into categories of illumination
and expressed in mean minutes/day. Circadian light and activity parameters, including mesor, amplitude, acrophase and R(2) cosinor fit, were determined using cosinor analysis. Associations between light exposure and circadian rest-activity rhythm parameters were examined using correlation and regression analyses. Data were collected between 2006 and 2007.

RESULTS: Infants spent only one-eighth of their daytime hours in an environment with >100 lux light level. There was a relatively large statistically significant relation between the acrophase of light exposure and the acrophase of activity. Increased duration of daily exposure to >100 lux of illumination, and increased amplitude of circadian rhythm of light were associated with stronger circadian patterns of infant activity.

CONCLUSION: Results suggest an association between light and activity patterns and that increasing duration of exposure to moderate light levels may be a simple and economical nursing intervention during the early postnatal weeks.

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Light of domestic intensity produces phase shifts of the circadian oscillator in humans.


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Twelve subjects have been studied in a chamber that isolated them from external noise and lighting. After several control days, one group (n = 6) was subjected
to 18 x 27-h 'days' and the other to 11 x 30-h 'days'. Sleep was in
the dark, and
awake times were spent in normal domestic lighting (150-500 lux).
Rectal
temperature and wrist actimetry were measured throughout, and the
phase of the
circadian oscillator was inferred from that of the temperature data,
purified to
remove direct effects of activity. During the experimental 'days' the
rhythms
showed a mean period of 24.4 h. A detailed examination of the phase
shifts from
one day to the next showed that small advances and delays were
superimposed upon
this drift. Moreover, the mean size and direction of these shifts
depended upon
the time of exposure to lighting relative to the temperature minimum,
as would be
predicted from a phase-response curve.

DOI: 10.1016/s0304-3940(98)00174-8
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s12885-018-4746-2.

Light therapy as a treatment of cancer-related fatigue in
(non-)Hodgkin lymphoma
survivors (SPARKLE trial): study protocol of a multicenter randomized
controlled
trial.

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BACKGROUND: Cancer related fatigue (CRF) is one of the most prevalent and distressing long-term complaints reported by (non-) Hodgkin survivors. To date there has been no standard treatment for CRF in this population. A novel and promising approach to treat CRF is exposure to bright white light therapy. Yet, large scale randomized controlled trials testing its efficacy in these patients and research on potential mechanisms is lacking. The objective of the current study is to investigate the efficacy of light therapy as a treatment for CRF and to explore potential mechanisms.

METHODS/DESIGN: In a multicenter, randomized controlled trial we are evaluating the efficacy of two intensities of light therapy in reducing CRF complaints and restrictions caused by CRF in survivors of Hodgkin lymphoma or diffuse large B-cell lymphoma. Secondary outcomes include sleep quality, depression, anxiety, quality of life, cognitive complaints, cancer worries, fatigue catastrophizing, self-efficacy to handle fatigue, biological circadian rhythms of melatonin, cortisol and activity, and biomarkers of inflammation. We will recruit 128 survivors, with fatigue complaints, from academic and general hospitals. Survivors are randomized to either an intervention (exposure to bright white light) or a comparison group (exposure to dim white light). The longitudinal
design includes four measurement points at baseline (T0), post-intervention at 3.5 weeks (T1), 3 months post-intervention (T2) and 9 months post-intervention (T3). Each measurement point includes self-reported questionnaires and actigraphy (10 days). T0 and T1 measurements also include collection of blood and saliva samples.

DISCUSSION: Light therapy has the potential to be an effective treatment for CRF in cancer survivors. This study will provide insights on its efficacy and potential mechanisms. If proven to be effective, light therapy will provide an easy to deliver, low-cost and low-burden intervention, introducing a new era in the treatment of CRF.

TRIAL REGISTRATION: The study is registered at ClinicalTrials.gov on August 8th 2017 (NCT03242902).

DOI: 10.1186/s12885-018-4746-2
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Light treatment improves sleep quality and negative affectiveness in high arctic residents during winter.

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The seasonal extremes of photoperiod in the high Arctic place particular strain on the human circadian system, which leads to trouble sleeping and increased feelings of negative affect in the winter months. To qualify for our study, potential participants had to have been at Canadian Forces Station (CFS) Alert (82° 30' 00" N) for at least 2 weeks. Subjects filled out questionnaires
regarding sleep difficulty, psychological well-being and mood and wore Actigraphs to obtain objective sleep data. Saliva was collected at regular intervals on two occasions, 2 weeks apart, to measure melatonin and assess melatonin onset. Individuals with a melatonin rhythm that was in disaccord with their sleep schedule were given individualized daily light treatment interventions based on their pretreatment salivary melatonin profile. The light treatment prescribed to seven of the twelve subjects was effective in improving sleep quality both subjectively, based on questionnaire results, and objectively, based on the actigraphic data. The treatment also caused a significant reduction in negative affect among the participants. Since the treatment is noninvasive and has minimal associated side effects, our results support the use of the light visors at CFS Alert and other northern outposts during the winter for individuals who are experiencing sleep difficulty or low mood.

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Light treatment prevents fatigue in women undergoing chemotherapy for breast cancer.


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PURPOSE: Fatigue is one of the most disturbing complaints of cancer patients and is often the reason for discontinuing treatment. This randomized controlled study tested the hypothesis that increased morning bright light, compared to dim light, would result in less fatigue in women with breast cancer undergoing chemotherapy.

METHODS: Thirty-nine women newly diagnosed with stage I–III breast cancer were randomized to either bright white light (BWL) or dim red light (DRL) treatment and were instructed to use the light box for 30 min every morning throughout the first four cycles of chemotherapy. The Multidimensional Fatigue Symptom Inventory was administered prior to the start of chemotherapy (baseline), during the chemotherapy treatment week of cycle 1 (C1TW), the last week (recovery week) of cycle 1 (C1RW), the chemotherapy treatment week of cycle 4 (C4TW), and the last week (recovery week) of cycle 4 (C4RW).

RESULTS: The DRL group reported increased fatigue at C1TW ($p = 0.003$) and C4TW ($p < 0.001$) compared to baseline, while there was no significant change from baseline in the BWL group. A secondary analysis showed that the increases in fatigue levels in the DRL group were not mediated through nor associated with changes in sleep or in circadian rhythms as measured with wrist actigraphy.

CONCLUSIONS: The results of this study suggest that morning bright light treatment may prevent overall fatigue from worsening during chemotherapy. Although our hypothesis that overall fatigue would improve with bright light treatment was not supported, the lack of deterioration in total fatigue scores suggests that bright morning light may be a useful intervention during chemotherapy for breast cancer.

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Light visor treatment for jet lag after westward travel across six time zones.


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INTRODUCTION: The aim of this field study was to evaluate the efficacy of a light treatment for jet lag, using a head-mounted light visor, following a westward flight across six time zones.

METHODS: There were 20 subjects who were exposed to bright white light (3000 lux) or dim red light (10 lux) for 3 h on the first two evenings after a flight from Zurich to New York. Salivary dim light melatonin onset (DLMO), assessed 2 d before and 2 d after the flight, provided a measure of circadian phase. Sleep was recorded by actigraphy, while post-flight performance testing and subjective scales provided additional indices of jet lag severity.

RESULTS: The DLMO measurements showed a larger phase delay in the bright light than in the dim light group (2.59 h vs. 1.58 h, p < 0.02). There was no overall difference in sleep efficiency (SE) between the two groups, but a significant Group x Night interaction reflected a small increase across the first two post-flight nights in the bright light group, and a small decrease in the dim light group. Reaction time on one of two performance tests was consistently faster in the dim light group, but was unrelated to circadian phase or to prior sleep. There were no major group differences in subjective sleep quality, daytime sleepiness, jet lag severity, or mood.

DISCUSSION: This is the first full-scale study to show that bright light treatment can accelerate circadian reentrainment following
transmeridian travel. However, the effect on reentrainment rate was modest, and was not accompanied by any improvement in sleep, performance, or subjective assessments of jet lag symptoms.

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Linear and Nonlinear Associations between Sleep and Adjustment in Adolescence.

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Background & Objectives: A growing body of work supports linear associations between sleep and socioemotional adjustment in adolescence. However, associations between sleep and adjustment are not necessarily linear and investigations of nonlinear effects are scarce. This study examined linear and nonlinear relations between several sleep-wake parameters and externalizing behavior and internalizing symptoms in adolescence, and assessed the role of adolescent sex as a moderator of effects. Participants: Participants were high school students (N = 180; M age = 17.49, SD = .62; 59% female; 68% White/European American, 32% Black/African American) from a wide range of socio-economic backgrounds living in semirural communities and small towns in Alabama. Methods: Sleep-wake parameters were indexed by actigraphy-derived sleep minutes and adolescents' reports on morningness-eveningness (circadian preference), sleep-wake problems
(sleep quality), and sleepiness. Adolescents completed questionnaires on externalizing behaviors and internalizing symptoms. Results: Controlling for sleep duration, a higher preference for eveningness and poor sleep quality were associated in a linear fashion with increased externalizing and internalizing symptoms. Nonlinear relations between sleepiness and internalizing symptoms emerged with pronounced sex-related effects, including somewhat delayed accelerating relations for males and rapidly accelerating associations that tended to plateau for females.

Conclusions: Results illustrate the importance of examining multiple sleep-wake and adjustment variables as well as linear and nonlinear associations.

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The link between maternal sleep and permissive parenting during late adolescence.

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Utilizing a multi-method design, the present study examined the association between maternal sleep, assessed via actigraphy and self-reports, and permissive parenting (e.g. lax, inconsistent discipline) during adolescence, as well as the extent to which this association differed by mothers' race/ethnicity and
socioeconomic status. The sample was comprised of 234 mothers (M age = 41.76 years, SD = 6.25; 67% European-American, 31% African-American, 2% other race/ethnicities) and 237 adolescents (113 boys, 124 girls; M age = 15.80 years, SD = 0.80; 66% European-American, 34% African-American).

Mothers' sleep duration (actual sleep minutes) and quality (sleep efficiency, latency, long wake episodes) were assessed using actigraphy. Mothers also reported on their sleep problems and adolescents reported on mothers' permissive parenting behaviours. Results revealed that actigraphy-based longer sleep duration and shorter sleep latency were associated with lower levels of permissive parenting. Further, mothers' race/ethnicity and socioeconomic status moderated the association between actigraphy-based sleep quality (i.e. sleep efficiency, long wake episodes) and permissive parenting. Specifically, a negative association between sleep efficiency and permissive parenting was evident only for African-American mothers. In addition, a positive association between more frequent night wakings and permissive parenting was evident only for mothers from lower socioeconomic status households. The findings highlight the benefits of longer and higher-quality sleep for reducing the risk of permissive parenting, especially among ethnic minority mothers and mothers from lower socioeconomic status households.

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Linking Light Exposure and Subsequent Sleep: A Field Polysomnography Study in Humans.

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Study objectives: To determine the effect of light exposure on subsequent sleep characteristics under ambulatory field conditions.

Methods: Twenty healthy participants were fitted with ambulatory polysomnography (PSG) and wrist-actigraphs to assess light exposure, rest-activity, sleep quality, timing, and architecture. Laboratory salivary dim-light melatonin onset was analyzed to determine endogenous circadian phase.

Results: Later circadian clock phase was associated with lower intensity ($R^2 = 0.34$, $\chi^2(1) = 7.19$, $p < .01$), later light exposure (quadratic, controlling for daylength, $R^2 = 0.47$, $\chi^2(3) = 32.38$, $p < .0001$), and to later sleep timing ($R^2 = 0.71$, $\chi^2(1) = 20.39$, $p < .0001$). Those with later first exposure to more than 10 lux of light had more awakenings during subsequent sleep (controlled for daylength, $R^2 = 0.36$, $\chi^2(2) = 8.66$, $p < .05$). Those with later light exposure subsequently had a shorter latency to first rapid eye movement (REM) sleep episode ($R^2 = 0.21$, $\chi^2(1) = 5.77$, $p < .05$). Those with less light exposure subsequently had a higher percentage of REM sleep ($R^2 = 0.43$, $\chi^2(2) = 13.90$, $p < .004$) in a clock phase modulated manner. Slow-wave sleep accumulation was observed to be larger after preceding exposure to high maximal intensity and early first light exposure ($p < .05$).

Conclusions: The quality and architecture of sleep is associated with preceding light exposure. We propose that light exposure timing and intensity do not only modulate circadian-driven aspects of sleep but also homeostatic sleep pressure. These novel ambulatory PSG findings are the first to highlight the direct
relationship between light and subsequent sleep, combining knowledge of homeostatic and circadian regulation of sleep by light. Upon confirmation by interventional studies, this hypothesis could change current understanding of sleep regulation and its relationship to prior light exposure. Clinical trial details: This study was not a clinical trial. The study was ethically approved and nationally registered (NL48468.042.14).

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Links between sleep and body mass index in bipolar disorders: an exploratory study.

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STUDY OBJECTIVES: Obesity and excess bodyweight are highly prevalent in individuals with bipolar disorders (BD) and are associated with adverse consequences. Multiple factors may explain increased bodyweight in BD including side effects of psychotropic medications, and reduced physical activity. Research in the general population demonstrates that sleep disturbances may also contribute to metabolic burden. We present a cross-sectional study of the associations between body mass index (BMI) and sleep parameters in patients with BD as compared with healthy controls (HC).

METHODS: Twenty-six French outpatients with remitted BD and 29 HC with a similar BMI completed a 21-day study of sleep parameters using objective (actigraphy) and subjective (PSQI: Pittsburgh Sleep Quality Index) assessments.

RESULTS: In BD cases, but not in HC, higher BMI was significantly correlated with lower sleep efficiency ($P=0.009$) and with several other sleep parameters: shorter total sleep time ($P=0.01$), longer sleep onset latency ($P=0.05$), higher fragmentation index ($P=0.008$), higher inter-day variability ($P=0.05$) and higher PSQI total score ($P=0.004$).

CONCLUSIONS: The findings suggest a link between a high BMI and several sleep disturbances in BD, including lower sleep efficiency. Physiological mechanisms in
BD cases may include an exaggeration of phenomena observed in non-clinical populations. However, larger scale studies are required to clarify the links between metabolic and sleep–wake cycle disturbances in BD.

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Long-term acute care patients weaning from prolonged mechanical ventilation maintain circadian rhythm.

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BACKGROUND: Circadian rhythm regulates many physiologic and immunologic processes. Disruption of these processes has been demonstrated in acutely ill, mechanically ventilated patients in the ICU setting. Light has not been studied as an entraining stimulus in the chronically mechanically ventilated patient. The purpose of this study was to determine the association of naturally occurring ambient light levels in a long-term acute care (LTAC) hospital with circadian rhythm in patients recovering from critical illness and requiring prolonged mechanical ventilation (PMV).

METHODS: We performed a prospective observational study of 15 adult patients who were recovering from critical illness and receiving PMV and who were admitted to the ventilator weaning unit at an LTAC hospital. Demographic data were obtained from chart review. Light stimuli in each patient room were assessed using a
photometer device placed at eye level. Circadian rhythm was assessed by wrist actigraphy. Cumulative data were obtained from each device for a 48-h period, averaged into 4-h intervals, and analyzed.

RESULTS: Patients receiving PMV were obese (mean body mass index of 32.7 ± 10.3 kg/m2) and predominantly female (73%) and had an average age of 63.1 ± 14.3 y. Light exposure to this cohort maintained diurnal variation (P < .001) and was significantly different across time periods. Circadian rhythm, as represented by actigraphy, also maintained diurnal variation (P < .001) and was in phase with light. Linear regression of movement and time demonstrated a moderate relationship between light and actigraphy (R2 = 0.56).

CONCLUSIONS: Despite requiring continued high-level care and a prolonged stay in a medical facility, patients recovering from critical illness and actively weaning from PMV maintain their circadian rhythm in phase with normal diurnal variations of light.

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Long-term effects of cranial irradiation for childhood malignancy on sleep in adulthood.

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BACKGROUND: Cranial radiation therapy (CRT) is required for successful treatment of a variety of brain tumours in childhood.
OBJECTIVE: To investigate whether childhood CRT leads to altered sleep–wakefulness organization in adulthood, and to identify the determinants of such alterations.

SUBJECTS AND METHODS: Subjective (questionnaires) and objective (actigraphy) measures of circadian rhythmicity and sleep were assessed in 25 individuals, 8–29 years after CRT for medulloblastoma (n=17) or other intracranial tumours (n=8), and in a group of 34 age-matched healthy individuals. Serum GH peak during insulin-induced hypoglycaemia and serum concentrations of prolactin and leptin (expressed per fat mass) were determined in the CRT group.

RESULTS: The CRT group showed a markedly increased sleep duration (8.66 h, compared with 7.66 h in controls). In addition, the sleep–wake rhythm showed greater amplitude and less fragmentation, and less tolerance for alterations in the timing of sleep. Regression analysis showed both radiation dosage and neuroendocrine status to be determinants of sleep changes, suggesting that some of the alterations may be normalized with hormone supplementation.

CONCLUSION: The present study shows that high-dose cranial radiation therapy in childhood is associated with objective and subjective changes in the sleep–wake rhythm in adulthood.

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AIM: The disturbed circadian rhythm in haemodialysis patients results in perturbed sleep. Short term melatonin supplementation has alleviated these sleep problems. Our aim was to investigate the effects of long-term melatonin supplementation on quality of life and sleep.

METHODS: In this randomized double-blind placebo-controlled trial haemodialysis patients suffering from subjective sleep problems received melatonin 3 mg day\(^{-1}\) vs. placebo during 12 months. The primary endpoint quality of life parameter 'vitality' was measured with Medical Outcomes Study Short Form-36. Secondary outcomes were improvement of three sleep parameters measured by actigraphy and nighttime salivary melatonin concentrations.

RESULTS: Sixty-seven patients were randomized. Forty-two patients completed the trial. With melatonin, no beneficial effect on vitality was seen. Other quality of life parameters showed both advantageous and disadvantageous effects of melatonin. Considering sleep, at 3 months sleep efficiency and actual sleep time had improved with melatonin compared with placebo on haemodialysis days (difference 7.6\%, 95% CI 0.77, 14.4 and 49 min, 95% CI 2.1, 95.9, respectively). At 12 months none of the sleep parameters differed significantly from placebo. Melatonin salivary concentrations at 6 months had significantly increased in the melatonin group compared with the placebo group.

CONCLUSIONS: The high drop-out rate limits the strength of our conclusions. However, although a previous study reported beneficial short term effects of melatonin on sleep in haemodialysis patients, in this long-term study the positive effects disappeared during follow up (6–12 months). Also the quality of life parameter, vitality, did not improve. Efforts should be made to elucidate the mechanism responsible for the loss of effect with chronic use.
Long-term fitness training improves the circadian rest-activity rhythm in healthy elderly males.

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In old age, the circadian timing system loses optimal functioning. This process is even accelerated in Alzheimer's disease. Because pharmacological treatment of day-night rhythm disturbances usually is not very effective and may have considerable side effects, nonpharmacological treatments deserve attention. Bright light therapy has been shown to be effective. It is known from animal studies that increased activity, or an associated process, also strongly affects the circadian timing system, and the present study addresses the question of whether an increased level of physical activity may improve circadian rhythms in elderly. In the study, 10 healthy elderly males were admitted to a fitness training program for 3 months. The circadian rest-activity rhythm was assessed by means of actigraphy before and after the training period and again 1 year after discontinuation. As a control for possible seasonal effects, repeated actigraphic recordings were performed during the same times of the year as were the pre and post measurements in a control group of 8 healthy elderly males.
Fitness training induced a significant reduction in the fragmentation of the rest-activity rhythm. Moreover, the fragmentation of the rhythm was negatively correlated with the level of fitness achieved after the training. No seasonal effect was found. Previous findings in human and animal studies are reviewed, and several possible mechanisms involved in the effect of fitness training on circadian rhythms are discussed. The results suggest that fitness training may be helpful in elderly people suffering from sleep problems related to circadian rhythm disturbances.

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A longitudinal assessment of sleep timing, circadian phase, and phase angle of entrainment across human adolescence.

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The aim of this descriptive analysis was to examine sleep timing, circadian phase, and phase angle of entrainment across adolescence in a longitudinal study design. Ninety-four adolescents participated; 38 (21 boys) were 9-10 years ("younger cohort") and 56 (30 boys) were 15-16 years ("older cohort") at the baseline assessment. Participants completed a baseline and then follow-up assessments approximately every six months for 2.5 years. At each assessment, participants wore a wrist actigraph for at least one week at home to measure self-selected sleep timing before salivary dim light melatonin onset (DLMO) phase – a marker of the circadian timing system – was measured in the laboratory. Weekday and weekend sleep onset and offset and weekend-weekday differences were derived from actigraphy. Phase angles were the time durations from DLMO to weekday sleep onset and offset times. Each cohort showed later sleep onset (weekend and weekday), later weekend sleep offset, and later DLMO with age. Weekday sleep offset shifted earlier with age in the younger cohort and later in the older cohort after age 17. Weekend-weekday sleep offset differences increased with age in the younger cohort and decreased in the older cohort after age 17.
DLMO to sleep offset phase angle narrowed with age in the younger cohort and became broader in the older cohort. The older cohort had a wider sleep onset phase angle compared to the younger cohort; however, an age-related phase angle increase was seen in the younger cohort only. Individual differences were seen in these developmental trajectories. This descriptive study indicated that circadian phase and self-selected sleep delayed across adolescence, though school-day sleep offset advanced until no longer in high school, whereupon offset was later. Phase angle changes are described as an interaction of developmental changes in sleep regulation interacting with psychosocial factors (e.g., bedtime autonomy).

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Longitudinal changes of day-time and night-time gross motor activity in clinical responders and non-responders of major depression.

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Psychomotor retardation (PR) is among the most important features of depression. This study investigates the development of day- and night-time as well as intensity and quantity of circadian motor activity during a 4-week course of treatment among 27 patients with depression compared to 27 healthy controls. A diagnosis of major depression was made using SCID. Motor activity was continuously measured with an actigraph during the study and clinical course of depression with HAM-D-21. Motor activity was described as the quantity and intensity of movements during day- and night-time. Clinically
improved patients had significantly intensified movements after 4 weeks, compared to subjects with <50% improvement on HAM-D. While the measures of day-time level of movements captured the clinical improvement of depression, clinical improvement was not reflected by the night-time measurements. This study demonstrates that the separated analysis of level and quantity of movements supports a better understanding of the nature of psychomotor retardation during depression. The subdivision in day- and night-time activity objectively measured with actigraphy captures distinct patterns of motor activity and represents prognostic factors in the treatment outcome of depression. The study also highlights the importance of studying the intensity of movements separately from the quantity of movements in relation to treatment outcome.

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Longitudinal study of sleep patterns of United States Military Academy cadets.

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STUDY OBJECTIVES: The study provided an opportunity to observe sleep patterns in a college-age population attending the United States Military Academy. DESIGN: This 4-year longitudinal study investigated sleep patterns of cadets. A stratified sample of 80 cadets had sleep patterns monitored using actigraphy for 8 months: one month in both fall and spring academic semesters over a 4-year period.
SETTING: Data were collected at the United States Military Academy,
West Point, NY.

PARTICIPANTS: Participants were members of the class of 2007 (n~1300) ranging in age from 17 to 22 when entering USMA.

MEASUREMENTS AND RESULTS: A sample of the class (n=80) wore wrist activity monitors and completed activity logs for one month in fall and spring academic semesters for the 4-year period. On average over the 4 years, cadets slept<5.5 h on school nights. Cadets napped extensively, perhaps in an attempt to compensate for chronic sleep debt. Cadets slept more during fall than spring semesters. Male and female cadet sleep patterns varied dramatically, with males consistently receiving less sleep than females (~21 m for nighttime sleep and ~23 m for daily sleep).

CONCLUSIONS: Cadet sleep at USMA is related to academic year, semester, season, sex, school day or weekend, and day of the week. These students suffer from chronic sleep debt. Restrictions imposed by the military academy limit the generalizability of the findings to other college age populations.

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A low-cost system to easily measure spontaneous physical activity in rodents.

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Spontaneous physical activity (SPA) can be responsible for variations of a lot of physiological parameters at the molecular, cellular, tissue, and systemic levels. It is increasingly recognized that good understanding of a large part of experimental results requires weighting them by SPA in order to reduce variability and thus to decrease the number of animals necessary to conduct a study. However, because of the high cost of this equipment, only a few laboratories are equipped with such equipment to measure the SPA of their animals. Here we present an effective, adaptable, and affordable system to measure SPA in rodents based on video acquisition of the animal in its own environment. We compared results obtained with our system to those collected at the same time with a commercial system of actimetry recording, and we found a high degree of correlation between these two approaches ($r = 0.93; P < 0.001$). We also were able to detect small variations of SPA induced by a special environment like chronic hypoxia exposure (25% less spontaneous activity compared with animals in normoxia, $P < 0.05$) or during the circadian cycle (107% more activity during the nocturnal phase compared with the diurnal phase, $P < 0.05$).

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Low socioeconomic status negatively affects sleep in pregnant women.
OBJECTIVE: To evaluate the effect of socioeconomic status on measures of sleep quality, continuity, and quantity in a large cohort of pregnant women.

DESIGN: Prospective, longitudinal study.

PARTICIPANTS: One hundred seventy (170) pregnant women at 10–20 weeks gestation.

METHODS: Sleep quality was assessed with the Pittsburgh Sleep Quality Index. Sleep duration and continuity (sleep fragmentation index [SFI]) were assessed with actigraphy at 10–12, 14–16, and 18–20 weeks gestation. Because sleep did not significantly differ across time, averages across all three time points were used in analyses. Socioeconomic status (SES) was defined by self-reported annual household income. Linear regression analyses were used to model the independent associations of SES on sleep after adjusting for age, race, parity, marital status, body mass index (BMI), perceived stress, depressive symptoms, and financial strain.

RESULTS: On average, women reported modestly poor sleep quality (M = 5.4, SD = 2.7), short sleep duration (391 [55.6] min) and fragmented sleep (SFI M = 33.9, SD = 10.4). A household income < $50,000/year was associated with poorer sleep quality (β = -.18, p < 0.05) and greater sleep fragmentation (β = -.18, p < 0.05) following covariate adjustment.

CONCLUSIONS: Low SES was associated with poorer sleep quality and fragmented sleep, even after statistical adjustments. Perceived stress and financial strain attenuated SES-sleep associations indicating that psychosocial situations preceding pregnancy are also important to consider.

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PMID: 24617761 [Indexed for MEDLINE]
Lower nocturnal urinary 6-sulfatoxymelatonin is associated with more severe insulin resistance in patients with prediabetes.

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Objective: Melatonin, a neurohormone secreted by the pineal gland, controls circadian rhythmicity, modulates sleep and plays a role in glucose metabolism. Low secretion of nocturnal urinary 6-sulfatoxymelatonin (aMT6S) was associated with incident diabetes. Sleep disturbances have also been shown to be risk factors for diabetes. In this study, we explored the relationship between nocturnal urinary aMT6s and markers of glucose metabolism in prediabetes patients, considering sleep related factors.

Methods: Sixty two non-shift working patients with prediabetes [hemoglobin A1c (HbA1c) 5.7–6.49%] who were not on beta-blockers participated. Sleep duration and efficiency was recorded using 7-day actigraphy. Obstructive sleep apnea was evaluated using an overnight in-home monitoring device. Nocturnal urinary aMT6s/creatinine ratio was measured from an overnight urine sample. Oral glucose tolerance test (OGTT, 75-grams glucose) was performed, with measurements of
insulin and glucose levels.
Results: Mean (SD) age was 55.3 (8.2) years and mean HbA1c level was 6.01 (0.2)%.
Mean (SD) sleep duration 6.0 (0.9) h, sleep efficiency was 83.4 (6.6)% and a
median (interquartile rage) apnea hypopnea index was 10.3 (3.6, 16.4). Median
nocturnal urinary aMT6s was 17.4 (9.4, 28.2) ng/mg creatinine. Higher
nocturnal
urinary aMT6s significantly correlated with lower fasting insulin (p = 0.004),
lower insulin response to OGTT (p = 0.027), and lower fasting and
whole body
insulin resistance as indicated by lower HOMA-IR and higher Matsuda
insulin
sensitivity index (p = 0.006 and p = 0.011, respectively), but it was not
correlated with fasting glucose, glucose response to OGTT, or HbA1c. Sleep
duration inversely correlated with HbA1c but no other correlations
were found
between other sleep variables and markers of glucose metabolism or
nocturnal
urinary aMT6s. After adjusting for body mass index, higher nocturnal
urinary
aMT6s significantly correlated with lower HOMA-IR (p = 0.025) and
fasting insulin
levels (p = 0.014).
Conclusion: Nocturnal urinary aMT6s inversely correlated with fasting
insulin
resistance and insulin levels in patients with prediabetes. These results support
the role of melatonin in glucose metabolism.

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Marital conflict and children's sleep: reciprocal relations and
socioeconomic
effects.

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We examined reciprocal relations between parental marital conflict and children's sleep disruptions over two years. The roles of ethnicity (African American and European American) and socioeconomic status were tested as moderators of the examined relations. A community sample of 176 school-age children (M age = 8.68 at T1) and their parents participated at T1 and T2 with a 2-year interval between waves. Mothers, fathers, and children reported on parental marital conflict, and children's sleep was measured via actigraphy and self-reports. Latent variable modeling indicated that T1 marital conflict predicted increases in children's sleep disruptions longitudinally; results were more pronounced for African American children and those from lower SES homes. Further, children's sleep disruptions at T1 predicted increases in marital conflict over time. Results demonstrate the importance of reciprocal relations between a prevalent familial stressor and a fundamental facet of children's health, especially when considering the sociocultural milieu.

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Marital conflict and disruption of children's sleep.

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Marital conflict was examined as a predictor of the quality and quantity of sleep in a sample of healthy 8- to 9-year-olds. Parents and children reported on marital conflict, the quantity and quality of children's sleep were examined.
through an actigraph worn for 7 consecutive nights, and child sleepiness was derived from child and mother reports. Increased marital conflict was associated with disruptions in the quantity and quality of children's sleep as well as subjective sleepiness, even after controlling for child age, ethnic group membership, socioeconomic status, sex, and body mass index. The results support the sensitization hypothesis in that exposure to marital conflict may influence an important facet of children's biological regulation, namely sleep.

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Marked 24-h rest/activity rhythms are associated with better quality of life, better response, and longer survival in patients with metastatic colorectal cancer and good performance status.


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The rest/activity circadian cycle has been used as a reference for chemotherapy administration at specific times to improve tolerability and efficacy. Because cancer processes may be associated with alterations of circadian rhythms, the rest/activity cycle was monitored noninvasively to assess its relationship with tumor response, survival, and quality of life in 200 patients with metastatic colorectal cancer. Patients wore an actigraph, a wristwatch that records the number of accelerations per minute, for 3 days before receiving chronomodulated chemotherapy. The circadian rhythms in activity were estimated by two
robust parameters: the autocorrelation coefficient at 24 h (r24), and the dichotomy index (I<0) for comparing amounts of activity when in bed and out of bed. Accurate data for inclusion, quality of life, response, and survival were available for 192 patients. Survival at 2 years was 5-fold higher (P = 10(-4)) in patients with marked activity rhythm (I<0 in upper quartile) than in those with rhythm alteration (I<0 in lower quartile). These results were supported by the multivariate Cox analysis. Multivariate regression analysis showed that circadian rhythms in activity (I<0; P = 3 x 10(-4)) and in WBCs (P = 0.03) as well as performance status (P = 0.02) were jointly prognostic of response. Patients with marked rest/activity rhythms also had better quality of life and reported significantly less fatigue. The individual rest/activity cycle provides a novel independent prognostic factor for cancer patients' survival and tumor response as well as a quantitative indicator for quality of life.

PMID: 10955782  [Indexed for MEDLINE]


Marker rhythms of circadian system function: a study of patients with metastatic colorectal cancer and good performance status.


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Cancer patients may exhibit normal or altered circadian rhythms in tumor and healthy tissues. Four rhythms known to reflect circadian clock function were
studied in 18 patients with metastatic colorectal cancer and good performance status. Rest-activity was monitored by wrist actigraphy for 72 h before treatment, and its circadian rhythm was estimated by an autocorrelation coefficient at 24h and a dichotomy index that compared the activity level when in and out of bed. Blood samples (9-11 time points, 3-6 h apart) were drawn on day 1 and day 4 of the first course of chronochemotherapy (5-fluorouracil: 800 mg/m2/day; folinic acid: 300 mg/m2/day; oxaliplatin: 25 mg/m2/day). Group 24h rhythms were validated statistically for plasma concentrations of melatonin, 6-alpha-sulfatoxymelatonin, and cortisol and for lymphocyte counts. Significant individual 24h rhythms were displayed in melatonin by 15 patients, cortisol by seven patients, lymphocytes by five patients, and prominent circadian rhythms in activity were displayed by 10 patients; only one patient exhibited significant rhythms in all the variables. The results suggest the rhythms of melatonin, cortisol, lymphocytes, and rest/activity reflect different components of the circadian system, which may be altered differently during cancer processes. Such 24h rhythm alterations appeared to be independent of conventional clinical factors.

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PMID: 11962672  [Indexed for MEDLINE]


Mars 520-d mission simulation reveals protracted crew hypokinesis and alterations of sleep duration and timing.


Author information:
The success of interplanetary human spaceflight will depend on many factors, including the behavioral activity levels, sleep, and circadian timing of crews exposed to prolonged microgravity and confinement. To address the effects of the latter, we used a high-fidelity ground simulation of a Mars mission to objectively track sleep-wake dynamics in a multinational crew of six during 520 d of confined isolation. Measurements included continuous recordings of wrist actigraphy and light exposure (4.396 million min) and weekly computer-based neurobehavioral assessments (n = 888) to identify changes in the crew's activity levels, sleep quantity and quality, sleep-wake periodicity, vigilance performance, and workload throughout the record-long 17 mo of mission confinement. Actigraphy revealed that crew sedentariness increased across the mission as evident in decreased waking movement (i.e., hypokinesis) and increased sleep and rest times. Light exposure decreased during the mission. The majority of crewmembers also experienced one or more disturbances of sleep quality, vigilance deficits, or altered sleep-wake periodicity and timing, suggesting inadequate circadian entrainment. The results point to the need to identify markers of differential vulnerability to hypokinesis and sleep-wake changes during the prolonged isolation of exploration spaceflight and the need to ensure maintenance of circadian entrainment, sleep quantity and quality, and optimal activity levels during exploration missions. Therefore, successful adaptation to such missions will require crew to transit in spacecraft and live in surface habitats that instantiate aspects of Earth's geophysical signals (appropriately timed light exposure, food intake, exercise) required for temporal...
Massage therapy by mothers enhances the adjustment of circadian rhythms to the nocturnal period in full-term infants.

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The objective of this study was to investigate the effect of massage therapy on phase adjustment of rest-activity and melatonin secretion rhythms to the nocturnal period in full-term infants. Rest-activity cycles of infants (measurement 1, n = 16) were measured by actigraphy before and after 14 days of massage therapy (starting at age 10 [+/-4] d) and subsequently at 6 and 8 weeks of age. 6-Sulphatoxymelatonin excretion was assessed in urine samples at 6, 8, and 12 weeks of age (measurement 2, n = 21). At 8 weeks the controls revealed one peak of activity at approximately 12 midnight (11 p.m.-3 a.m.) and another one at approximately 12 noon (11 a.m.-3 p.m.), whereas in the treated group, a major peak was early in the morning (3 a.m.-7 a.m.) and a secondary peak in the late afternoon (3 p.m.-7 p.m.). At 12 weeks, nocturnal 6-sulphatoxymelatonin excretions were significantly higher in the treated infants (1346.38 +/- 209.40 microg/night vs 823.25 +/- 121.25 microg/night, respectively; <.05).

It is concluded that massage therapy by mothers in the perinatal period serves as a strong time cue, enhancing coordination of the developing circadian system with...
environmental cues.

DOI: 10.1097/00004703-200212000-00003
PMID: 12476070  [Indexed for MEDLINE]


Maternal and infant activity: Analytic approaches for the study of circadian rhythm.

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The study of infant and mother circadian rhythm entails choice of instruments appropriate for use in the home environment as well as selection of analytic approach that characterizes circadian rhythm. While actigraphy monitoring suits the needs of home study, limited studies have examined mother and infant rhythm derived from actigraphy. Among this existing research a variety of analyses have been employed to characterize 24-h rhythm, reducing ability to evaluate and synthesize findings. Few studies have examined the correspondence of mother and infant circadian parameters for the most frequently cited approaches: cosinor, non-parametric circadian rhythm analysis (NPCRA), and autocorrelation function (ACF). The purpose of this research was to examine analytic approaches in the study of mother and infant circadian activity rhythm. Forty-three
healthy mother and infant pairs were studied in the home environment over a 72h period at infant age 4, 8, and 12 weeks. Activity was recorded continuously using actigraphy monitors and mothers completed a diary. Parameters of circadian rhythm were generated from cosinor analysis, NPCRA, and ACF. The correlation among measures of rhythm center (cosinor mesor, NPCRA mid level), strength or fit of 24-h period (cosinor magnitude and R(2), NPCRA amplitude and relative amplitude (RA)), phase (cosinor acrophase, NPCRA M10 and L5 midpoint), and rhythm stability and variability (NPCRA interdaily stability (IS) and intradaily variability (IV), ACF) was assessed, and additionally the effect size (eta(2)) for change over time evaluated. Results suggest that cosinor analysis, NPCRA, and autocorrelation provide several comparable parameters of infant and maternal circadian rhythm center, fit, and phase. IS and IV were strongly correlated with the 24-h cycle fit. The circadian parameters analyzed offer separate insight into rhythm and differing effect size for the detection of change over time. Findings inform selection of analysis and circadian parameters in the study of maternal and infant activity rhythm.

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Maternal Depressive Symptoms and Household Income in Relation to Sleep in Early Childhood.

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OBJECTIVE: Sleep health is critical for children to adapt to evolving cognitive-socioemotional contexts. Given that sleep timing in early childhood is instituted under caregiver control, the family context likely has an influential role on children's sleep. This study investigated links between maternal depressive symptoms and variability in children's sleep, and whether household income moderated this relation.

METHOD: 90 children (Mage = 53 ± 9 months) wore actigraphs to objectively measure sleep for 4-16 days. Mothers reported income and depressive symptomatology. RESULTS: Higher maternal depressive symptoms were related to greater variability in 24-hr sleep duration. Income moderated this relation. Lower income, but not maternal depressive symptoms, was linked to greater variability in sleep onset time. CONCLUSIONS: Findings demonstrate important relations between maternal depressive symptoms, income, and children's sleep. Understanding distal and proximal family characteristics that may be related to children's developing sleep schedules could help identify populations and strategies for promoting optimal sleep health.
Maternal psychological control and child internalizing symptoms: vulnerability and protective factors across bioregulatory and ecological domains.

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BACKGROUND: We examined ecological (family socioeconomic status (SES)) and bioregulatory (sleep duration, sleep efficiency) moderators of the link between maternal psychological control and children's vulnerability to internalizing symptoms.

METHOD: A large socioeconomically diverse sample of third graders (N = 141) and their mothers participated. Sleep was examined via actigraphy for one week. Psychological control and internalizing symptoms (depressive symptoms, anxiety symptoms, pre-sleep arousal) were examined through children's reports.

RESULTS: For children with poorer sleep, lower SES, or a combination of the two, maternal psychological control was positively related to depressive symptoms; this association was not evident for children with both better sleep and higher SES. Further, maternal psychological control, sleep efficiency, and SES interacted to predict both anxiety symptoms and pre-sleep arousal. Children were protected from the negative effects of psychological control when they were from higher SES families and had higher sleep efficiency; for all other
groups of children, psychological control was associated with anxiety symptoms. A similar but less robust pattern of results was found for pre-sleep arousal. CONCLUSIONS: Findings highlight the importance of children's bioregulatory processes within the socioeconomic context for an enhanced understanding of children's vulnerability to internalizing problems in the context of maternal psychological control. DOI: 10.1111/j.1469-7610.2009.02140.x PMID: 19703095 [Indexed for MEDLINE]


Maternal stress and psychological status and sleep in minority preschool children.

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OBJECTIVES: Minority women living in inner city environments may be at more risk for psychological distress. Maternal stress, anxiety, depression, and psychological trauma can influence the preschool child's behavior and may have a negative impact on the preschool child's sleep patterns. The purpose of the study was to: (a) examine objective and subjective preschool children sleep patterns and (b) explore the relationship between objective and subjective sleep patterns in preschool children and maternal psychological status.

DESIGN AND SAMPLE: A cross-sectional observational design was used. Descriptive analyses and correlations were conducted to examine the data. Twenty-one minority women were recruited from the Special Supplemental Nutrition Program for Women, Infants, and Children Program.
MEASURES: Preschool children wore wrist actigraphs, and their sleep efficiency, time in bed, and sleep periods were analyzed. Mothers completed measures on depression, anxiety, stress, and psychological trauma.

RESULTS: Mothers' self-report of their children's sleep habits indicated at risk scores for sleep problems. Life stress in the mothers was statistically significant and negatively related to preschool child's sleep duration. Mild to severe symptoms of depression and mild anxiety were reported and criteria for Post Traumatic Stress Disorder were found in 12 of the 21 mothers. The results of the study indicate that parent education on sleep and the minority preschool child should be part of community interventions and screening preschool parents for psychological distress should be considered with referrals for support services.

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Maternal stress, sleep, and parenting.

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Associations between stress, sleep, and functioning have been well-established in the general adult population, but not as well-established in the specific subpopulation of interest here—parents. To advance understanding of how maternal
Sleep is linked with both mothers' experiences of stress and their parenting, this study used actigraphic and mother-report measures of sleep, observed and mother reports of parenting, and measures of multiple stressors of relevance. In a community sample of mothers of toddlers (N = 314; child age M = 2.60, SD = 0.07 years), maternal stress was indexed with a cumulative risk score that combined sociodemographic risks and common parent stressors, including household chaos, role overload, parenting hassles, child misbehavior, negative life events, and lack of social support. We found that mothers who experienced shorter, later, and more variable sleep experienced higher levels of stress as indexed by the cumulative risk index. In addition, those with higher stress required longer to fall asleep and perceived more sleep problems. We also found that actigraphic measures of poor and insufficient maternal sleep were associated with less observed positive parenting, even when controlling for the cumulative risk index and maternal age, employment, and family size. Mothers who required longer to fall asleep also reported more dysfunctional parenting, with the same statistical controls. The findings, coupled with research showing that sleep is amenable to intervention, suggest that parental sleep may ultimately prove to be a useful intervention target for promoting positive parent involvement and responsiveness. (PsycINFO Database Record (c) 2019 APA, all rights reserved).

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The µMCTQ: An Ultra-Short Version of the Munich ChronoType Questionnaire.
Individuals vary in how their circadian system synchronizes with the cyclic environment (zeitgeber). Assessing these differences in "phase of entrainment"—often referred to as chronotype—is an important procedure in laboratory experiments and epidemiological studies but is also increasingly applied in circadian medicine, both in diagnosis and therapy. While biochemical measurements (e.g., dim-light melatonin onset [DLMO]) of internal time are still the gold standard, they are laborious, expensive, and mostly rely on special conditions (e.g., dim light). Chronotype estimation in the form of questionnaires is useful in approximating the timing of an individual's circadian clock. They are simple, inexpensive, and location independent (e.g., administrable on- and offline) and can therefore be easily administered to many individuals. The Munich ChronoType Questionnaire (MCTQ) is an established instrument to assess chronotype by asking subjects about their sleep–wake–behavior. Here we present a shortened version of the MCTQ, the μMCTQ, for use in situations in which instrument length is critical, such as in large cohort studies. The μMCTQ contains only the core
chronotype module of the standard MCTQ (stdMCTQ), which was shortened and adapted from 17 to 6 essential questions, allowing for a quick assessment of chronotype and other related parameters such as social jetlag and sleep duration. µMCTQ results correspond well to the ones collected by the stdMCTQ and are externally validated by actimetry and DLMO, assessed at home (no measure of compliance). Sleep onset, midpoint of sleep, and the µMCTQ-derived marker of chronotype showed slight deviations toward earlier times in the µMCTQ when compared with the stdMCTQ (<35 min). The µMCTQ assessment of chronotype showed good test-retest reliability and correlated significantly with phase markers from actimetry and melatonin (DLMO), especially with measurements taken on work-free days. Because of its brevity, the µMCTQ represents an ideal tool to estimate individual internal time in time-critical contexts, from large cohort studies to individualized medicine.

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Meal Timing Regulates the Human Circadian System.

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Circadian rhythms, metabolism, and nutrition are intimately linked [1, 2], although effects of meal timing on the human circadian system are poorly understood. We investigated the effect of a 5-hr delay in meals on markers of the human master clock and multiple peripheral circadian rhythms. Ten healthy young men undertook a 13-day laboratory protocol. Three meals (breakfast, lunch, dinner) were given at 5-hr intervals, beginning either 0.5 (early) or 5.5 (late) hr after wake. Participants were acclimated to early meals and then switched to late meals for 6 days. After each meal schedule, participants' circadian rhythms were measured in a 37-hr constant routine that removes sleep and environmental rhythms while replacing meals with hourly isocaloric snacks. Meal timing did not alter actigraphic sleep parameters before circadian rhythm measurement. In constant routines, meal timing did not affect rhythms of subjective hunger and sleepiness, master clock markers (plasma melatonin and cortisol), plasma triglycerides, or clock gene expression in whole blood. Following late meals, however, plasma glucose rhythms were delayed by 5.69 ± 1.29 hr (p < 0.001), and average glucose concentration decreased by 0.27 ± 0.05 mM (p < 0.001). In adipose tissue, PER2 mRNA rhythms were delayed by 0.97 ± 0.29 hr (p < 0.01), indicating that human molecular clocks may be regulated by feeding time and could underpin plasma glucose changes. Timed meals therefore play a role in synchronizing peripheral circadian rhythms in humans and may have particular relevance for patients with circadian rhythm disorders, shift workers, and transmeridian travelers.

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Measuring sleep quality in older adults: a comparison using subjective and objective methods.

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Sleep quality decreases with aging and thus sleep complaints are prevalent in older adults, particularly for those with cognitive impairment and dementia. For older adults, emerging evidence suggests poor sleep quality increases risk of developing cognitive impairment and dementia. Given the aging population—and the impending economic burden associated with increasing numbers of dementia
patients—there is pressing need to improve sleep quality among older adults. As such, research efforts have increased focus on investigating the association between age-related sleep changes and cognitive decline in older adults. Sleep quality is a complex construct to evaluate empirically, and yet the Pittsburg Sleep Quality Index (PSQI) is commonly used in studies as their only measure of sleep quality. Furthermore, the PSQI may not be the best sleep quality measure for older adults, due to its reliance on the cognitive capacity to reflect on the past month. Further study is needed to determine the PSQI's validity among older adults. Thus, the current study examined sleep quality for 78 community dwelling adults 55+ to determine the PSQI's predictive validity for objective sleep quality (as measured by actigraphy). We compared two subjective measures of sleep quality—the PSQI and Consensus Sleep Diary (CSD)—with actigraphy (MotionWatch 8©; camntech). Our results suggest perceived sleep quality is quite different from objective reality, at least for adults 55+. Importantly, we show this difference is unrelated to age, gender, education, or cognitive status (assessed using standard screens). Previous studies have shown the PSQI to be a valuable tool for assessing subjective sleep quality; however, our findings indicate for older adults the PSQI should not be used as a substitute for actigraphy, or vice versa. Hence, we conclude best practice is to include both subjective and objective measures when examining sleep quality in older adults (i.e., the PSQI, CSD, and actigraphy).

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PMID: 26441633

Measuring the impact of apnea and obesity on circadian activity patterns using functional linear modeling of actigraphy data.


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BACKGROUND: Actigraphy provides a way to objectively measure activity in human subjects. This paper describes a novel family of statistical methods that can be used to analyze this data in a more comprehensive way.

METHODS: A statistical method for testing differences in activity patterns measured by actigraphy across subgroups using functional data analysis is described. For illustration this method is used to statistically assess the impact of apnea-hypopnea index (apnea) and body mass index (BMI) on circadian activity patterns measured using actigraphy in 395 participants from 18 to 80 years old, referred to the Washington University Sleep Medicine Center for general sleep medicine care. Mathematical descriptions of the methods and results from their application to real data are presented.

RESULTS: Activity patterns were recorded by an Actical device (Philips Respironics Inc.) every minute for at least seven days. Functional linear modeling was used to detect the association between circadian activity patterns and apnea and BMI. Results indicate that participants in high apnea group have statistically lower activity during the day, and that BMI in our study population does not significantly impact circadian patterns.

CONCLUSIONS: Compared with analysis using summary measures (e.g., average activity over 24 hours, total sleep time), Functional Data Analysis (FDA) is a novel statistical framework that more efficiently analyzes information from actigraphy data. FDA has the potential to reposition the focus of
Measuring Variability in Rest-Activity Rhythms from Actigraphy with Application to Characterizing Symptoms of Depression.

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The twenty-four hour sleep-wake pattern known as the rest-activity rhythm (RAR) is associated with many aspects of health and well-being. Researchers have utilized a number of interpretable, person-specific RAR measures that can be estimated from actigraphy. Actigraphs are wearable devices that dynamically record acceleration and provide indirect measures of physical activity over time.

One class of useful RAR measures are those that quantify variability around a mean circadian pattern. However, current parametric and nonparametric RAR measures used by applied researchers can only quantify variability from a limited or undefined number of rhythmic sources. The primary goal of this article is to consider a new measure of RAR variability: the log-power spectrum of stochastic error around a circadian mean. This functional measure quantifies the relative contributions of variability about a circadian mean from all possibly frequencies, including weekly, daily, and high-frequency sources of variation. It can be estimated through a two-stage procedure that smooths the log-
periodogram
of residuals after estimating a circadian mean. The development of this measure
was motivated by a study of depression in older adults and revealed that slow,
rhythmic variations in activity from a circadian pattern are correlated with
depression symptoms.

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Medial temporal lobe atrophy relates more strongly to sleep-wake rhythm
fragmentation than to age or any other known risk.

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Atrophy of the medial temporal lobe of the brain is key to memory function and memory complaints in old age. While age and some morbidities are major risk factors for medial temporal lobe atrophy, individual differences remain, and mechanisms are insufficiently known. The largest combined neuroimaging and whole genome study to date indicates that medial temporal lobe volume is most associated with common polymorphisms in the GRIN2B gene that encodes for the 2B subunit (NR2B) of the NMDA receptor. Because sleep disruption induces a selective loss of NR2B from hippocampal synaptic membranes in rodents, and because of several other reports on medial temporal lobe sensitivity to sleep disruption, we hypothesized a contribution of the typical age-related increase in sleep-wake rhythm fragmentation to medial temporal lobe atrophy. Magnetic resonance imaging and actigraphy in 138 aged individuals showed that individual differences in sleep-wake rhythm fragmentation accounted for more (19%) of the variance in medial temporal lobe atrophy than age did (15%), or any of a list of health and brain structural indicators. The findings suggest a role of sleep-wake rhythm fragmentation in age-related medial temporal lobe atrophy, that might in part be prevented or reversible.

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The mediating role of sleep, physical activity, and diet in the association between shift work and respiratory infections.
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Objectives Shift work may be associated with an increased incidence of respiratory infections. However, underlying mechanisms are unclear. Therefore, our aim was to examine the mediating role of sleep, physical activity, and diet in the association between shift work and respiratory infections.

Methods This prospective cohort study included 396 shift and non-shift workers employed in hospitals. At baseline, sleep duration and physical activity were measured using actigraphy and sleep/activity diaries, sleep quality was reported, and frequency of meal and snack consumption was measured using food diaries. In the following six months, participants used a smartphone application to report their influenza-like illness/acute respiratory infection (ILI/ARI) symptoms daily. Mediation analysis of sleep, physical activity, and diet as potential mediators of the effect of shift work on ILI/ARI incidence rate was performed using structural equation modeling with negative binomial and logistic regression.

Results Shift workers had a 23% [incidence rate ratio (IRR) 1.23, 95% CI 1.01-1.49] higher incidence rate of ILI/ARI than non-shift workers. After adding the potential mediators to the model, this reduced to 15% (IRR 1.15, 95% CI 0.94-1.40). The largest mediating (ie, indirect) effect was found for poor sleep quality, with shift workers having 29% more ILI/ARI episodes via the pathway of poorer sleep quality (IRR 1.29, 95% CI 1.02-1.95). Conclusions Compared to non-shift workers, shift workers had a higher incidence rate of ILI/ARI that was partly mediated by poorer sleep quality. Therefore, it may be relevant for future research to focus on perceived sleep quality as an underlying
mechanism in the
relation between shift work and increased infection susceptibility.

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PMID: 32255192


The Mediation of Racial Differences in Hypertension by Sleep Characteristics:
Chicago Area Sleep Study.

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BACKGROUND: Racial disparities in hypertension prevalence in the United States
are established. Given our understanding of racial and ethnic disparities in
sleep characteristics and demonstrated associations between sleep characteristics
and hypertension, we tested whether sleep characteristics mediated racial
disparities in hypertension.

METHODS: Analyses were performed in the Chicago Area Sleep Study, a
population-based cohort study of 154 Blacks, 128 Whites, 103 Hispanics, and 109
Asians without obstructive sleep apnea. Participants underwent 7 days of wrist
actigraphy monitoring. Algorithms were used to determine sleep duration and sleep
maintenance (the percent of sleep in the sleep period). Hypertension was
determined as systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm
Hg or the use of antihypertensive medications. We estimated sample
prevalence
ratios for hypertension before and after adjustment for sleep characteristics and also conducted mediation analysis.

RESULTS: The sample prevalence of hypertension was highest in Blacks (36%), followed by Hispanics (14%), Asians (8%), and Whites (5%). The sample prevalence ratio for hypertension for Blacks vs. Whites was 5.52 (95% confidence interval (CI): 2.36, 13.23) after adjusting for age, sex, and education. Adjustment for sleep duration had no influence on the effect estimate, but adjustment for sleep maintenance attenuated the sample prevalence ratio to 4.55 (95% CI: 1.91, 11.14). Sleep maintenance mediated 11.4% of the difference in hypertension prevalence between Blacks and Whites in this sample.

CONCLUSIONS: Sleep maintenance mediated a small but significant portion of the disparity in hypertension between Blacks and Whites. Future research should investigate the mechanisms underlying these findings.

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Medical resident driving simulator performance following a night on call.

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This study compared driving simulation performance after night call and after being off call in 22 medical residents and 1 medical student in a prospective within-subjects counterbalanced design. The results demonstrated an unexpected
interaction between call and sex wherein men performed more poorly after night call than women as measured by lane variance and crash frequency. Secondary measures, including caffeine, actigraphy, and subjective total sleep time, did not differ between men and women. Collectively, results of this study and others suggest that medical residents are at risk when driving after a night on call and support the need for resident education to address sleep needs, consequences of sleep disruption, postcall recovery sleep, and countermeasures that may reduce residents' driving risks.

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Melanopsin-Driven Pupil Response and Light Exposure in Non-seasonal Major Depressive Disorder.


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Background: Melanopsin-expressing intrinsically photosensitive Retinal Ganglion Cells (ipRGCs) signal non-imaging forming effects of environmental light for circadian phoentrainment, the pupil light reflex, and mood regulation.
In seasonal affective disorder, ipRGC dysfunction is thought to cause aberrant transmission of the external illumination for photoentrainment. It is not known if patients with non-seasonal depression have abnormal melanospin mediated signaling and/or irregular environmental light exposure. Methods: Twenty-one adults who live in a sub-tropical region, including eight patients with non-seasonal depression and thirteen age-matched healthy controls were recruited. The Mini International Neuropsychiatry Interview diagnosed the presence of a major depressive disorder. Light exposure was determined using actigraphy over a 2 week period. The melanopsin mediated post-illumination pupil response (PIPR) and outer retinal inputs to ipRGCs (transient pupil response and maximum pupil constriction amplitude) were measured in response to 1 s, short and long wavelength light with high and low melanopsin excitation. Results: The mean daylight exposure as a function of clock hours and total light exposure duration (mins) to illumination levels commonly recommended for depression therapy were not significantly different between groups. Out of 84 pupil measurements (42 each in the depression and control groups), the melanopsin-mediated PIPR amplitude, transient pupil response, and pupil constriction amplitude were not significantly different between groups. Conclusions: This report provides initial evidence of normal melanopsin function and environmental light exposures in patients with pre-dominately mid and moderate non-seasonal depression in a subtropical location in the southern hemisphere.

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Melanopsin retinal ganglion cell loss in Alzheimer disease.

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OBJECTIVE: Melanopsin retinal ganglion cells (mRGCs) are photoreceptors driving circadian photoentrainment, and circadian dysfunction characterizes Alzheimer disease (AD). We investigated mRGCs in AD, hypothesizing that they contribute to
circadian dysfunction.

METHODS: We assessed retinal nerve fiber layer (RNFL) thickness by optical coherence tomography (OCT) in 21 mild-moderate AD patients, and in a subgroup of 16 we evaluated rest-activity circadian rhythm by actigraphy. We studied postmortem mRGCs by immunohistochemistry in retinas, and axons in optic nerve cross-sections of 14 neuropathologically confirmed AD patients. We coimmunostained for retinal amyloid β (Aβ) deposition and melanopsin to locate mRGCs. All AD cohorts were compared with age-matched controls.

RESULTS: We demonstrated an age-related optic neuropathy in AD by OCT, with a significant reduction of RNFL thickness (p = 0.038), more evident in the superior quadrant (p = 0.006). Axonal loss was confirmed in postmortem AD optic nerves. Abnormal circadian function characterized only a subgroup of AD patients. Sleep efficiency was significantly reduced in AD patients (p = 0.001). We also found a significant loss of mRGCs in postmortem AD retinal specimens (p = 0.003) across all ages and abnormal mRGC dendritic morphology and size (p = 0.003). In flat-mounted AD retinas, Aβ accumulation was remarkably evident inside and around mRGCs.

INTERPRETATION: We show variable degrees of rest-activity circadian dysfunction in AD patients. We also demonstrate age-related loss of optic nerve axons and specifically mRGC loss and pathology in postmortem AD retinal specimens, associated with Aβ deposition. These results all support the concept that mRGC degeneration is a contributor to circadian rhythm dysfunction in AD.


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Melatonin and bright-light treatment for rest-activity disruption in
institutionalized patients with Alzheimer's disease.

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OBJECTIVES: To test whether the addition of melatonin to bright-light therapy enhances the efficacy in treating rest-activity (circadian) disruption in institutionalized patients with Alzheimer's disease (AD).

DESIGN: Randomized, controlled trial.

SETTING: Two nursing homes in San Francisco, California.

PARTICIPANTS: Fifty subjects (mean age 86) with AD.

INTERVENTION: Experimental subjects received 1 hour of morning light exposure (> or = 2,500 lux in gaze direction) Monday to Friday for 10 weeks and 5 mg melatonin (LM, n=16) or placebo (LP, n=17) in the evening. Control subjects (n=17) received usual indoor light (150–200 lux).

MEASUREMENTS: Nighttime sleep variables, day sleep time, day activity, day:night sleep ratio, and rest-activity parameters were determined using actigraphy.

RESULTS: Linear mixed models were employed to test the primary study hypotheses. No significant differences in nighttime sleep variables were found between groups. At the end of the intervention, the LM group showed significant improvement in daytime somnolence as indicated by a reduction in the duration of daytime sleep, an increase in daytime activity, and an improvement in day:night sleep ratio. The LM group also evidenced a significant increase in rest-activity rhythm amplitude and goodness of fit to the cosinor model.

CONCLUSION: Light treatment alone did not improve nighttime sleep, daytime wake, or rest-activity rhythm. Light treatment plus melatonin increased daytime wake time and activity levels and strengthened the rest-activity rhythm. Future
studies should resolve the question of whether these improvements can be attributed to melatonin or whether the two zeitgebers interact to amplify efficacy.

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PMCID: PMC2642966
PMID: 18070004 [Indexed for MEDLINE]


Melatonin and circadian rhythms in autism: Case report.

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Among the most co-occurring conditions in autism spectrum disorders (ASD), there are sleep disorders which may exacerbate associated behavioral disorders and lead to intensification of existing autistic symptoms. Several studies investigating the use of melatonin in the treatment of sleep disorders in ASD have shown comparative efficiency in sleep with little or no side effects. Here we report a case of ASD with non-24-hour rhythm and the effect of melatonin in circadian parameters by actigraphy. Visual analysis of the first 10 days recorded and the periodogram suggest that this patient showed a non-24-hour rhythm. This ASD subject showed before melatonin administration an activity/rest rhythm lower than 24 hours. The results show that melatonin increased approximately 4.7 times the regularity of circadian activity rhythm and resting staying on average between
00:00 and 06:00 and showed positive effects in improving the quality of sleep and behavior. So, the actigraphy showed an ASD subject with a non-24-hour activity/rest rhythm which changed this rhythm to a 24-hour rhythm after melatonin administration. This result reinforces the prospect of therapy with melatonin for synchronization (increased regularity) of endogenous rhythms and improve sleep quality and hence behavior and indicates the actigraphy as a choice tool to characterize several parameters of the activity/rest rhythm of ASD individuals.

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Melatonin and cortisol in individuals with spinal cord injury.

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STUDY OBJECTIVES: The aim of this study was to investigate circadian rhythm and sleep complaints in individuals with spinal cord injury (SCI) as determined by diurnal saliva melatonin and cortisol as well as activity measurements
and subjective sleep quality.
METHODS: Fourteen patients with cervical SCI (cSCI), six patients with thoracic SCI (tSCI) and eight able-bodied controls all underwent two consecutive weeks wearing a wrist actigraph in addition to filling out a sleep diary. During one 24-h period, cortisol and melatonin were measured at 4-h intervals. Furthermore, participants' sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) and their overall daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS).
RESULTS: The cSCI group demonstrated lower melatonin levels compared with the tSCI group and the controls at the 24:00 and 04:00 time points. Moreover, at one time point the tSCI group had a higher cortisol level than the cSCI group and the controls. In addition, baseline systolic blood pressure and oxygen saturation were significantly lower in the cSCI group. No differences were found in activity measurements or self-reported sleep quality.
CONCLUSIONS: Individuals with cSCI demonstrate reduced melatonin secretion compared with tSCI individuals, but not in other circadian measures. This supports an involvement of melatonergic cervical fibers associated with the cervical lesion.

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Melatonin and zopiclone as facilitators of early circadian sleep in operational air transport crews.

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INTRODUCTION: This study was an extension into an operational setting of previous laboratory work investigating the use of zopiclone and melatonin to facilitate early circadian sleep in transport aircrew. The previous laboratory-based study demonstrated that both melatonin and zopiclone were effective in inducing early circadian sleep without impacting on psychomotor performance after a 7-h sleep period.

METHODS: In a repeated measures, placebo-controlled protocol, 30 aircrew flew 3 transatlantic missions over which they took each of the 3 medications (placebo, sustained-release melatonin 2 mg, or zopiclone 5 mg) at an early body clock time (17:00) during their first stopover. They wore wrist actigraphs prior to and throughout the missions, took a single dose of their scheduled medication immediately prior to their early circadian bedtime, and completed a sleep questionnaire on arising from their medicated sleep.

RESULTS: The results of the actigraphic data show that relative to placebo, aircrew on melatonin and zopiclone fell asleep more quickly (melatonin: \( p < 0.01 \), zopiclone: \( p < 0.003 \)), slept more (melatonin: \( p < 0.02 \), zopiclone: \( p < 0.005 \)), had fewer awakenings after sleep onset (melatonin: \( p < 0.004 \), zopiclone: \( p < 0.01 \)), and spent less time awake after sleep onset (melatonin: \( p < 0.01 \), zopiclone: \( p < 0.05 \)). The results of the questionnaire data show that relative to placebo, aircrew on melatonin and zopiclone experienced less difficulty getting to sleep (melatonin: \( p < 0.0001 \), zopiclone: \( p < 0.001 \)), had fewer awakenings (melatonin: \( p < 0.005 \), zopiclone: \( p < 0.001 \)), less difficulty returning to sleep after awakening (melatonin: \( p < 0.0001 \), zopiclone: \( p < 0.0001 \)), and reported a better sleep quality (melatonin: \( p < 0.0003 \), zopiclone: \( p < 0.0004 \)). There were no statistically significant differences between melatonin and
zopiclone in any of the actigraphic or questionnaire sleep parameters.
CONCLUSIONS: Melatonin and zopiclone, in the dosages we used, are equipotent facilitators of early circadian sleep during transmeridian air transport operations.

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Melatonin dysregulation, sleep disturbances and fatigue in multiple sclerosis.

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BACKGROUND: Sleep disruption and fatigue are common in Multiple Sclerosis (MS). Melatonin is one of the major regulators of sleep-wake cycle. The role of melatonin in MS-related sleep disturbances and fatigue as well as the interaction between melatonin and Interferon beta (IFN-β) treatment were the subject of this study.

OBJECTIVE: To assess the influence of IFN-β treatment on melatonin secretion, fatigue and sleep characteristics in patients with MS.

METHODS: 13 MS patients and 12 healthy controls participated. Fatigue was evaluated using the Fatigue Impact Scale (FIS), sleep was assessed by actigraphy and day/night levels of 6-sulphatoxy-melatonin (6-SMT) in urine were determined using a highly specific ELISA assay.

RESULTS: Naïve MS patients demonstrated significantly decreased levels of 6-SMT and disrupted circadian regulation of its secretion, which were increased with IFN-β treatment, in association with improved fatigue. Sleep
Efficiency was significantly lower in the MS group compared to controls. CONCLUSION: Our findings suggest dysregulation of Melatonin secretion in MS, which may be influenced by IFN-β treatment. The results call for further characterization of the role of neuro-hormones such as melatonin in MS, and their cross-regulation with immune-mediators.

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Melatonin fails to improve sleep or agitation in double-blind randomized placebo-controlled trial of institutionalized patients with Alzheimer disease.

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OBJECTIVES: Patients with Alzheimer dementia often display both agitated behavior and poor sleep. Given that the disease is often associated with low endogenous levels of melatonin, exogenous melatonin administration may lead to improvements in sleep and agitation.

DESIGN: Randomized, placebo-controlled study.

SETTING: Nursing homes in San Diego, CA, metropolitan area.

PARTICIPANTS: Subjects were patients with probable Alzheimer disease.

INTERVENTION: Melatonin (8.5 mg immediate release and 1.5 mg sustained release) (N = 24) or placebo (N = 17) administered at 10:00 P.M. for 10 consecutive nights. The protocol consisted of baseline (3 days), treatment (10 days), and posttreatment (5 days) phases.

MEASUREMENTS: Sleep was measured continuously using actigraphy.
Agitation was rated using both the Agitated Behavior Rating Scale and the Cohen-Mansfield Agitation Inventory. Treatment effects were examined both across the 24-hr day and separately by nursing shift.

RESULTS: There were no significant effects of melatonin, compared with placebo, on sleep, circadian rhythms, or agitation.

CONCLUSION: This study failed to find a beneficial effect of exogenous melatonin, consistent with a number of other studies. The lack of efficacy may be related to the absence of a true treatment effect or to the superphysiologic dose of melatonin used.

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Melatonin for sleep disturbances in Parkinson's disease.

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BACKGROUND AND PURPOSE: Many patients with Parkinson's disease (PD) experience sleep-related symptoms. Studies in other populations indicate that melatonin can increase sleep efficiency, decrease nighttime activity, and shorten sleep latency, but there has been little research on the use of melatonin in PD. The purpose of this study was to compare the effects of two doses of melatonin to placebo on sleep, daytime sleepiness, and level of function in patients with PD who complained of sleep disturbances.

PATIENTS AND METHODS: A multi-site double-blind placebo-controlled cross-over trial was employed; 40 subjects completed the 10-week protocol. There was a
2-week screening period, 2-week treatment periods, and 1-week washouts between treatments. Nocturnal sleep was assessed by actigraphy and diaries, whereas daytime sleepiness and function were assessed by the Epworth Sleepiness Scale (ESS), Stanford Sleepiness Scale (SSS), and General Sleep Disturbance Scale (GSDS).

RESULTS: Repeated measures analysis of variance revealed a significant improvement in total nighttime sleep time during the 50 mg melatonin treatment compared to placebo. There was significant improvement in subjective sleep disturbance, sleep quantity, and daytime sleepiness during the 5 mg melatonin treatment compared to placebo as assessed by the GSDS.

CONCLUSIONS: Although we found a statistically significant improvement in actigraphically measured total sleep time on 50 mg melatonin compared to 5 mg or placebo, this small improvement (10 min) may not be clinically significant. However, the significant improvement found in subjective sleep disturbance suggests that these modest effects may be clinically relevant in this patient population.

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Melatonin improves sleep and reduces nitrite in the exhaled breath condensate in cystic fibrosis—a randomized, double-blind placebo-controlled study.

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Cystic fibrosis (CF) is a chronic progressive disorder characterized by repeated
episodes of respiratory infection. Impaired sleep is common in CF leading to reduced quality of life. Melatonin, a secretory product of the pineal gland, has an important function in the synchronization of circadian rhythms, including the sleep-wake cycle, and has been shown to possess significant anti-oxidant properties. To evaluate the effects of exogenous melatonin on sleep and inflammation and oxidative stress markers in CF, a randomized double-blind, placebo-controlled study initially involving 20 patients with CF was conducted. One individual failed to conclude the study. All subjects were clinically stable when studied and without recent infectious exacerbation or hospitalization in the last 30 days. Groups were randomized for placebo (n = 10; mean age 12.1 +/- 6.0) or 3 mg melatonin (n = 9; mean age 16.6 +/- 8.26) for 21 days. Actigraphy was performed for 6 days before the start of medication and in the third week (days 14-20) of treatment. Isoprostane and nitrite levels were determined in exhaled breath condensate (EBC) at baseline (day 0) and after treatment (day 21). Melatonin improved sleep efficiency (P = 0.01) and tended to improve sleep latency (P = 0.08). Melatonin reduced EBC nitrite (P = 0.01) but not isoprostane. In summary, melatonin administration reduces nitrite levels in EBC and improves sleep measures in clinically stable CF patients. The failure of melatonin to reduce isoprostane levels may have been a result of the low dose of melatonin used as a treatment.

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Melatonin phase-shifts human circadian rhythms with no evidence of changes in the duration of endogenous melatonin secretion or the 24-hour production of
reproductive hormones.

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Erratum in
J Clin Endocrinol Metab. 2004 Jun;89(6):2997.

The pineal hormone melatonin is a popular treatment for sleep and circadian rhythm disruption. Melatonin administered at optimal times of the day for treatment often results in a prolonged melatonin profile. In photoperiodic (day length–dependent) species, changes in melatonin profile duration influence the timing of seasonal rhythms. We investigated the effects of an artificially prolonged melatonin profile on endogenous melatonin and cortisol rhythms, wrist actigraphy, and reproductive hormones in humans. Eight healthy men took part in this double-blind, crossover study. Surge/sustained release melatonin (1.5 mg) or placebo was administered for 8 d at the beginning of a 16-h sleep opportunity (1600 h to 0800 h) in dim light. Compared with placebo, melatonin administration advanced the timing of endogenous melatonin and cortisol rhythms. Activity was reduced in the first half and increased in the second half of the sleep opportunity with melatonin; however, total activity during the sleep opportunities and wake episodes was not affected. Melatonin treatment did not affect the endogenous melatonin profile duration, pituitary/gonadal hormone levels (24-h), or sleepiness and mood levels on the subsequent day. In the short term, suitably timed sustained-release melatonin phase-shifts circadian rhythms and redistributes activity during a 16-h sleep opportunity, with no evidence of changes in the duration of endogenous melatonin secretion or pituitary/gonadal
Melatonin secretion rhythm disorders in patients with senile dementia of Alzheimer's type with disturbed sleep-waking.

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BACKGROUND: There is growing evidence that the dysregulation of circadian rhythms may play an important role in irregular sleep-waking in demented elderly. In this study, we investigated daily variation of the pineal hormone melatonin, which has been reported to possess hypnogenic and synchronizing effects, in patients with senile dementia of Alzheimer's type.

METHODS: Serum melatonin secretion rhythms in inpatients with senile dementia of Alzheimer's type (SDAT group, n = 10, average age = 75.7 years) with disturbed sleep-waking and nondemented elderly (ND group, n = 10, age = 78.3 years) without clinical sleep disorders in the same facility were monitored under a dim light condition without excessive physical exercise.

RESULTS: The SDAT group showed a significantly higher degree of irregularities in actigraphically recorded rest-activity (R-A) rhythm during the 7-day baseline period compared with the ND group. The SDAT group simultaneously showed significantly reduced amplitude, larger variation of peak times, and diminished amount of total secretion in the melatonin secretion rhythm compared with the ND group. There were significantly positive correlations between the severity of R-A rhythm disorder and the reduced amplitude as well as diminished amount of total
melatonin secretion. CONCLUSIONS: The SDAT patients with disturbed sleep-waking possessed melatonin secretion rhythm disorders that may play an important role in irregular sleep-waking in demented elderly.

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Melatonin, sleep, and shift work adaptation.

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BACKGROUND: Night work is associated with disrupted circadian rhythms, fatigue, accidents, and chronic disease. Melatonin secretion helps regulate sleep and circadian rhythms.

OBJECTIVE: Melatonin, sleep disturbances, and symptoms (sleep, fatigue, mental) were compared among workers on permanent day, swing, and night shifts.

METHODS: Urinary 6-hydroxymelatonin sulfate (6-OHMS) was measured in postwork and postsleep samples. Disrupted circadian melatonin production was evaluated using the sleep:work 6-OHMS ratio. Wrist actigraphy characterized light exposures and sleep characteristics.

RESULTS: Night workers had altered melatonin, disrupted sleep, and elevated symptom prevalence. Subjects grouped by their sleep:work 6-OHMS ratio rather than shift had even greater symptom prevalence. Risks for two or more symptoms were 3.5 to 8 times greater among workers with sleep:work ratios < or =1 compared to those with ratios >1.

CONCLUSIONS: This ratio may help identify workers at increased risk for accidents or injuries.
INTRODUCTION: Sleep disturbances are common in critically ill patients and when sleep does occur it traverses the day-night periods. The reduction in plasma melatonin levels and loss of circadian rhythm observed in critically ill patients receiving mechanical ventilation may contribute to this irregular sleep-wake pattern. We sought to evaluate the effect of exogenous melatonin on nocturnal sleep quantity in these patients and, furthermore, to describe the kinetics of melatonin after oral administration in this patient population, thereby guiding future dosing schedules.

METHODS: We conducted a randomised double-blind placebo-controlled trial in 24 patients who had undergone a tracheostomy to aid weaning from mechanical ventilation. Oral melatonin 10 mg or placebo was administered at 9 p.m. for four nights. Nocturnal sleep was monitored using the bispectral index (BIS) and was expressed in terms of sleep efficiency index (SEI) and area under the curve (AUC). Secondary endpoints were SEI measured by actigraphy and nurse and patient assessments. Plasma melatonin concentrations were measured in nine patients in the melatonin group on the first night.
RESULTS: Nocturnal sleep time was 2.5 hours in the placebo group (mean SEI = 0.26, 95% confidence interval [CI] 0.17 to 0.36). Melatonin use was associated with a 1-hour increase in nocturnal sleep (SEI difference = 0.12, 95% CI −0.02 to 0.27; P = 0.09) and a decrease in BIS AUC indicating 'better' sleep (AUC difference = −54.23, 95% CI −104.47 to −3.98; P = 0.04). Results from the additional sleep measurement methods were inconclusive. Melatonin appeared to be rapidly absorbed from the oral solution, producing higher plasma concentrations relative to similar doses reported in healthy individuals. Plasma concentrations declined biexponentially, but morning (8 a.m.) plasma levels remained supraphysiological.

CONCLUSION: In our patients, nocturnal sleep quantity was severely compromised and melatonin use was associated with increased nocturnal sleep efficiency. Although these promising findings need to be confirmed by a larger randomised clinical trial, they do suggest a possible future role for melatonin in the routine care of critically ill patients. Our pharmacokinetic analysis suggests that the 10-mg dose used in this study is too high in these patients and may lead to carryover of effects into the next morning. Reduced doses of 1 to 2 mg could be used in future studies.

TRIAL REGISTRATION: Current Controlled Trials ISRCTN47578325.

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Melatonin treatment for circadian rhythm sleep disorders.

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We administered 1-3 mg melatonin to 11 patients (eight men, three women, aged 16-46 years) with circadian rhythm sleep disorders; nine with delayed sleep phase syndrome and two with non-24-hour sleep-wake syndrome. Sleep logs were recorded throughout the study periods and actigraph and rectal temperature were monitored during treatment periods. Melatonin was administered 1-2 h before the desirable bedtime for expected phase-shifting, or 0.5-1 h before habitual bedtime for gradual advance expecting an hypnotic effect of the melatonin. Melatonin treatments were successful in 6/11 patients. Timing and dose of melatonin administration, together with its pharmacological properties for circadian rhythm sleep disorders, should be further studied.

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Menopausal hot flashes and the default mode network.

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OBJECTIVE: To test whether more physiologically assessed hot flashes were associated with more connectivity in the default mode network (DMN), the network of brain regions active during rest. We particularly focus on DMN networks supporting the hippocampus as this region is rich in estrogen (E) receptors (ER) and has previously been linked to hot flashes.

DESIGN: Women underwent 24 hours of physiologic and diary hot flash monitoring, functional magnetic resonance imaging (MRI), 72 hours of sleep actigraphy monitoring, a blood draw, questionnaires, and physical measures.

SETTING: University medical center.

PATIENT(S): Twenty midlife women aged 40–60 years who had their uterus and both ovaries and were not taking hormone therapy (HT).

INTERVENTION(S): None.

MAIN OUTCOME MEASURE(S): The DMN functional connectivity.

RESULT(S): Controlling for age, race, and education, more physiologically-monitored hot flashes were associated with greater DMN connectivity (beta, B [SE] = 0.004 [0.002]), particularly hippocampal DMN connectivity (B [SE] = 0.005 [0.002]). Findings were most pronounced for sleep physiologic hot flashes (with hippocampal DMN, B [SE] = 0.02 [0.007]). Associations also persisted controlling for sleep, depressive symptoms, and serum E2 concentrations.

CONCLUSION(S): More physiologically-monitored hot flashes were associated with more DMN connectivity, particularly networks supporting the hippocampus. Findings were most pronounced for sleep hot flashes. Findings underscore the importance of continued investigation of the central nervous system in efforts to understand this classic menopausal phenomenon.

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Metabolic syndrome and actigraphy measures of sleep and circadian rhythms in bipolar disorders during remission.


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OBJECTIVE: This study explored the correlations between sleep and circadian rhythm measures and the metabolic syndrome (MetS) components in remitted patients with bipolar disorder (BD).

METHOD: Euthymic patients with BD (n = 67) were recorded by 3 weeks with actigraphy. We used nonparametric correlations to study the links between the MetS parameters, atherogenic index of plasma (AIP), sleep efficacy, sleep latency, fragmentation index, and phase and amplitude of rhythms. We performed multivariable analyses to take into account potential confounding factors such as sleep apnea risk, antipsychotics use, and smoker status.

RESULTS: We found correlations between lower sleep efficiency and higher triglyceride levels (P = 0.002), lower M10 onset (beginning of the 10 most active
hours during the 24-h cycle) and higher systolic blood pressure (P = 0.03),
higher fragmentation index and higher systolic blood pressure (P = 0.009), lower
sleep efficiency, higher fragmentation index, and higher AIP
(respectively P = 0.02 and P = 0.04). These correlations mostly remained significant
when adjusting
for confounders, with the exception of M10 onset and systolic blood pressure.
CONCLUSION: Sleep efficiency and fragmentation index might contribute to the
cardiovascular risk of patients with BD independently of major confounding
factors. Although these associations did not imply causality, proposing
interventions on sleep quality and circadian rhythm regularity might contribute
to reduce cardiovascular risk in patients with BD.

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Methodological challenges when using actigraphy in research.

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Actigraphy has become a valuable clinical and research tool to
objectively evaluate sleep, daytime activity, and circadian activity rhythms in healthy
individuals as well as persons with primary and comorbid insomnia. However,
procedures used for sampling, data processing, and analysis are not consistently
reported in the literature. The wide variability in how actigraphy is reported
makes it difficult to compare findings across studies. The procedures
and reporting methods from 21 studies that used actigraphs to assess sleep and wake in adult patients with cancer are reviewed to highlight the differences in reporting strategies. Patients with cancer were chosen to illustrate the methodological challenges related to procedures and reporting in one population. The aim of this article was to advance standards of information presented in publications to enable comparisons across research studies that use actigraphy. Specific methodological challenges when using actigraphy in research include instrumentation, selection of pertinent variables, sampling, and data processing and analysis. Procedural decisions are outlined and discussed, and suggestions are made for standardized actigraphy information to include in research reports. More consistent procedures and reporting will advance the science of sleep, daytime activity, and circadian activity rhythms and their association with other health-related variables.

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Methodological issues for studying the rest-activity cycle and sleep disturbances: a chronobiological approach using actigraphy data.

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Shift work schedules, intensive physical exercise late in the day, psychological stress, or a busy lifestyle might induce disorders of the circadian structure,
which can affect health on both the physiological and neurobehavioral levels. Rest-activity rhythm is strongly connected with an organism's circadian structure, and irregular sleep-wake patterns can lead to a disruption of entrainment, resulting in physiological and neurobehavioral dysfunction. Shift nurses are often subject to disturbances in the quality and duration of their sleep, raising the possibility of negative impacts on their health and their patients' safety. Researchers have used actigraphy in a number of studies to assess sleep patterns. Because of the close connection between sleep and circadian structure, it may be useful to extend the evaluation of actigraphy data to the analysis of the rest-activity rhythm with rhythmometric procedures to provide a better understanding of possible sleep disorders in relation to entrainment. Actigraphy is an easy and reliable way to study these rhythms and identify possible circadian-rhythm disorders. In this article, the authors discuss methodological issues concerning the evaluation of the rest-activity rhythm, with a focus on actigraphy.

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A methodology for the real-time measurement of distal extremity temperature.

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The real-time measurement of distal extremity temperature may have a wide variety of uses, from assessing occupational cold exposure to determining the impact of
autonomic dysfunction on normal thermoregulation. In this study, we
describe a novel approach to the measurement of this physiologic parameter by the
use of datalogger iButtons affixed to the foot and outer clothing, the latter serving as
an approximate measure of ambient temperature, in conjunction with the
measurement of foot movement via actigraphy. This approach was piloted in 20
individuals, all of whom were also requested to maintain a diary of activities
during the measurement period. The technique was found to be reliable and well
tolerated amongst the group of subjects, with no individual suffering an adverse
reaction (e.g. skin breakdown) while wearing the device. However, periods of
ambient temperature data were suspect in at least 25% of the recordings,
presumably due to misplacement of the sensor. Several approaches to
data analysis suggested themselves, including separate analysis of the nocturnal/
sleep and awake data sets. The use of datalogger iButtons in conjunction with
actigraphy appears to be a potential useful approach for the acquisition of real-
time distal extremity temperature and movement data and has the potential of
serving a variety of clinical and research purposes.

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Mindfulness meditation training to reduce symptom distress in transplant
patients: rationale, design, and experience with a recycled waitlist.

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BACKGROUND: Solid organ transplant recipients must take immune
suppressive medications that have side effects, cause complications, and lead to distressing symptoms that reduce health-related quality of life (QOL). Mindfulness meditation has been shown to reduce these symptoms in other patient populations, and it is unlikely to interfere with the immune suppressive medication regimen. PURPOSE: This article describes the design and rationale of a clinical trial to determine whether training in mindfulness meditation can reduce depression, anxiety and insomnia after transplantation, and summarizes baseline characteristics of the participants. METHODS: Transplant recipients were randomized in equal numbers to one of three arms: a Mindfulness-based Stress Reduction (MBSR) program consisting of 8 weeks of group instruction, home practice and telephone monitoring; a time and attention control Health Education program; or a waitlist arm. After serving 6 months as waitlist controls, these participants were re-randomized to MBSR or Health Education. Evaluations were obtained at baseline (prior to the active interventions), 8 weeks, 6 months, and 1 year (after randomization to MBSR or Health Education only). The primary analysis will compare composite symptom scores between MBSR and Health Education, initially or after serving in the waitlist. Subsequent analyses will compare these two groups on depression, anxiety, and insomnia symptom scales and secondary outcomes of health-related QOL, actigraphy, and health care utilization. A separate analysis, using only data collected before re-randomization, will compare short-term outcomes between the waitlist and active treatment arms. RESULTS: One hundred fifty recipients were randomized and 72% of waitlist participants (31/43) were recycled to an active intervention after 6 months. Patient characteristics were balanced across trial arms after initial and secondary randomizations. LIMITATIONS: Transplant recipients are a very select population. Their adherence
to the intervention and willingness to serve as waitlist controls prior to re-randomization may be atypical. Participants were not blinded to treatment and primary outcomes are self-reports.

CONCLUSION: The innovative design used in the trial enabled the waitlist group to directly contribute to the number in the primary analysis of active arms, and to also serve as an internal validation test. The trial may be a useful model for trials involving very small target populations.

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Minimum duration of actigraphy-defined nocturnal awakenings necessary for morning recall.

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BACKGROUND: Healthy adults awaken between each sleep cycle approximately 5 times each night but generally do not remember all of these awakenings in the morning. A rule of thumb has arisen in the sleep field that approximately 5 min of continuous wakefulness are required to form a memory for an awakening. However, few studies have examined memory for these sleep-wake transitions and none have done so in the home, while participants follow their normal routine.

METHODS: Self-report and actigraphy were used in the participant's home environment to determine the minimum duration of an awakening necessary for morning recall for each of the 39 healthy adults.

RESULTS: Recall thresholds ranged from 30 to 600 s with a mean of 259
s (4 min 19 s) and were negatively associated with sleep efficiency but not significantly associated with total sleep time, age, income, or education. There also was a sex by cohabitation interaction, with single men having lower thresholds than single women and cohabiting participants, which was explained by higher sleep efficiency in noncohabitating men. Large individual differences suggest that many factors may influence recall threshold.

CONCLUSIONS: Our preliminary study is the first to calculate the duration of wakefulness necessary for morning recall of nocturnal awakenings and the first to use a field-based design, allowing for the study of habitual sleep patterns at the participant's home. Further study is needed to explore if recall thresholds calculated using actigraphy can be validated against polysomnography (PSG) or be used to guide potential treatments.

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Mirtazapine does not improve sleep disorders in Alzheimer's disease: results from a double-blind, placebo-controlled pilot study.

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AIM: The aim of this study was to test the efficacy and safety of mirtazapine in the treatment of sleep disorders in patients with Alzheimer's disease by means of a randomized, double-blind, placebo-controlled trial. Measurements were obtained for 7 days before intervention (baseline) and for 2 weeks after the onset of treatment.

METHODS: Alzheimer's disease patients with sleep disorders (n = 24) received 15-mg mirtazapine (n = 8) or placebo (n = 16) once daily at 2100 hours for 2 weeks. Patients were evaluated with actigraphy and structured scales before and after intervention. Historical control was employed.

RESULTS: Treatment with mirtazapine or placebo had no effect on cognitive and functional status as assessed by the Mini-Mental State Examination and the Katz scale, respectively. There were no differences between groups in the frequency or severity of the adverse events reported. Compared with the placebo group, mirtazapine users showed increased daytime sleepiness but no improvement in the duration or efficiency of nocturnal sleep after treatment.

CONCLUSIONS: This study showed no significant therapeutic effects of 15-mg mirtazapine in community-dwelling Alzheimer's disease patients with sleep disorders. Instead, this study found evidence of worsening of daytime sleep patterns.


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shift work nurses.

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Circadian rhythms greatly influence 24-h variation in cognition in
nearly all
organisms, including humans. Circadian clock impairment and sleep
disruption are
detrimental to hippocampus-dependent memory and negatively influence the
acquisition and recall of learned behaviors. The circadian clock can become out
of sync with the environment during circadian misalignment. Shift work
represents a real-world model of circadian misalignment that can be studied for its
physiological implications. The present study aimed to test the hypothesis that
circadian misalignment disrupts vigilance and cognitive performance on
occupationally relevant tasks using shift work as a model. As such, we sought to
(1) explore the general effects of night- and day-shift worker
schedules on
sleep-wake parameters and core body temperature (CBT) phase, and (2)
determine
whether shift-type and CBT phase impact cognitive performance and
vigilance at
the end of a 12-h shift. We observed a sample of day-shift and night-shift
hospital nurses over a 10-day period. At the end of three, consecutive, 12-h shifts (7 pm-7am or 7am-7 pm), participants completed a cognitive battery assessing vigilance, cognitive throughput, and medication calculation fluency (via an investigator developed and tested metric). Night-shift nurses exhibited significantly greater sleep fragmentation as well as a greater disparity between their wake-time and time of CBT minimum compared to day-shift nurses. Night-shift nurses exhibited significantly slower cognitive proficiency at the end of their shifts, even after adjustment for CBT phase. These results suggest that circadian disruption and reduced sleep quality both contribute to cognitive functioning and performance.

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Misdiagnosis of narcolepsy.

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Comment in
BACKGROUND: Narcolepsy is a chronic primary sleep disorder, characterized by excessive daytime sleepiness and sleep dysfunction with or without cataplexy. Narcolepsy is uncommon, with a low prevalence rate which makes it difficult to diagnose definitively without a complex series of tests and a detailed history. The aim of this study was to review patients referred to a tertiary sleep centre who had been labelled with a diagnosis of narcolepsy prior to referral in order to assess if the diagnosis was accurate, and if not, to determine the cause of diagnostic misattribution.

METHODS: All patients seen at a sleep centre from 2007-2013 (n = 551) who underwent detailed objective testing including an MSLT PSG, as well as wearing an actigraphy watch and completing a sleep diary for 2 weeks, were assessed for a pre-referral and final diagnosis of narcolepsy.

RESULTS: Of the 41 directly referred patients with a diagnostic label of narcolepsy, 19 (46%) were subsequently confirmed to have narcolepsy on objective testing and assessment by a sleep physician using ICSD-2 criteria.

CONCLUSIONS: The diagnosis of narcolepsy was incorrectly attributed to almost 50% of patients labelled with a diagnosis of narcolepsy who were referred for further opinion by a variety of specialists and generalists. Accurate diagnosis of narcolepsy is critical for many reasons, such as the impact it has on quality of life, driving, employment, insurance and pregnancy in women as well as medication management.

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Conflict of interest statement: Compliance with ethical standards Funding No funding was received for this research. Conflict of interest All authors certify that they have no affiliations or involvement with any organization or
entity with any financial interest (such as honoraria; educational grants; participation in speakers’ bureaus; membership, employment, consultancies, stock ownership or other equity interest; and exert testimony or patent-licensing arrangements) or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript. Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent This study does not have any informed consent. Authors’ contributions Laura Dunne did the writing, analysis and primary data collection. Pallavi Patel and Emily L Maschauer did the writing and editing. Ian Morrison did the writing, editing and design. Renata Riha did the design, analysis, writing and editing. Disclosures Laura Dunne, Pallavi Patel, Emily L Maschauer, Ian Morrison and Renata Riha report no disclosures with respect to this study.


Mitigating and monitoring flight crew fatigue on a westward ultra-long-range flight.

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BACKGROUND: This study examined the uptake and effectiveness of fatigue mitigation guidance material including sleep recommendations for a trip with a westward ultra-long-range flight and return long-range flight.
METHODS: There were 52 flight crew (4-pilot crews, mean age 55 yr) who completed a sleep/duty diary and wore an actigraph prior to, during, and after the trip. Primary crew flew the takeoff and landing, while relief crew flew the aircraft during the Primary crew's breaks. At key times in flight, crewmembers rated their fatigue (Samn–Perelli fatigue scale) and sleepiness (Karolinska Sleepiness Scale) and completed a 5-min Psychomotor Vigilance Task.

RESULTS: Napping was common prior to the outbound flight (54%) and did not affect the quantity or quality of in-flight sleep (mean 4.3 h). Primary crew obtained a similar amount on the inbound flight (mean 4.0 h), but Secondary crew had less sleep (mean 2.9 h). Subjective fatigue and sleepiness increased and performance slowed across flights. Performance was faster on the outbound than inbound flight. On both flights, Primary crew were less fatigued and sleepy than Secondary crew, particularly at top of descent and after landing. Crewmembers slept more frequently and had more sleep in the first 24 h of the layover than the last, and had shifted their main sleep to the local night by the second night.

DISCUSSION: The suggested sleep mitigations were employed by the majority of crewmembers. Fatigue levels were no worse on the outbound ultra-long-range flight than on the return long-range flight.

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Moderate Changes in the Circadian System of Alzheimer's Disease Patients Detected in Their Home Environment.

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Alzheimer's disease (AD) is a neurodegenerative disease often accompanied with disruption of sleep-wake cycle. The sleep-wake cycle is controlled by mechanisms involving internal timekeeping (circadian) regulation. The aim of our present pilot study was to assess the circadian system in patients with mild form of AD in their home environment. In the study, 13 elderly AD patients and 13 age-matched healthy control subjects (the patient's spouses) were enrolled. Sleep was recorded for 21 days by sleep diaries in all participants and checked by actigraphy in 4 of the AD patient/control couples. The samples of saliva and buccal mucosa were collected every 4 hours during the same 24 h-interval to detect melatonin and clock gene (PER1 and BMAL1) mRNA levels, respectively. The AD patients exhibited significantly longer inactivity interval during the 24 h and significantly higher number of daytime naps than controls. Daily profiles of melatonin levels exhibited circadian rhythms in both groups. Compared with controls, decline in amplitude of the melatonin rhythm in AD patients was not significant, however, in AD patients more melatonin profiles were dampened or had atypical waveforms. The clock genes PER1 and BMAL1 were expressed rhythmically with high amplitudes in both groups and no significant differences in phases between both groups were detected. Our results suggest moderate differences in functional state of the circadian system in patients with mild form of AD compared with healthy controls which are present in conditions of their home dwelling.
Moderating effect of APOE ε4 on the relationship between sleep-wake cycle and brain β-amyloid.

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OBJECTIVES: To clarify the relationships between sleep-wake cycle and cerebral β-amyloid (Aβ) deposition in cognitively normal (CN) older adults, focusing primarily on the moderating effects of the APOE ε4 allele.

METHODS: The present study included 133 CN older adults who participated in the Korean Brain Aging Study for Early Diagnosis & Prediction of Alzheimer's Disease cohort. All participants underwent [11C] Pittsburgh compound B-PET imaging to quantify Aβ deposition in the brain and blood sampling for APOE genotyping. Sleep and circadian parameters were measured using actigraphy for 8 consecutive days.

RESULTS: The APOE ε4 allele had moderating effects on the associations of sleep latency (SL), mesor, and acrophase with cerebral Aβ deposition, and the interactions between APOE ε4 status and SL and between APOE ε4 status and acrophase remained significant after adjusting for multiple comparisons. In APOE ε4 noncarriers, shorter SL, higher mesor, and advanced acrophase were associated with Aβ positivity. In contrast, APOE ε4 carriers showed a relationship between delayed acrophase and Aβ accumulation that approached but did not reach significance. After the Bonferroni correction, the associations of shorter SL and
higher mesor with Aβ positivity remained significant for APOE ε4 noncarriers.

CONCLUSIONS: Our findings suggest that the APOE ε4 allele may act as a moderator in the relationship between the sleep-wake cycle and Aβ accumulation in CN older adults. Thus, APOE ε4 status needs to be considered as a key factor when designing related research or interventions.

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Modified Children's sleep habits questionnaire for behavioral sleep problems: A validation study.

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OBJECTIVES: Behavioral sleep problems (BSPs) are prevalent and consequential in young children. There is a need for screening tools that identify BSPs—which are often rooted in the parent-young child relationship—and typically respond to behavior management. Such a tool would increase capacity to identify and treat BSPs. We sought to validate a short-form version of the widely used
Children's Sleep Habits Questionnaire (SF-CSHQ) that omitted items that would not be responsive to behavioral strategies.

METHODS: The original 33-item CSHQ elicits parent report of "behaviorally-based" and "medically-based" sleep items (eg, parasomnias and sleep disordered breathing). We conducted analyses to develop a SF-CSHQ that excludes its "medically-based" items, to determine (a) the SF-CSHQ threshold score corresponding to the full CSHQ clinical cut-off score (≥41), and (b) preliminary validity of this SF-CSHQ. Data were re-analyzed from the original data that established the CSHQ's psychometric properties in 4–10 year olds, and a second dataset that established its validity in 24–66 month olds. RESULTS: In both datasets, a threshold score of 30 had correlations of 0.90–0.94 with the original cut-off. This 23-item SF-CSHQ cut-off functioned as well as the full CSHQ cut-off in discriminating between children with vs without a parent-reported behavioral sleep problem, and with vs without prolonged sleep latency (per actigraphy).

CONCLUSION: We established preliminary validity of modified version of the widely-used CSHQ. This SF-CSHQ may be useful for widening screening and first-line guidance for behavioral sleep problems in young children, among professionals who are not sleep medicine specialists.

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Modifying the Sleep Treatment Education Program for Students to include technology use (STEPS–TECH): Intervention effects on objective and subjective
University students often have sleep issues that arise from poor sleep hygiene practices and technology use patterns. Yet, technology-related behaviors are often neglected in sleep hygiene education. This study examined whether the Sleep Treatment Education Program for Students—modified to include information regarding managing technology use (STEPS-TECH)—helps improve both subjective and objective sleep outcomes among university students. Results of an experimental study among 78 university students showed improvements in objective indicators of sleep quantity (total sleep time) and sleep quality (less awakenings) during the subsequent week for students in the STEPS-TECH intervention group compared to a control group. Exploratory analyses indicated that effects were driven by improvements in weekend days immediately following the intervention. There were also no intervention effects on subjective sleep quality or quantity outcomes. In terms of self-reported behavioral responses to educational content in the intervention, there were no group differences in sleep hygiene practices or technology use before bedtime. However, the intervention group reported less technology use during sleep periods than the control group. These preliminary findings suggest that STEPS-TECH may be a useful educational tool to help improve objective sleep and reduce technology use during sleep periods among university students.

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Molecular circadian rhythm shift due to bright light exposure before bedtime is related to subthreshold bipolarity.

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This study examined the link between circadian rhythm changes due to bright light exposure and subthreshold bipolarity. Molecular circadian rhythms, polysomnography, and actigraphy data were studied in 25 young, healthy male subjects, divided into high and low mood disorder questionnaire (MDQ) score groups. During the first 2 days of the study, the subjects were exposed to daily-living light (150 lux) for 4 hours before bedtime. Saliva and buccal cells were collected 5 times a day for 2 consecutive days. During the subsequent 5 days, the subjects were exposed to bright light (1,000 lux), and
saliva and buccal cell samples were collected in the same way. Molecular circadian rhythms were analyzed using sine regression. Circadian rhythms of cortisol (F = 16.956, p < 0.001) and relative PER1/ARNTL gene expression (F = 122.1, p < 0.001) showed a delayed acrophase in both groups after bright light exposure. The high MDQ score group showed a significant delay in acrophase compared to the low MDQ score group only in salivary cortisol (F = 8.528, p = 0.008). The high MDQ score group showed hypersensitivity in cortisol rhythm shift after bright light exposure, suggesting characteristic molecular circadian rhythm changes in the high MDQ score group may be related to biological processes downstream from core circadian clock gene expression.

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Mood and motor activity in euthymic bipolar disorder with sleep disturbance.

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(2)Department of Neuroscience, NTNU, the Norwegian University of Science and Technology, Trondheim, Norway and Department of Psychiatry, St. Olav's University Hospital, P.O. box 3008 Lade, N-7441 Trondheim, Norway.
BACKGROUND: The aims of this observational study of patients with euthymic bipolar disorder and sleep disturbance were to 1) compare characteristics related to mood and sleep between two groups with stable and unstable rest-activity cycles and 2) detect between-group differences in motor activity patterns.
METHODS: 43 patients wore an actigraph for 6-8 days while reporting daily mood and sleep. Patients were defined as having an unstable rest-activity cycle if their diurnal active period duration presented variation above 2h from the mean during one week: 22 patients had stable and 21 unstable rest-activity cycles. Mood variability was defined as at least moderate symptoms and a change across two levels on a 7-point mood scale during one week.
RESULTS: Patients with unstable rest-activity cycles were younger (37 vs. 48 years, \( p=0.01 \)) and displayed more mood variability (\( p=0.02 \)). Ten of 11 patients diagnosed with delayed sleep phase disorder were in the unstable group (\( p<0.01 \)), and the unstable group had later and more variable get-up-times and bedtimes. In actigraphy recordings, the mean activity counts per minute did not differ between groups, but the minute-to-minute variability was elevated (\( p=0.04 \)) and increased relative to the overall variability (\( p=0.03 \)).
LIMITATIONS: A relatively small study sample and a 1-week study period prevent exploration of long-term clinical implications of results.
CONCLUSIONS: A subgroup of euthymic patients with bipolar disorder displayed unstable rest-activity cycles combined with mood variability and motor activity.
patterns that resemble findings in affective episodes.

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More evening preference is positively associated with systemic inflammation in prediabetes and type 2 diabetes patients.

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Currently it is not known whether morningness–eveningness preference in non-night shift working population is associated with systemic inflammation. This study investigated the relationship between morningness–eveningness and
systemic inflammation, as measured by high-sensitivity C-reactive protein (hs-CRP) in 163 non-night shift working patients with abnormal glucose tolerance (86 type 2 diabetes and 77 prediabetes). Morningness–eveningness was assessed by Composite Scale of Morningness, and participants were screened for Obstructive sleep apnea (OSA). Sleep duration, efficiency, and variability were obtained using actigraphy, and depressive symptoms and dietary patterns were also captured. Participants' mean age was 54.7 ± 10.4 years and median hs-CRP was 1.39 (interquartile range 0.82, 3.33) mg/L. More evening preference was significantly associated with higher natural log transformed (ln) hs-CRP (B = -0.051, p = 0.001). Diabetes status, glycemic control, OSA severity, sleep duration, caloric consumption and timing were not related to hs-CRP. After adjusting for age, sex, body mass index, depressive symptoms, sleep efficiency, sleep variability, percentage of daily caloric intake from protein, and statin use, more evening preference was independently associated with higher ln hs-CRP (B = -0.032, p = 0.014). In summary, in non-night shift working patients with abnormal glucose tolerance, more evening preference was independently associated with higher systemic inflammation. This finding underscore the importance of circadian regulation on cardiovascular health.

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Morning Bright Light Treatment for Sleep-Wake Disturbances in Primary Biliary Cholangitis: A Pilot Study.

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Patients with Primary Biliary Cholangitis (PBC) exhibit delayed sleep-wake habits, disturbed night sleep and daytime sleepiness/fatigue. Such combination of symptoms is reminiscent of delayed sleep-wake phase disorder (DSPD), which benefits from morning light treatment. The aim of the present pilot study was to test the effect of morning light treatment in a group of 13 well-characterized patients with PBC [all females; (mean ± SD) 53 ± 10 years]. Six healthy individuals (4 females, 57 ± 14 years) and 7 patients with cirrhosis (1 female, 57 ± 12 years) served as controls and diseased controls, respectively. At baseline, all participants underwent an assessment of quality of life, diurnal preference, sleep quality/timing (subjective plus actigraphy), daytime sleepiness, and urinary 6-sulphatoxymelatonin (aMT6s) rhythmicity. Then they underwent a 15-day course of morning bright light treatment, immediately after getting up (light box, 10,000 lux, 45 min) whilst monitoring sleep-wake patterns and aMT6s rhythmicity. At baseline, both patients with PBC and patients with cirrhosis had significantly worse subjective sleep quality compared to controls. In patients with PBC, light treatment resulted in an improvement in subjective sleep quality and a reduction in daytime sleepiness. In addition, both their
sleep onset and get-up time were significantly advanced. Finally, the robustness of aMT6s rhythmicity (i.e., strength of the cosinor fit) increased after light administration but post-hoc comparisons were not significant in any of the groups. In conclusion, a brief course of morning bright light treatment had positive effects on subjective sleep quality, daytime sleepiness, and sleep timing in patients with PBC. This unobtrusive, side-effect free, non-pharmacological treatment is worthy of further study.

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Morning Circadian Misalignment Is Associated With Insulin Resistance in Girls With Obesity and Polycystic Ovarian Syndrome.


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CONTEXT: To our knowledge, circadian rhythms have not been examined in girls with polycystic ovarian syndrome (PCOS), despite the typical delayed circadian timing of adolescence, which is an emerging link between circadian health and insulin sensitivity (SI), and decreased SI in PCOS.

OBJECTIVE: To examine differences in the circadian melatonin rhythm between obese adolescent girls with PCOS and control subjects, and evaluate relationships between circadian variables and SI.

DESIGN: Cross-sectional study.

PARTICIPANTS: Obese adolescent girls with PCOS (n = 59) or without PCOS (n = 33).

OUTCOME MEASURES: Estimated sleep duration and timing from home actigraphy monitoring, in-laboratory hourly sampled dim-light, salivary-melatonin and fasting hormone analysis.

RESULTS: All participants obtained insufficient sleep. Girls with PCOS had later clock-hour of melatonin offset, later melatonin offset relative to sleep timing, and longer duration of melatonin secretion than control subjects. A later melatonin offset after wake time (i.e., morning wakefulness occurring during the biological night) was associated with higher serum free testosterone levels and worse SI regardless of group. Analyses remained significant after controlling for daytime sleepiness and sleep-disordered breathing.

CONCLUSION: Circadian misalignment in girls with PCOS is characterized by later melatonin offset relative to clock time and sleep timing. Morning circadian misalignment was associated with metabolic dysregulation in girls with PCOS and obesity. Clinical care of girls with PCOS and obesity would benefit from assessment of sleep and circadian health. Additional research is needed to
understand mechanisms underlying the relationship between morning circadian misalignment and SI in this population.

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Morning melatonin has limited benefit as a soporific for daytime sleep after night work.

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Exogenous melatonin administration in humans is known to exert both chronobiotic (phase shifting) and soporific effects. In a previous study in our lab, young, healthy, subjects worked five consecutive simulated night shifts (23:00 to 07:00 h) and slept during the day (08:30 to 15:30 h). Large phase delays of various magnitudes were produced by the study interventions, which included bright light exposure during the night shifts, as assessed by the dim light melatonin onset (DLMO) before (baseline) and after (final) the five night shifts. Subjects also ingested either 1.8 mg sustained-release melatonin or placebo before daytime sleep. Although melatonin at this time should delay the circadian clock, this previous study found that it did not increase the magnitude of phase delays. To determine whether melatonin had a soporific effect, we controlled the various magnitudes of phase delay produced by the other study interventions. Melatonin (n=18) and placebo (n=18) groups were formed by matching a melatonin participant
with a placebo participant that had a similar baseline and final DLMO (+/-1 h).
Sleep log measurements of total sleep time (TST) and actigraphic measurements of sleep latency, TST, and three movement indices for the two groups were examined.
Although melatonin was associated with small improvements in sleep quality and quantity, the differences were not statistically significant by analysis of variance. However, binomial analysis indicated that melatonin participants were more likely to sleep better than their placebo counterparts on some days with some measures. It was concluded that, the soporific effect of melatonin is small when administered prior to 7 h daytime sleep periods following night shift work.

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Morningness–eveningness scores predict outcomes differentially for depressed patients attending morning vs. afternoon day treatment streams.


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At the Center for Addiction and Mental Health (CAMH) Integrated Day Treatment (IDT) program, each patient attends either a morning stream or an afternoon stream, but not both. We examined whether subjective chronotype, or the time of day an individual prefers to be most active and alert, predicted
treatment outcomes differentially in depressed patients attending the morning vs. afternoon IDT streams. The Horne-Östberg Morningness-Eveningness Questionnaire (MEQ) was administered before IDT treatment to 203 consecutive patients experiencing a major depressive episode. Multiple regression was used to predict change in depression and quality of life scores based on treatment stream (morning or afternoon), baseline MEQ scores and the treatment stream by MEQ interaction. The treatment stream by MEQ interaction was a highly significant predictor of both depression and quality of life change scores. Post-hoc analyses based on established MEQ categories revealed that definite evening chronotypes had significantly better responses in the morning stream than did morning chronotypes, and significantly worse responses in the afternoon stream relative to moderate evening or neutral chronotypes. There were insufficient morning chronotypes in the afternoon stream to assess clinical responses for this subgroup. In the morning stream only, there was a significant positive correlation between the change in MEQ scores after four weeks of IDT treatment (i.e. a shift to greater morningness) and the decrease in depression scores ($r = .36, p = .003$), consistent with a therapeutic phase advance in circadian rhythms. In sum, these preliminary data suggest that definite evening chronotypes may have the greatest relative benefit from attending the morning vs. afternoon IDT stream. As patients currently select which IDT stream they will attend, future work based on randomized treatment assignment and using passive actigraphy to assess circadian phase is currently planned to extend these preliminary findings.

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PMID: 31495294

OBJECTIVE: Entrainment to the day-night cycle is critical for infant sleep and social development. Synchronization of infant circadian systems with the social 24-hr day may require maternal activity signals as an entraining cue. This descriptive and exploratory research examines the activity level and circadian pattern in mothers and infants.

METHOD: Twenty-two healthy mothers and their infants (postnatal age 49.8 ± 17.1 days) wore actigraph monitors for seven days. Daytime (06:00-21:59) and nighttime (22:00-05:59) activity levels and circadian parameters of rest-activity patterns (i.e., mesor, amplitude, acrophase, and 24-hr cosinor fit) were calculated.

RESULTS: Mothers and infants were significantly more active during the day than at night. The goodness-of-fit index for the model (R2) indicates that circadian rhythm accounted for a mean of 29 ± 10% and 12 ± 8% of the variability in maternal and infant activity, respectively. Acrophase of activity occurred at 15:46 ± 1:07 for the mothers and 15:20 ± 1:21 for the infants. The mean within-dyad correlation of activity counts was r = .46 ± .11, and the within-dyad correlation was associated with the amplitude (r = .66, p < .01) and 24-hr cosinor fit of infant activity (r = .67, p < .01).

CONCLUSIONS: Our findings suggest maternal rhythms as a possible exogenous influence on shaping an infant's emerging rhythms and synchronizing them with the
external light–dark cycle. Strong pattern synchrony between maternal and infant activity may support infant circadian entrainment and enhance a regular 24-hr sleep–wake schedule during the early postnatal weeks.

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Mother–infant circadian rhythm: development of individual patterns and dyadic synchrony.

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BACKGROUND: Mutual circadian rhythm is an early and essential component in the development of maternal–infant physiological synchrony.
AIMS: The aim of this to examine the longitudinal pattern of maternal–infant circadian rhythm and rhythm synchrony as measured by rhythm parameters.
STUDY DESIGN: In-home dyadic actigraphy monitoring at infant age 4, 8, and 12 weeks.
SUBJECTS: Forty-three healthy mother–infant pairs.
OUTCOME MEASURES: Circadian parameters derived from cosinor and non-parametric analysis including mesor, magnitude, acrophase, L5 and M10 midpoints (midpoint of lowest 5 and highest 10h of activity), amplitude, interdaily stability (IS), and intradaily variability (IV).

RESULTS: Mothers experienced early disruption of circadian rhythm, with re-establishment of rhythm over time. Significant time effects were noted in increasing maternal magnitude, amplitude, and IS and decreasing IV (p<.001). Infants demonstrated a developmental trajectory of circadian pattern with significant time effects for increasing mesor, magnitude, amplitude, L5, IS, and IV (p<.001). By 12 weeks, infant phase advancement was evidenced by mean acrophase and M10 midpoint occurring 60 and 43 min (respectively) earlier than at 4 weeks. While maternal acrophase remained consistent over time, infants became increasingly phase advanced relative to mother and mean infant acrophase at 12 weeks occurred 60 min before mother. Mother-infant synchrony was evidenced in increasing correspondence of acrophase at 12 weeks (r=0.704), L5 (r=0.453) and M10 (r=0.479) midpoints.

CONCLUSIONS: Development of mother-infant synchrony reflects shared elements of circadian rhythm.

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Mothers' wakefulness at night in the post-partum period is related to their infants' circadian sleep-wake rhythm.

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Author information:
The relationship between a post-partum mother's wakefulness at night and her infant's circadian sleep-wake rhythm was examined. The subjects were seven primipara and their infants. Actigraphic recordings for the mothers and their infants were made over three to five continuous days during Weeks 3, 6, 9 and 12. A 24-h peak of autocorrelograms of the infants' movements appeared in two cases at Week 6, in six cases at Week 9, and in seven cases at Week 12. The mothers' night-time movements significantly decreased from Week 3 to Week 12. Mothers' wakefulness during night sleep in the post-partum period is related to their infants' obtaining circadian sleep-wake rhythm.

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spontaneous motor activity and experienced intensity of symptoms were measured in 21 depressed patients who showed daily variations of subjective symptoms. Patients felt significantly less active, awake, and more depressed in the morning compared to the evening. However, corresponding activity levels, which were measured by actigraphy, appeared significantly higher in the morning compared to the evening. Increased motor activity could represent the observable behavioral equivalent of self-experienced psychomotor retardation and depressed mood.

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Motor overactivity and loss of motor circadian rhythm in fatal familial insomnia: an actigraphic study.


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The 24-hour rest-activity pattern and the amount of motor activity was studied in a patient with fatal familial insomnia (FFI) by means of wrist actigraphy. During the study, the patient underwent indirect calorimetry. The 52-day recording showed severe disruption of the 24-hour rest-activity pattern with increased motor activity up to 80%. The 24-hour energy expenditure, assayed in a respiration chamber, was strikingly elevated by 60%. Chronic motor overactivity and loss of circadian rest-activity rhythm may play a role in the progressive metabolic exhaustion leading to death in FFI patients.

DOI: 10.1093/sleep/20.9.739
PMID: 9406326 [Indexed for MEDLINE]
Multi-Modal Home Sleep Monitoring in Older Adults.

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The gold standard for sleep monitoring is attended in-lab polysomnography; however, this method may be cost-prohibitive and inconvenient for patients and research participants. Home sleep testing has gained momentum in the field of sleep medicine due to its convenience and lower cost, as well as being more naturalistic. The accuracy and quality of home sleep testing, however, may be variable because studies are not monitored by sleep technologists. There has been some success in improving the accuracy of home sleep studies by having trained sleep technicians assist participants inside their homes with putting on the devices, but this can be intrusive and time-consuming for those involved. In this protocol, participants undergo at-home sleep monitoring with multiple devices: 1) a single-channel EEG device; 2) a home sleep test for sleep-disordered breathing and periodic limb movements; 3) actigraphy; and 4) sleep logs. A major challenge of this study is obtaining high-quality sleep monitoring data on the first attempt in order to minimize participant burden. This protocol describes the
A multicomponent nonpharmacological intervention improves activity rhythms among nursing home residents with disrupted sleep/wake patterns.

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BACKGROUND: Sleep and circadian rhythms are disrupted among many nursing home (NH) residents. We examined the impact of a multicomponent nonpharmacological intervention on 24-hour rest/activity rhythms among long-stay NH residents.

METHODS: The study was a randomized controlled trial in which, following a 3-day baseline, participants received 5 days of either usual care (control condition) or the active intervention. The intervention combined increased exposure to outdoor bright light, efforts to keep residents out of bed during the day, structured physical activity, institution of a bedtime routine, and efforts to reduce nighttime noise and light in residents' rooms. For 100 residents with baseline and follow-up wrist actigraphy data (mean age = 87 years; 76% women), rest/activity rhythms were modeled to determine the rhythm acrophase (peak time), nadir (trough time), midline estimating statistic of rhythm (MESOR) (midpoint), amplitude (height of peak), slope, and the rest period/active period ratio (alpha).

RESULTS: The intervention led to an increase in the duration of the
"active" portion of the rhythm, which was primarily accounted for by a shift in the rest/activity rhythm rise to an earlier time. Findings persisted when analyses were adjusted for age, cognitive functioning, medical comorbidities, and behavioral disturbances.

CONCLUSIONS: These findings suggest that the intervention may effectively improve the robustness of rest/activity rhythms in NH residents. Further research is needed to examine the impact of similar interventions on other measures of circadian rhythms (e.g., body temperature, melatonin) among NH residents.

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The multidisciplinary therapy in binge eating disorder is able to influence the interdaily stability and sleep quality?

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We have recently shown that rest-activity circadian rhythm significantly differed in women with Binge Eating Disorder (BED) compared to the Ctrl group. In details, patients with BED exhibited significantly reduced levels of MESOR and Amplitude with respect to the Ctrl group. In addition, in this previous study, the results
of the actigraphic sleep monitoring provided no evidence of differences in sleep parameters between the two groups. We expanded the original sample obtaining a total of 28 volunteered women, 14 BED women, and 14 Ctrl. We recorded in all 28 participants a 5-day actigraphic monitoring to detect the rhythmometric parameters, interdaily stability, intradaily variability, L5, M10, and sleep parameters. During the study, BED's women group kept an individual multidisciplinary therapy lasting five weekly days, from Monday to Friday, consisting in cognitive-behavioral therapy and nutritional program, administered in outpatient care from 8:00 a.m. at 5:00 p.m. The combination of both our previous and current study supports the conclusion that the sleep quality of the BED group is significantly better compared to Ctrl. The non-parametric indexes showed how interdaily stability, significantly correlated to sleep efficiency, was higher in BED group compared to the Ctrl group, indicating a better synchronization of rest-activity circadian rhythm. In conclusion, the maintenance of a regular lifestyle, such as imposed by the multidisciplinary therapy, is important to avoid alterations in the sleep-wake cycle, particularly in patients with eating disorders.

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Multiple lifestyle behaviours and overweight and obesity among children aged 9-11 years: results from the UK site of the International Study of Childhood Obesity, Lifestyle and the Environment.

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OBJECTIVES: The purpose of this study was to explore the independent associations between multiple lifestyle behaviours (physical activity, sleep, screen time (ST) and diet) and overweight and obesity in UK children. The second objective was to compare body mass index (BMI) z-score between children who meet health guidelines for each lifestyle behaviour and those who do not and to explore the impact of interactions between lifestyle behaviours on BMI z-score.

DESIGN, SETTING AND PARTICIPANTS: Cross-sectional study on children aged 9–11 years in the UK (n=374).

OUTCOME MEASURES: Participants were classified as overweight or obese using the WHO BMI cut-points. Moderate-to-vigorous intensity physical activity (MVPA) and sleep duration were measured using an ActiGraph GT3X+ accelerometer, whereas ST and dietary habits were assessed using questionnaires. Multilevel multiple logistic regression was employed to analyse associations between lifestyle behaviours and overweight/obesity. Participants were then categorised according to whether or not they met specific health criteria for MVPA, ST, sleep and diet. Multilevel multiple linear regression was used to compare these groupings on the outcome of BMI z-score and interactions were explored.

RESULTS: MVPA and longer sleep duration were associated with lower odds of overweight or obesity, whereas ST and a healthy diet score were associated with increased odds of overweight/obesity. No association was found for an unhealthy diet score. Meeting MVPA guidelines was significantly associated with a lower BMI z-score in all models, and significant two-way interactions were observed for physical activity and sleep, ST and sleep, and physical activity and diet.

CONCLUSIONS: MVPA, sleep and ST are important lifestyle behaviours associated with overweight/obesity among children. More research is required to confirm the
role of diet on adiposity and such work would benefit from objective assessment.
Overall, this work suggests that strategies aimed at improving compliance with
health guidelines are needed.
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Multiscale adaptive analysis of circadian rhythms and intradaily variability:
Application to actigraphy time series in acute insomnia subjects.
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Erratum in

Circadian rhythms become less dominant and less regular with chronic-dggenerative
disease, such that to accurately assess these pathological conditions it is
important to quantify not only periodic characteristics but also more
irregular aspects of the corresponding time series. Novel data-adaptive techniques, such as singular spectrum analysis (SSA), allow for the decomposition of experimental time series, in a model-free way, into a trend, quasiperiodic components and noise fluctuations. We compared SSA with the traditional techniques of cosinor analysis and intradaily variability using 1-week continuous actigraphy data in young adults with acute insomnia and healthy age-matched controls. The findings suggest a small but significant delay in circadian components in the subjects with acute insomnia, i.e. a larger acrophase, and alterations in the day-to-day variability of acrophase and amplitude. The power of the ultradian components follows a fractal 1/f power law for controls, whereas for those with acute insomnia this power law breaks down because of an increased variability at the 90min time scale, reminiscent of Kleitman's basic rest-activity (BRAC) cycles. This suggests that for healthy sleepers attention and activity can be sustained at whatever time scale required by circumstances, whereas for those with acute insomnia this capacity may be impaired and these individuals need to rest or switch activities in order to stay focused. Traditional methods of circadian rhythm analysis are unable to detect the more subtle effects of day-to-day variability and ultradian rhythm fragmentation at the specific 90min time scale.

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Multisite accelerometry for sleep and wake classification in children.
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Actigraphy is a useful alternative to the gold standard polysomnogram for non-invasively measuring sleep and wakefulness. However, it is unable to accurately assess sleep fragmentation due to its inability to differentiate restless sleep from wakefulness and quiet wake from sleep. This presents significant limitations in the assessment of sleep-related breathing disorders where sleep fragmentation is a common symptom. We propose that this limitation may be caused by hardware constraints and movement representation techniques. Our objective was to determine if multisite tri-axial accelerometry improves sleep and wake classification. Twenty-four patients aged 6-15 years (median: 8 years, 16 male) underwent a diagnostic polysomnogram while simultaneously recording motion from the left wrist and index fingertip, upper thorax and left ankle and great toe using a custom accelerometry system. Movement was quantified using several features and two feature selection techniques were employed to select optimal features for restricted feature set sizes. A heuristic was also applied to identify movements during restless sleep. The sleep and wake classification performance was then assessed and validated against the manually scored polysomnogram using discriminant analysis. Tri-axial accelerometry measured at the wrist significantly improved the wake detection when compared to uni-axial accelerometry (specificity at 85% sensitivity: 71.3(14.2)% versus 55.2(24.7)%,

\[ p < 0.01 \]). Multisite accelerometry significantly improved the performance when compared to the single wrist placement (specificity at 85% sensitivity: 82.1(12.5)% versus 71.3(14.2)%, \( p < 0.05 \)). Our results indicate that multisite
accelerometry offers a significant performance benefit which could be further improved by analysing movement in raw multisite accelerometry data.

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The Munich ChronoType Questionnaire for Shift-Workers (MCTQShift).
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Sleep is systematically modulated by chronotype in day-workers. Therefore, investigations into how shift-work affects sleep, health, and cognition may provide more reliable insights if they consider individual circadian time (chronotype). The Munich ChronoType Questionnaire (MCTQ) is a useful tool for determining chronotype. It assesses chronotype based on sleep behavior, specifically on the local time of mid-sleep on free days corrected for sleep debt accumulated over the workweek (MSFsc). Because the original MCTQ addresses people working standard hours, we developed an extended version that accommodates shift-work (MCTQ(Shift)). We first present the validation of this new version with daily sleep logs (n = 52) and actimetry (n = 27). Next, we evaluated 371 MCTQ(Shift) entries of shift-workers (rotating through 8-h shifts starting at 0600 h, 1400 h, and 2200 h). Our results support experimental findings showing that sleep is difficult to initiate and to maintain under the constraints of shift-work. Sleep times are remarkably stable on free days (on average between midnight and 0900 h), so that chronotype of shift-workers can be assessed by
means of MSF—similar to that of day-workers. Sleep times on free-days are, however, slightly influenced by the preceding shift (displacements <1 h), which are smallest after evening shifts. We therefore chose this shift-specific mid-sleep time (MSF(E)) to assess chronotype in shift-workers. The distribution of MSF(E) in our sample is identical to that of MSF in day-workers. We propose conversion algorithms for chronotyping shift-workers whose schedules do not include free days after evening shifts.

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Myotonic dystrophy type 1—report of non-24-h sleep-wake disorder with excessive daytime sleepiness.


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Myotonic dystrophy (MD) is a neuromuscular disease with myotonia, progressive weakness, and involvement of CNS, heart, and gastrointestinal system. Excessive daytime sleepiness (EDS) in myotonic dystrophy type 1 (MD1) is related to sleep breathing diseases, restless leg syndrome, periodic limb movements during sleep and narcoleptic-like phenotype. However, authors highlight a central
dysfunction of sleep regulation. We describe a 26-year-old, female, MD1 patient with EDS.

Sleep diary/actigraphy evidenced two different circadian periods with values of 1442 and 1522 min. Agomelatine, 50 mg at night, was prescribed with improvement of the circadian rhythm and complaints of sleepiness. The identification of unanticipated causes of EDS, such as circadian rhythm disorders permits an appropriated treatment. As we know, it is the first relate of non-24-h sleep-wake disorder in patient with MD1. Sleep diary and actigraphy could be good options to investigate sleep-wake cycle disorder in patients with MD and EDS.

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McDonald J, Potyk D, Fischer D, Parmenter B, Lillis T, Tompkins L, Bowen A, Grant D, Lamp A, Belenky G.

BACKGROUND: Physicians in training experience fatigue from sleep loss, high workload, and working at an adverse phase of the circadian rhythm, which collectively degrades task performance and the ability to learn and remember. To minimize fatigue and sustain performance, learning, and memory, humans generally need 7 to 8 hours of sleep in every 24-hour period.

METHODS: In a naturalistic, within-subjects design, we studied 17 first- and second-year internal medicine residents working in a tertiary care medical center, rotating between day shift and night float every 4 weeks. We studied each resident for 2 weeks while he/she worked the day shift and for 2 weeks while he/she worked the night float, objectively measuring sleep by wrist
actigraphy, vigilance by the Psychomotor Vigilance Task test, and visual-spatial and verbal learning and memory by the Brief Visuospatial Memory Test-Revised and the Rey Auditory-Verbal Learning Test.

RESULTS: Residents, whether working day shift or night float, slept approximately 7 hours in every 24-hour period. Residents, when working day shift, consolidated their sleep into 1 main sleep period at night. Residents working night float split their sleep, supplementing their truncated daytime sleep with nighttime on-duty naps. There was no difference in vigilance or learning and memory, whether residents worked day shift or night float.

CONCLUSIONS: Off-duty sleep supplemented with naps while on duty appears to be an effective strategy for sustaining vigilance, learning, and memory when working night float.

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PMID: 24455014


Naturalistic field study of the restart break in US commercial motor vehicle drivers: Truck driving, sleep, and fatigue.

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Commercial motor vehicle (CMV) drivers in the US may start a new duty cycle after taking a 34-h restart break. A restart break provides an opportunity for sleep recuperation to help prevent the build-up of fatigue across duty cycles. However, the effectiveness of a restart break may depend on its timing, and on how many nighttime opportunities for sleep it contains. For daytime drivers, a 34-h restart break automatically includes two nighttime periods. For nighttime drivers, who are arguably at increased risk of fatigue, a 34-h restart break contains only one nighttime period. To what extent this is relevant for fatigue depends in part on whether nighttime drivers revert back to a nighttime-oriented sleep schedule during the restart break. We conducted a naturalistic field study with 106 CMV drivers working their normal schedules and performing their normal duties. These drivers were studied during two duty cycles and during the intervening restart break. They provided a total of 1260 days of data and drove a
total of 414,937 miles during the study. Their duty logs were used to identify the periods when they were on duty and when they were driving and to determine their duty cycles and restart breaks. Sleep/wake patterns were measured continuously by means of wrist actigraphy. Fatigue was assessed three times per day by means of a brief psychomotor vigilance test (PVT-B) and a subjective sleepiness scale. Data from a truck-based lane tracking and data acquisition system were used to compute lane deviation (variability in lateral lane position). Statistical analyses focused on 24-h patterns of duty, driving, sleep, PVT-B performance, subjective sleepiness, and lane deviation. Duty cycles preceded by a restart break containing only one nighttime period (defined as 01:00–05:00) were compared with duty cycles preceded by a restart break containing more than one nighttime period. During duty cycles preceded by a restart break with only one nighttime period, drivers showed more nighttime-oriented duty and driving patterns and more daytime-oriented sleep patterns than during duty cycles preceded by a restart break with more than one nighttime period. During duty cycles preceded by a restart break with only one nighttime period, drivers also experienced more lapses of attention on the PVT-B and increased lane deviation at night, and they reported greater subjective sleepiness. Importantly, drivers exhibited a predominantly nighttime-oriented sleep schedule during the restart break, regardless of whether the restart break contained only one or more than one nighttime period. Consistent with findings in laboratory-based studies of the restart break, the results of this naturalistic field study indicate that having at least two nighttime periods in the restart break provides greater opportunity for sleep recuperation and helps to mitigate fatigue.

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Naturally occurring circadian rhythm and sleep duration are related to executive functions in early adulthood.


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Experimental sleep deprivation studies suggest that insufficient sleep and circadian misalignment associates with poorer executive function. It is not known whether this association translates to naturally occurring sleep patterns. A total of 512 of full-term-born members of the Arvo Ylppö Longitudinal Study [mean
age = 25.3, standard deviation (SD) = 0.65] (44.3% men) wore actigraphs to define sleep duration, its irregularity and circadian rhythm (sleep midpoint) during a 1-week period (mean 6.9 nights, SD = 1.7). Performance-based executive function was assessed with the Trail-Making Test, Conners' Continuous Performance Test and Stroop. The self-rated adult version of Behavior Rating Inventory of Executive Function was used to assess trait-like executive function. We found that performance-based and self-reported trait-like executive function correlated only modestly (all correlations ≤0.17). Shorter sleep duration associated with more commission errors. Later circadian rhythm associated with poorer trait-like executive function, as indicated by the Brief Metacognitive Index and the Behavior Regulation Index. Those belonging to the group with the most irregular sleep duration performed slower than others in the Trail-Making Test Part A. All associations were adjusted for sex, age, socioeconomic status and body mass index. In conclusion, naturally occurring insufficient sleep and later circadian rhythm showed modest associations with poorer executive function. Shorter habitual sleep duration was associated with lower scores of performance-based tests of executive function, and later circadian rhythm was associated mainly with poorer trait-like executive function characteristics. Our findings suggest additionally that sleep duration and circadian rhythm associate with different domains of executive function, and there are no additive effects between the two.

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Neighborhood disadvantage is associated with actigraphy-assessed sleep
Study Objectives: Neighborhood disadvantage has been linked to poor sleep. However, the extant research has primarily focused on self-reported assessments of sleep and neighborhood characteristics. The current study examines the association between objective and perceived neighborhood characteristics and actigraphy-assessed sleep duration, efficiency, and wakefulness after sleep onset (WASO) in an urban sample of African American adults.

Methods: We examined data from predominantly African American adults (n = 788, mean age 55 years; 77% female) living in two low-income neighborhoods. Perceived neighborhood characteristics included safety, social cohesion, and satisfaction with one’s neighborhood as a place to live. Objective neighborhood conditions included walkability, disorder, street lighting, and crime levels. Sleep duration, efficiency, and WASO were measured via 7 days of wrist-worn actigraphy. Analyses estimated each of the sleep outcomes as a function of perceived and objective neighborhood characteristics. Individual-level sociodemographics, body mass index, and psychological distress were included as covariates.

Results: Greater perceived safety was associated with higher sleep efficiency and
shorter WASO. Greater neighborhood disorder and street lighting were associated with poorer sleep efficiency and longer WASO and greater likelihood of short sleep duration (<7 versus 7–9 hr as referent). Higher levels of crime were associated with poorer sleep efficiency and longer WASO, but these associations were only evident in one of the neighborhoods.

Conclusions: Both how residents perceive their neighborhood and their exposure to objectively measured neighborhood disorder, lighting, and crime have implications for sleep continuity. These findings suggest that neighborhood conditions may contribute to disparities in sleep health.

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Neighborhood Economic Deprivation and Social Fragmentation: Associations With Children's Sleep.

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BACKGROUND & OBJECTIVE: A growing body of work indicates that experiences of neighborhood disadvantage place children at risk for poor sleep. This study aimed to examine how both neighborhood economic deprivation (a measure of poverty) and social fragmentation (an index of instability) are associated with objective measures of the length and quality of children's sleep.

PARTICIPANTS: Participants were 210 children (54.3% boys) living predominantly in
small towns and semirural communities in Alabama. On average children were 11.3 years old (SD = .63); 66.7% of the children were European American and 33.3% were African American. The sample was socioeconomically diverse with 67.9% of the participants living at or below the poverty line and 32.1% from lower-middle-class or middle-class families.

METHODS: Indicators of neighborhood characteristics were derived from the 2012 American Community Survey and composited to create two variables representing neighborhood economic deprivation and social fragmentation. Child sleep period, actual sleep minutes, and efficiency were examined using actigraphy.

RESULTS: Higher levels of neighborhood economic deprivation were associated with fewer sleep minutes and poorer sleep efficiency. More neighborhood social fragmentation was also linked with poorer sleep efficiency. Analyses controlled for demographic characteristics, child health, and family socioeconomic status.

CONCLUSIONS: Findings indicate that living in economically and socially disadvantaged neighborhoods predicts risk for shorter and lower-quality sleep in children. Examination of community context in addition to family and individual characteristics may provide a more comprehensive understanding of the factors shaping child sleep.

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Neighborhood Factors as Predictors of Poor Sleep in the Sueño Ancillary Study of the Hispanic Community Health Study/Study of Latinos.

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Study Objectives: To evaluate whether an adverse neighborhood environment has higher prevalence of poor sleep in a US Hispanic/Latino population.

Methods: A cross-sectional analysis was performed in 2156 US Hispanic/Latino participants aged 18–64 years from the Sueño ancillary study of the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Participants completed surveys of neighborhood environment including perceived safety, violence and noise, the Insomnia Severity Index (ISI), and 7 days of wrist actigraphy.

Results: In age and sex-adjusted analyses, short sleep, low sleep efficiency, and late sleep midpoint were all more prevalent among those living in an unsafe
neighborhood. After adjustment for background, site, nativity, income, employment, depressive symptoms, and sleep apnea, the absolute risk of sleeping <6 hours was 7.7 (95% CI [0.9, 14.6]) percentage points greater in those living in an unsafe compared to a safe neighborhood. There were no differences in the prevalence of insomnia by level of safety or violence. Insomnia was more prevalent among those living in a noisy neighborhood. In adjusted analysis, the absolute risk of insomnia was 4.4 (95% CI [0.4, 8.4]) percentage points greater in those living in noisy compared to non-noisy neighborhoods.

Conclusion: Using validated measures of sleep duration and insomnia, we have demonstrated the existence of a higher prevalence of short sleep and insomnia by adverse neighborhood factors. An adverse neighborhood environment is an established risk factor for a variety of poor health outcomes. Our findings suggest negative effects on sleep may represent one pathway by which neighborhood environment influences health.

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The Neighborhood Social Environment and Objective Measures of Sleep in the Multi-Ethnic Study of Atherosclerosis.


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Study objectives: To investigate cross-sectional associations of neighborhood social environment (social cohesion, safety) with objective measures of sleep duration, timing, and disturbances.

Methods: A racially/ethnically diverse population of men and women (N = 1949) aged 54 to 93 years participating in the Multi-Ethnic Study of Atherosclerosis Sleep and Neighborhood Ancillary studies. Participants underwent 1-week actigraphy between 2010 and 2013. Measures of sleep duration, timing, and disruption were averaged over all days. Neighborhood characteristics were assessed via questionnaires administered to participants and an independent sample within the same neighborhood and aggregated at the neighborhood (census tract, N = 783) level using empirical Bayes estimation. Multilevel linear regression models were used to assess the association between the neighborhood social environment and each sleep outcome.

Results: Neighborhood social environment characterized by higher levels of social cohesion and safety were associated with longer sleep duration and earlier sleep.
midpoint. Each 1 standard deviation higher neighborhood social environment score was associated with 6.1 minutes longer [95% confidence interval (CI): 2.0, 10.2] sleep duration and 6.4 minutes earlier (CI: 2.2, 10.6) sleep midpoint after adjustment for age, sex, race, socioeconomic status, and marital status. These associations persisted after adjustment for other risk factors. Neighborhood social factors were not associated with sleep efficiency or sleep fragmentation index.

Conclusions: A more favorable neighborhood social environment is associated with longer objectively measured sleep duration and earlier sleep timing. Intervening on the neighborhood environment may improve sleep and subsequent health outcomes.

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Neighborhood socioeconomic status and child sleep duration: a systematic review and meta-analysis.


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BACKGROUND: The objective of this systematic review and meta-analysis was to investigate the associations between neighborhood socioeconomic status (nSES) and sleep duration in children aged 0–18 years.

METHODS: Three electronic databases were searched for relevant articles that assessed nSES and sleep duration (either subjectively or objectively). Inclusion criteria included peer-reviewed scholarly articles on the topic area that reported an association between nSES and sleep in children and adolescents.

RESULTS: The database searched identified 6080 potentially eligible studies, of which 1210 were selected for full-text review, and 8 met the inclusion criteria. Data included 67,677 unique participants. Studies were conducted in either the United States of America or Australia. Pooled estimates suggested that poorer nSES was associated with shorter child sleep duration (odds ratio: 1.262; 95% confidence interval: 1.086–1.467). This relationship between nSES and sleep was moderated by sleep assessment type (self-report versus actigraphy), child sex/gender, and child race/ethnicity.

CONCLUSIONS: Across studies, there is an association between nSES and child sleep duration. This study adds child sleep to the growing number of child health disparities associated with nSES.

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Neural connectivity moderates the association between sleep and impulsivity in adolescents.

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Adolescence is characterized by chronic insufficient sleep and extensive brain development, but the relation between adolescent sleep and brain function remains unclear. We report the first functional magnetic resonance imaging study to investigate functional connectivity as a moderator between sleep and impulsivity, a problematic behavior during this developmental period. Naturalistic differences in sleep have not yet been explored as treatable contributors to adolescent impulsivity. Although public and scientific attention focuses on sleep duration, we report individual differences in sleep quality, not duration, in fifty-five adolescents (ages 14–18) yielded significant differences in functional connectivity between the prefrontal cortex and default mode network. Poor sleep quality was related to greater affect-related impulsivity among adolescents with low, but not high, connectivity, suggesting neural functioning relates to individual differences linking sleep quality and impulsivity. Response
inhibition and cognitive impulsivity were not related to sleep quality, suggesting that sleep has a greater impact on affect-related impulsivity. Exploring environmental contributors of poor sleep quality, we demonstrated pillow comfort was uniquely related to sleep quality over age, sex, and income, a promising advance ripe for intervention.

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The neurobiology of adaptation to seasons: Relevance and correlations in bipolar disorders.


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Bipolar disorders (BDs) are severe and common psychiatric disorders.
BD pathogenesis, clinical manifestations and relapses are associated with numerous circadian rhythm abnormalities. In addition, infradian fluctuations of mood, social activity, weight and sleep patterns are very frequent in BD. Disease course with a seasonal pattern (SP) occurs in approximately 25% of depressive and 15% of manic episodes, which is coupled to a more severe disease symptomatology. The pathophysiological mechanisms of seasonal effects in BD await clarification, with likely important clinical consequences. This review aims at synthesizing available data regarding the underlying pathophysiological mechanisms of seasonality in BD patients, with implications for future research directions in the study of seasonality in BD. Three factors are suggested to play significant roles in BD with SP, namely the suprachiasmatic nuclei, as well as the melatonergic and photoperiodism systems. It is proposed that BD with SP may be considered as a complex disorder resulting from the interaction of clock gene vulnerabilities and biological clock neuroplasticity, with environmental factors, such as the response to light. Light seems to play a key role in BD with SP, mainly due to two seasonal signaling pathways: a light to cortex serotonin transporter pathway, as well as a pathway connecting light to melatonin synthesis. This provides a theoretical framework for BD with SP, including for future research and clinical management. The review proposes that future research should explore markers of seasonality in BD, such as plasma melatonin, sleep-wake rhythms (with actigraphy) and genetic or epigenetic variants within the melatonin synthesis pathway. The role of light in driving BD with SP is an active area of research. Seasonality may also be intimately linked to wider aspects of BD, including via interactions with the gut microbiome, the gut-liver axis, cholesterol regulation, aspects of metabolic syndrome, vitamin D, decreased
longevity, suicide risk and medication treatment targets. Further research on the role of seasonality in BD is likely to clarify the etiology, course and treatment of BD more widely.

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A new chronobiological approach to discriminate between acute and chronic depression using peripheral temperature, rest-activity, and light exposure parameters.


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BACKGROUND: Circadian theories for major depressive disorder have suggested that the rhythm of the circadian pacemaker is misaligned. Stable phase relationships between internal rhythms, such as temperature and rest/activity, and the external day-night cycle, are considered to be crucial for adapting to life in the external environmental. Therefore, the relationship and possible alterations among (i) light exposure, (ii) activity rhythm, and (iii) temperature rhythm could be important factors in clinical depression. This study aimed to investigate the rhythmic alterations in depression and evaluate the ability of chronobiological parameters to discriminate between healthy subjects and depressed patients.

METHODS: Thirty female subjects, including healthy subjects, depressed patients in the first episode, and major recurrent depression patients.
Symptoms were assessed using Hamilton Depression Scale, Beck Depression Inventory and Montgomery-Åsberg Scale. Motor activity, temperature, and light values were determined for 7 days by actigraph, and circadian rhythms were calculated.

RESULTS: Depressed groups showed a lower amplitude in the circadian rhythm of activity and light exposure, but a higher amplitude in the rhythm of peripheral temperature. The correlation between temperature and activity values was different in the day and night among the control and depressed groups. For the same level of activity, depressed patients had lowest temperature values during the day. The amplitudes of temperature and activity were the highest discriminant parameters.

CONCLUSIONS: These results indicate that the study of rhythms is useful for diagnosis and therapy for depressive mood disorders.

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A new integrated variable based on thermometry, actimetry and body position (TAP) to evaluate circadian system status in humans.

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The disruption of the circadian system in humans has been associated with the development of chronic illnesses and the worsening of pre-existing pathologies. Therefore, the assessment of human circadian system function under free living conditions using non-invasive techniques needs further research.
Traditionally, overt rhythms such as activity and body temperature have been analyzed separately; however, a comprehensive index could reduce individual recording artifacts. Thus, a new variable (TAP), based on the integrated analysis of three simultaneous recordings: skin wrist temperature (T), motor activity (A) and body position (P) has been developed. Furthermore, we also tested the reliability of a single numerical index, the Circadian Function Index (CFI), to determine the circadian robustness. An actimeter and a temperature sensor were placed on the arm and wrist of the non-dominant hand, respectively, of 49 healthy young volunteers for a period of one week. T, A and P values were normalized for each subject. A non-parametric analysis was applied to both TAP and the separate variables to calculate their interdaily stability, intradaily variability and relative amplitude, and these values were then used for the CFI calculation. Modeling analyses were performed in order to determine TAP and CFI reliability. Each variable (T, A, P or TAP) was independently correlated with rest-activity logs kept by the volunteers. The highest correlation ($r = -0.993$, $p<0.0001$), along with highest specificity (0.870), sensitivity (0.740) and accuracy (0.904), were obtained when rest-activity records were compared to TAP. Furthermore, the CFI proved to be very sensitive to changes in circadian robustness. Our results demonstrate that the integrated TAP variable and the CFI calculation are powerful methods to assess circadian system status, improving sensitivity, specificity and accuracy in differentiating activity from rest over the analysis of wrist temperature, body position or activity alone.

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Night sleep influences white matter microstructure in bipolar depression.

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BACKGROUND: Alteration of circadian rhythms and sleep disruption are prominent trait-like features of bipolar disorder (BD). Diffusion tensor imaging (DTI) measures suggest a widespread alteration of white matter (WM) microstructure in patients with BD. Sleep promotes myelination and oligodendrocyte precursor cells proliferation. We hypothesized a possible association between DTI measures of WM microstructure and sleep quantity measures in BD.

METHODS: We studied 69 inpatients affected by a depressive episode in course of type I BD. We used whole brain tract-based spatial statistics on DTI measures of WM microstructure: axial, radial, and mean diffusivity (AD, RD, MD), and fractional anisotropy (FA). Self-assessed measures of time asleep (TA) and total sleep time (TST) were extracted from the Pittsburgh Sleep Quality Index (PSQI). Actigraphic recordings were performed on a subsample of 23 patients.

RESULTS: We observed a positive correlation of DTI measures of FA with actigraphic measures of TA and TST, and with PSQI measure of TA. DTI measures of RD inversely associated with actigraphic measure of TA, and with PSQI measures of TA and TST. Several WM tracts were involved, including corpus callosum, cingulate gyrus, uncinate fasciculus, left superior and inferior longitudinal
and fronto-occipital fasciculi, thalamic radiation, corona radiata, retrolenticular part of internal capsule and corticospinal tract.

LIMITATIONS: The study is correlational in nature, and no conclusion about a causal connection can be drawn.

CONCLUSIONS: Reduced FA with increased RD and MD indicate higher water diffusivity associated with less organized myelin and/or axonal structures. Our findings suggest an association between sleep disruption and these measures of brain microstructure in specific tracts contributing to the functional connectivity in BD.

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Night-time sleep in Parkinson's disease – the potential use of Parkinson's KinetiGraph: a prospective comparative study.


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BACKGROUND AND PURPOSE: Night-time sleep disturbances are important non-motor symptoms and key determinants of health-related quality of life (HRQoL) in patients with Parkinson's disease (PD). The Parkinson's KinetiGraph (PKG) can be used as an objective measure of different motor states and periods of immobility may reflect episodes of sleep. Our aim was to evaluate whether PKG can be used as an objective marker of disturbed night-time sleep in PD.

METHODS: In this prospective comparative study, data from PKG recordings over six consecutive 24 h periods are compared with Hauser diaries and scales focusing on motor state, sleep and HRQoL in PD patients. Thirty-three 'non-sleepy' PD patients (PD-NS) were compared with 30 PD patients presenting with excessive daytime sleepiness (PD-EDS). The groups were matched for age, gender and Hoehn and Yahr state.

RESULTS: In the PD-EDS group subjective sleep reports correlated with the PKG's parameters for quantity and quality night-time sleep, but not in the PD-NS group. There were no significant correlations of the night-time sleep quantity parameters of the Hauser diary with subjective sleep perception, neither in the PD-EDS nor in the PD-NS group.

CONCLUSIONS: This first PKG based study of night-time sleep in PD suggests that PKG could be used to provide an easy to use and rough evaluation of aspects of night-time sleep and one that could flag patients where polysomnography may be required. In sleepy PD patients for instance, quantity and quality PKG parameters correlate with different aspects of sleep such as insomnia, parasomnia and restless legs syndrome.

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Night work effects on salivary cytokines TNF, IL-1β and IL-6.

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Shift work is unavoidable in modern societies, but at the same time disrupts biological rhythms and contributes to social distress and disturbance of sleep, health and well-being of shift workers. Shift work has been associated with some chronic diseases in which a chronic inflammatory condition may play a role. However, few studies investigating the association of cytokine and other inflammation markers with shift workers have been published in recent years. In this study we evaluated the effects of permanent night work on the production of tumor necrosis factor (TNF), interleukin-1β (IL-1β), IL-6 and melatonin in saliva. Another aim was to demonstrate the benefit of the use of salivary cytokines for studies in chronobiology, since it is an easy and non-invasive method that allows for sampling at several times. Thirty-eight healthy male workers, being 21 day workers and 17 night workers, agreed to participate in this study. Sleep was evaluated by actigraphy and activity protocols. Saliva was collected during three workdays approximately at the middle of the work shift and at bed and wake times of the main sleep episode. Saliva samples were then analyzed by enzyme-linked immunosorbent assay to measure TNF, IL-1β, IL-6 and melatonin levels, and the results were submitted to non-parametric statistical
analysis. The use of saliva instead of blood allowed for a greater number of samples from the same subjects, allowing identifying alterations in the daily production patterns of salivary cytokines TNF, IL-1β and IL-6 that probably are linked to night work. Salivary TNF and IL-1β levels were similar for day and night workers, with higher daily production after awakening, in the morning hours for day workers and in the afternoon for night workers. Both groups presented a significant daily variation pattern of these two cytokines. Day and night workers produced similar amounts of salivary IL-6. Nevertheless, the daily variation pattern observed among day workers, with a peak after awakening, was absent among night workers. Thus, in our study, night workers showed partially adjusted daily variation patterns for salivary TNF and IL-1β, not seen for salivary IL-6. Results for salivary IL-6 could be better explained as a consequence of circadian disruption due to permanent night work. Our results suggest that the whole circadian system, including clocks and pineal gland, is involved in regulating cytokine profile in shift workers and that a coordinated production of these cytokines, important for an adequate inflammatory response, could be disturbed by shift work. The distinct effects that shift work may have on different cytokines could give some cues about the mechanisms involved in this association.

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Night workers with circadian misalignment are susceptible to alcohol-induced intestinal hyperpermeability with social drinking.

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Alcohol-induced intestinal hyperpermeability (AIHP) is a known risk factor for alcoholic liver disease (ALD), but only 20–30% of heavy alcoholics develop AIHP and ALD. The hypothesis of this study is that circadian misalignment would promote AIHP. We studied two groups of healthy subjects on a stable work schedule for 3 mo [day workers (DW) and night workers (NW)]. Subjects underwent two circadian phase assessments with sugar challenge to access intestinal permeability between which they drank 0.5 g/kg alcohol daily for 7 days. Sleep architecture by actigraphy did not differ at baseline or after alcohol between either group. After alcohol, the dim light melatonin onset (DLMO) in the DW group did not change significantly, but in the NW group there was a significant 2-h phase delay. Both the NW and DW groups had no change in small bowel
permeability with alcohol, but only in the NW group was there an increase in colonic and whole gut permeability. A lower area under the curve of melatonin inversely correlated with increased colonic permeability. Alcohol also altered peripheral clock gene amplitude of peripheral blood mononuclear cells in CLOCK, BMAL, PER1, CRY1, and CRY2 in both groups, and inflammatory markers lipopolysaccharide-binding protein, LPS, and IL-6 had an elevated mesor at baseline in NW vs. DW and became arrhythmic with alcohol consumption. Together, our data suggest that central circadian misalignment is a previously unappreciated risk factor for AIHP and that night workers may be at increased risk for developing liver injury with alcohol consumption.

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Nighttime breastfeeding behavior is associated with more nocturnal sleep among first-time mothers at one month postpartum.

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STUDY OBJECTIVE: To describe sleep duration and quality in the first month postpartum and compare the sleep of women who exclusively breastfed at night to
those who used formula.

METHODS: We conducted a longitudinal study in a predominantly low-income and ethnically diverse sample of 120 first-time mothers. Both objective and subjective measures of sleep were obtained using actigraphy, diary, and self-report data. Measures were collected in the last month of pregnancy and at one month postpartum. Infant feeding diaries were used to group mothers by nighttime breastfeeding behavior.

RESULTS: Mothers who used at least some formula at night (n = 54) and those who breastfed exclusively (n = 66) had similar sleep patterns in late pregnancy. However, there was a significant group difference in nocturnal sleep at one month postpartum as measured by actigraphy. Total nighttime sleep was 386 ± 66 minutes for the exclusive breastfeeding group and 356 ± 67 minutes for the formula group. The groups did not differ with respect to daytime sleep, wake after sleep onset (sleep fragmentation), or subjective sleep disturbance at one month postpartum.

CONCLUSION: Women who breastfed exclusively averaged 30 minutes more nocturnal sleep than women who used formula at night, but measures of sleep fragmentation did not differ. New mothers should be encouraged to breastfeed exclusively since breastfeeding may promote sleep during postpartum recovery. Further research is needed to better understand how infant feeding method affects maternal sleep duration and fragmentation.

CITATION: Doan T; Gay CL; Kennedy HP; Newman J; Lee KA. Nighttime breastfeeding behavior is associated with more nocturnal sleep among first-time mothers at one month postpartum.

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Nighttime variability in wrist actigraphy.

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Wrist actigraphy measures sleep activity and circadian rhythm. This study examined nighttime variability in Actiwatch parameters in a sample of breast cancer survivors (BCSs) to determine a minimum number of nights needed to obtain an accurate picture of objective sleep. A descriptive, quantitative, and repeated measures design was used. Consenting participants wore an actigraph and completed a sleep diary across 7 nights. There were no significant differences in wake after sleep onset (WASO), total sleep time (TST), sleep latency, or sleep disturbances across nights of week (Monday to Sunday) or monitoring nights (1st to 7th). Sleep efficiency was significantly better at Night 6 compared with Night 7. The coefficients of variation (CVs) for WASO ranged from 46% to 86%, TST 23%-34%, sleep latency 154%-246%, sleep efficiency 12%-22%, and sleep disturbances 33%-41%. Although the CVs indicated high variability across women, there was little internight variability in WASO or TST during across 7 nights of sleep. This suggests that in BCSs, Actiwatch data could be collected and evaluated from any single night for an accurate measure of usual sleep.

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No objectively measured sleep disturbances in children with attention-deficit/hyperactivity disorder.

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The main goal of this study was to gain more insight into sleep disturbances in children with attention-deficit/hyperactivity disorder, using objective measures of sleep quality and quantity. The evidence for sleep problems in children with attention-deficit/hyperactivity disorder thus far is inconsistent, which might be explained by confounding influences of comorbid internalizing and externalizing problems and low socio-economic status. We therefore investigated the mediating and moderating role of these factors in the association between attention-deficit/hyperactivity disorder and sleep problems. To control for the effects of stimulant medication use, all participants were tested free of medication. Sixty-three children with attention-deficit/hyperactivity disorder and 61 typically developing children, aged 6-13 years, participated. Sleep was monitored for one to three school nights using actigraphy. Parent and teacher questionnaires assessed symptoms of attention-deficit/hyperactivity disorder, internalizing behaviour, oppositional defiant disorder and conduct disorder. Results showed no differences between the attention-deficit/hyperactivity disorder and typically developing group in any sleep parameter. Within the attention-deficit/hyperactivity disorder group, severity of attention-deficit/hyperactivity disorder symptoms was not related to sleep quality or quantity. Moderation analyses in the attention-deficit/hyperactivity disorder group showed an interaction effect between attention-deficit/hyperactivity disorder symptoms and internalizing and externalizing behaviour on total sleep time, time in bed and average sleep bout.
duration. The results of our study suggest that having attention-deficit/hyperactivity disorder is not a risk factor for sleep problems. Internalizing and externalizing behaviour moderate the association between attention-deficit/hyperactivity disorder and sleep, indicating a complex interplay between psychiatric symptoms and sleep.

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Nocturia and increase in nocturnal blood pressure: the Nagahama study.

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OBJECTIVE: Abnormalities in circadian blood pressure (BP) variation, particularly increase in nocturnal BP, have been reported to be risk factors for cardiovascular disease, although the factors associated with BP abnormalities are not fully understood. This study aimed to clarify possible associations of sleep characteristics, including sleep fragmentation, sleep disordered breathing, and nocturia, with sleep BP by simultaneous multiday measurements.

METHODS: A cross-sectional study evaluated 5959 community participants
having home-measured data on nocturnal BP change (sleep BP – awaking BP), sleep characteristics, and sleep disordered breathing. Sleep characteristics including the fragmentation index were assessed using wrist-wearable actigraphy, whereas sleep disordered breathing was assessed by 3% oxygen desaturation index obtained using a finger-type monitor. The number of nocturnal urinations was recorded in a sleep diary.

RESULTS: Mean nocturnal SBP change was $-8.5 \pm 7.9\%$. A 3% oxygen desaturation index was associated with the BP change independently of the basic covariates ($\beta = 0.051$, $P = 0.001$), although the association became insignificant ($P = 0.196$) after adjusting the fragmentation index ($\beta = 0.105$, $P < 0.001$). The association of the fragmentation index was also insignificant ($P = 0.153$) after adjusting measurement season (middle season: $\beta = 0.163$, $P < 0.001$; summer season: $\beta = 0.249$, $P < 0.001$). In contrast, the frequency of urination showed strong and independent association ($\beta = 0.140$, $P < 0.001$), with smaller nocturnal BP drop in participants with frequent urination.

CONCLUSION: Subjective sleep estimates and frequent nocturnal urination may represent a potential risk for circadian BP abnormalities.

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Noise and sleep on board vessels in the Royal Norwegian Navy.

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Previous research indicates that exposure to noise during sleep can cause sleep disturbance. Seamen on board vessels are frequently exposed to noise also during sleep periods, and studies have reported sleep disturbance in this occupational group. However, studies of noise and sleep in maritime settings are few. This study's aim was to examine the associations between noise exposure during sleep, and sleep variables derived from actigraphy among seamen on board vessels in the Royal Norwegian Navy (RNoN). Data were collected on board 21 RNoN vessels, where navy seamen participated by wearing an actiwatch (actigraph), and by completing a questionnaire comprising information on gender, age, coffee drinking, nicotine use, use of medication, and workload. Noise dose meters were used to assess noise exposure inside the seamen's cabin during sleep. Eighty-three sleep periods from 68 seamen were included in the statistical analysis. Linear mixed-effects models were used to examine the association between noise exposure and the sleep variables percentage mobility during sleep and sleep efficiency, respectively. Noise exposure variables, coffee drinking status, nicotine use status, and sleeping hours explained 24.9% of the total variance in percentage mobility during sleep, and noise exposure variables explained 12.0% of the total variance in sleep efficiency. Equivalent noise level and number of noise events per hour were both associated with increased percentage mobility during sleep, and the number of noise events was associated with decreased sleep efficiency.

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810. Sleep. 2013 Jul 1;36(7):1091-1100.

Non-24-Hour Disorder in Blind Individuals Revisited: Variability and the Influence of Environmental Time Cues.
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STUDY OBJECTIVES: To assess the interindividual and intraindividual variability in the circadian rhythms of blind individuals with non-24-h disorder and to quantify the influence of environmental time cues in blind subjects lacking entrainment (non-24-h individuals or N-24s).

DESIGN: An observational study of 21 N-24s (11 females and 10 males, age 9–78 years) who kept a sleep/wake schedule of their choosing. Circadian phase was determined using the melatonin onset (MO) from plasma or saliva samples that were collected every 2 weeks. Melatonin concentrations were measured by radioimmunoassay. A total of 469 MO assessments were conducted over 5,536 days of study. The rate of drift of circadian phase was calculated using a series of MOs (total number of hours the MO drifted divided by the total number of days studied). Stability of the rest/activity rhythm was calculated using chi-squared periodogram analysis of wrist actigraphy data in 19 subjects.

SETTING: Academic medical center.

PARTICIPANTS: Paid volunteers.

INTERVENTIONS: N/A.

MEASUREMENTS AND RESULTS: Subjects lacked entrainment such that circadian phase drifted an average (± standard deviation) of 0.39 ± 0.29 h later per day; however, there was notable intersubject and intrasubject variability in the rate of drift including relative coordination and periods of transient entrainment during which there was little to no drift in the circadian phase. A regular, reproducible, and significant oscillation in the rate of drift was detected in 14 of the 21 subjects. A significant non-24-h rest/activity rhythm was detected in 18 of 19 subjects. There was a strong correlation (r = 0.793, P = 0.0001) between
the non-24-h rest/activity rhythm and the rate of drift of the circadian phase.
CONCLUSIONS: Most N-24s are influenced by unidentified environmental time cues and the non-entrained biological clock in such N-24s is reflected in their rest/activity rhythms. These findings may have diagnostic and treatment implications: this disorder might be diagnosed with actigraphy alone, relative coordination and transient entrainment may result in misdiagnosis and responsiveness to environmental time cues may influence treatment success with oral melatonin.
CITATION: Emens JS; Laurie AL; Songer JB; Lewy AJ. Non-24-hour disorder in blind individuals revisited: variability and the influence of environmental time cues. SLEEP 2013;36(7):1091-1100.
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Non-24-Hour Sleep-Wake Circadian Rhythm Disorder in a Sighted Male With Normal Functioning.

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ABSTRACT: This is a rare case of non-24-hour sleep-wake rhythm disorder in a sighted male with normal functioning. The patient, a 23-year-old doctorate graduate student, presented with difficulty falling asleep and excessive daytime sleepiness. He reported variable sleep and wake times. Overnight baseline polysomnography was unremarkable and his Multiple Sleep Latency Test was significant for short mean sleep latency. Sleep diary and actigraphy
were obtained, which demonstrated a pattern of delaying of sleep and wake times each day. He had excellent symptom response to nightly melatonin.

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Non-24-Hour Sleep-Wake Disorder Revisited – A Case Study.

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The human sleep-wake cycle is governed by two major factors: a homeostatic hourglass process (process S), which rises linearly during the day, and a circadian process C, which determines the timing of sleep in a ~24-h rhythm in accordance to the external light-dark (LD) cycle. While both individual processes are fairly well characterized, the exact nature of their interaction
remains unclear. The circadian rhythm is generated by the suprachiasmatic nucleus ("master clock") of the anterior hypothalamus, through cell-autonomous feedback loops of DNA transcription and translation. While the phase length (tau) of the cycle is relatively stable and genetically determined, the phase of the clock is reset by external stimuli ("zeitgebers"), the most important being the LD cycle. Misalignments of the internal rhythm with the LD cycle can lead to various somatic complaints and to the development of circadian rhythm sleep disorders (CRSD). Non-24-hour sleep–wake disorders (N24HSWD) is a CRSD affecting up to 50% of totally blind patients and characterized by the inability to maintain a stable entrainment of the typically long circadian rhythm (tau > 24.5 h) to the LD cycle. The disease is rare in sighted individuals and the pathophysiology less well understood. Here, we present the case of a 40-year-old sighted male, who developed a misalignment of the internal clock with the external LD cycle following the treatment for Hodgkin's lymphoma (ABVD regimen, four cycles and AVD regimen, four cycles). A thorough clinical assessment, including actigraphy, melatonin profiles and polysomnography led to the diagnosis of non-24-hour sleep–wake disorders (N24HSWD) with a free-running rhythm of tau = 25.27 h. A therapeutic intervention with bright light therapy (30 min, 10,000 lux) in the morning and melatonin administration (0.5–0.75 mg) in the evening failed to entrain the free-running rhythm, although a longer treatment duration and more intense therapy might have been successful. The sudden onset and close timely connection led us to hypothesize that the chemotherapy might have caused a mutation of the molecular clock components leading to the observed elongation of the circadian period.

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Nonlinear indices of circadian changes in individuals with dementia and aggression.

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Nonlinear analyses of actigraphy data were utilized to investigate circadian rest–activity system motor control in nursing-home residents with dementia and with/without aggressive behavior (AB). Significant differences observed between groups in measures of approximate entropy (ApEn) and fractal dimension (FD). ApEn and FD are sensitive to detecting and characterizing discrete changes in central motoric control and temporality of behaviors in dementia. Findings may inform understanding of clinical heterogeneity and possible physiologic sub-classifications of Alzheimer's dementia.

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Circadian rhythmicity in humans has been well studied using actigraphy, a method of measuring gross motor movement. As actigraphic technology continues to evolve, it is important for data analysis to keep pace with new variables and features. Our objective is to study the behavior of two variables, interdaily stability and intradaily variability, to describe rest activity rhythm. Simulated data and actigraphy data of humans, rats, and marmosets were used in this study. We modified the method of calculation for IV and IS by modifying the time intervals of analysis. For each variable, we calculated the average value (IVm and ISm) results for each time interval. Simulated data showed that (1) synchronization analysis depends on sample size, and (2) fragmentation is independent of the amplitude of the generated noise. We were able to obtain a significant difference in the fragmentation patterns of stroke patients using an IVm variable, while the variable IV60 was not identified. Rhythmic synchronization of activity and rest was significantly higher in young than adults with Parkinson’s when using the ISm variable; however, this difference was not seen using IS60. We propose an updated format to calculate rhythmic fragmentation, including two additional optional variables. These alternative methods of nonparametric analysis aim to more precisely detect sleep-wake cycle fragmentation and synchronization.
OBJECTIVE: There are currently no reference values for actigraphy-measured sleep length and fragmentation in preschool children. We created standardized parameters using a community sample.

METHODS: Ninety-seven 2-to-6-year-old children (56 boys) wore an actigraph on their non-dominant wrist for seven days. The data was extracted and scored, calculating total sleep time, sleep latency, sleep efficiency, fragmentation index, circadian rhythm length, cosine peak and light/dark ratio.
Subjects were divided into groups of 2-3-year-olds, 4-5-year-olds and 6-year-olds. Means and standard deviations were calculated, and reference values were created using the 2.5th and the 97.5th percentiles.

RESULTS: Reference intervals were 7 h 23 min–9 h 47 min for 24-hour total sleep time, 0.2–48.4 min for sleep latency, 69–87% for sleep efficiency, 23–53% for fragmentation index, 23 h 39 min–24 h 24 min for circadian rhythm length, 12:37–15:53 for the timing of the cosine peak, and 1.14–5.63 for the light-dark ratio. With increasing age, daily sleep time, sleep latency, sleep fragmentation, and napping decreased.

CONCLUSIONS: We were able to create previously non-established reference values, including trends with increasing age, on actigraphy-assessed sleep in preschool children.

SIGNIFICANCE: Sleep disorders in young children are easier to evaluate against normative data.

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Not later, but longer: sleep, chronotype and light exposure in adolescents with remitted depression compared to healthy controls.

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The relationship between sleep and adolescent depression is much discussed, but still not fully understood. One important sleep variable is self-selected sleep timing, which is also referred to as chronotype. Chronotype is mostly regulated by the circadian clock that synchronises the internal time of the body with the external light dark cycle. A late chronotype as well as a misalignment between internal time and external time such as social jetlag has been shown to be associated with depressive symptoms in adults. In this study, we investigated whether adolescents with remitted depression differ from healthy controls in terms of chronotype, social jetlag and other sleep-related variables. For this purpose, we assessed chronotype and social jetlag with the Munich ChronoType Questionnaire (MCTQ), subjective sleep quality with the Pittsburgh Sleep Quality Index (PSQI) and used continuous wrist-actimetry over 31 consecutive days to determine objective sleep timing. Given the potentially mediating effect of light on chronotype and depressive symptoms, we measured light exposure with a light sensor on the actimeter. In our sample, adolescents with remitted depression showed similar chronotypes and similar amounts of social jetlag compared to controls. However, patients with remitted depression slept significantly longer on work-free days and reported a worse subjective sleep quality than controls. Additionally, light exposure in remitted patients was significantly higher, but this finding was mediated by living in a rural environment. These findings indicate that chronotype might be modified during remission, which
should be further investigated in longitudinal studies.

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A novel machine learning unsupervised algorithm for sleep/wake identification using actigraphy.


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Actigraphy is widely used in sleep studies but lacks a universal unsupervised algorithm for sleep/wake identification. An unsupervised algorithm is useful in large-scale population studies and in cases where polysomnography (PSG) is unavailable, as it does not require sleep outcome labels to train the model but utilizes information solely contained in actigraphy to learn sleep and wake characteristics and separate the two states. In this study, we proposed a machine learning unsupervised algorithm based on the Hidden Markov Model (HMM) for
sleep/wake identification. The proposed algorithm is also an individualized approach that takes into account individual variabilities and analyzes each individual actigraphy profile separately to infer sleep and wake states. We used Actiwatch and PSG data from 43 individuals in the Multi-Ethnic Study of Atherosclerosis study to evaluate the method performance. Epoch-by-epoch comparisons and sleep variable comparisons were made between our algorithm, the unsupervised algorithm embedded in the Actiwatch software (AS), and the pre-trained supervised UCSD algorithm. Using PSG as the reference, the accuracy was 85.7% for HMM, 84.7% for AS, and 85.0% for UCSD. The sensitivity was 99.3%, 99.7%, and 98.9% for HMM, AS, and UCSD, respectively, and the specificity was 36.4%, 30.0%, and 31.7%, respectively. The Kappa statistic was 0.446 for HMM, 0.399 for AS, and 0.311 for UCSD, suggesting fair to moderate agreement between PSG and actigraphy. The Bland-Altman plots further show that the total sleep time, sleep latency, and sleep efficiency estimates by HMM were closer to PSG with narrower 95% limits of agreement than AS and UCSD. All three methods tend to overestimate sleep and underestimate wake compared to PSG. Our HMM approach is also able to differentiate relatively active and sedentary individuals by quantifying variabilities in activity counts: individuals with higher estimated activity variabilities tend to show more frequent sedentary behaviors. Our unsupervised data-driven HMM algorithm achieved better performance than the commonly used Actiwatch software algorithm and the pre-trained UCSD algorithm. HMM can help expand the application of actigraphy in cases where PSG is hard to acquire and supervised methods cannot be trained. In addition, the estimated HMM parameters can characterize individual activity patterns and sedentary tendencies that can be further utilized in downstream analysis.
A novel sleep optimisation programme to improve athletes' well-being and performance.


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OBJECTIVES: To improve well-being and performance indicators in a group of Australian Football League (AFL) players via a six-week sleep optimisation programme.

DESIGN: Prospective intervention study following observations suggestive of reduced sleep and excessive daytime sleepiness in an AFL group.

METHODS: Athletes from the Adelaide Football Club were invited to participate if they had played AFL senior-level football for 1-5 years, or if they had excessive daytime sleepiness (Epworth Sleepiness Scale [ESS] >10), measured via ESS. An initial education session explained normal sleep needs, and how to achieve
increased sleep duration and quality. Participants (n = 25) received ongoing feedback on their sleep, and a mid-programme education and feedback session. Sleep duration, quality and related outcomes were measured during week one and at the conclusion of the six-week intervention period using sleep diaries, actigraphy, ESS, Pittsburgh Sleep Quality Index, Profile of Mood States, Training Distress Scale, Perceived Stress Scale and the Psychomotor Vigilance Task.

RESULTS: Sleep diaries demonstrated an increase in total sleep time of approximately 20 min (498.8 ± 53.8 to 518.7 ± 34.3; p < .05) and a 2% increase in sleep efficiency (p < 0.05). There was a corresponding increase in vigour (p < 0.001) and decrease in fatigue (p < 0.05).

CONCLUSIONS: Improvements in measures of sleep efficiency, fatigue and vigour indicate that a sleep optimisation programme may improve athletes' well-being. More research is required into the effects of sleep optimisation on athletic performance.

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'nparACT' package for R: A free software tool for the non-parametric analysis of actigraphy data.

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For many studies, participants' sleep-wake patterns are monitored and recorded prior to, during and following an experimental or clinical intervention using actigraphy, i.e. the recording of data generated by movements. Often, these data are merely inspected visually without computation of descriptive parameters, in part due to the lack of user-friendly software. To address this deficit, we developed a package for R Core Team [6], that allows computing several non-parametric measures from actigraphy data. Specifically, it computes the interdaily stability (IS), intradaily variability (IV) and relative amplitude (RA) of activity and gives the start times and average activity values of M10 (i.e. the ten hours with maximal activity) and L5 (i.e. the five hours with least activity). Two functions compute these 'classical' parameters and handle either single or multiple files. Two other functions additionally allow computing an L-value (i.e. the least activity value) for a user-defined time span termed 'Lflex' value. A plotting option is included in all functions. The package can be downloaded from the Comprehensive R Archives Network (CRAN). •The package 'nparACT' for R serves the non-parametric analysis of actigraphy data. •Computed parameters include interdaily stability (IS), intradaily variability (IV) and relative amplitude (RA) as well as start times and average activity during the 10 h with maximal and the 5 h with minimal activity (i.e. M10 and L5).

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PMID: 27294030


Objective assessment of circadian activity and sleep patterns in individuals at behavioural risk of hypomania.

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Although sleep and circadian rhythm disturbances are significant features of bipolar disorder and are associated with illness severity and recurrence, less is known about their significance prior to illness onset. Therefore, this study investigated these variables using objective assessment methods within a sample at high-risk of bipolar spectrum disorders. Thirty-one high-risk and 24 age- and gender-matched control participants wore an actigraph for 7 days to obtain sleep and circadian activity data. Self-report measures of mood, bed and get-up times, and cognitive style were also obtained. High-risk participants exhibited greater variability in duration, fragmentation, and efficiency of sleep, shorter sleep duration, and later and more variable bedtimes than controls. They also had lower relative amplitude of activity patterns and made more positive self-appraisals for hypomanic experiences. Logistic regression showed that positive self-appraisal and variability in bedtime significantly discriminated between the two groups. Results suggest that sleep and circadian activity differences are apparent in high-risk participants and, therefore, may not simply represent an artifact of the illness. Such individuals also report cognitive styles consistent with those observed in bipolar patients. Relevance of these results to current evolutions of the instability theory of bipolar disorder is discussed.

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Stress Disorder.


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BACKGROUND: Wearables have been gaining increasing momentum and have enormous potential to provide insights into daily life behaviors and longitudinal health monitoring. However, to date, there is still a lack of principled algorithmic framework to facilitate the analysis of actigraphy and objectively characterize day-by-day data patterns, particularly in cohorts with sleep problems.

OBJECTIVE: This study aimed to propose a principled algorithmic framework for the assessment of activity, sleep, and circadian rhythm patterns in people with posttraumatic stress disorder (PTSD), a mental disorder with long-lasting distressing symptoms such as intrusive memories, avoidance behaviors, and sleep disturbance. In clinical practice, these symptoms are typically assessed using retrospective self-reports that are prone to recall bias. The aim of this study was to develop objective measures from patients' everyday lives, which could potentially considerably enhance the understanding of symptoms, behaviors, and treatment effects.

METHODS: Using a wrist-worn sensor, we recorded actigraphy, light, and temperature data over 7 consecutive days from three groups: 42 people diagnosed with PTSD, 43 traumatized controls, and 30 nontraumatized controls. The participants also completed a daily sleep diary over 7 days and the standardized
Pittsburgh Sleep Quality Index questionnaire. We developed a novel approach to automatically determine sleep onset and offset, which can also capture awakenings that are crucial for assessing sleep quality. Moreover, we introduced a new intuitive methodology facilitating actigraphy exploration and characterize day-by-day data across 49 activity, sleep, and circadian rhythm patterns.

RESULTS: We demonstrate that the new sleep detection algorithm closely matches the sleep onset and offset against the participants' sleep diaries consistently outperforming an existing open-access widely used approach. Participants with PTSD exhibited considerably more fragmented sleep patterns (as indicated by greater nocturnal activity, including awakenings) and greater intraday variability compared with traumatized and nontraumatized control groups, showing statistically significant (P<.05) and strong associations (|R|>0.3).

CONCLUSIONS: This study lays the foundation for objective assessment of activity, sleep, and circadian rhythm patterns using passively collected data from a wrist-worn sensor, facilitating large community studies to monitor longitudinally healthy and pathological cohorts under free-living conditions. These findings may be useful in clinical PTSD assessment and could inform therapy and monitoring of treatment effects.


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PMID: 32310142


[Objective improvement of sleep disorders in the elderly by a health education program].

[Article in French]
INTRODUCTION: The prevalence of sleep disorders increases with age and reaches 20 to 40% of those older than 60 years. We set up a health education program to help the elderly to improve their sleep. It includes a preliminary 9-day evaluation with a sleep diary and wrist actigraph, a day of group cognitive behavioral therapy, and a follow-up assessment, again with sleep diary and actigraph.

METHODS: Of the 26 study participants (9 men and 17 women, mean age: 68+/-1 years), 14 had insomnia with night awakenings of 1 hour or longer or a sleep latency of 30 minutes or longer or both (group 1). The other 12 (group 2) also complained of insufficient sleep.

RESULTS: In the weeks following cognitive behavioral therapy, group 1 improved their total sleep time by an average of 24 to 33 minutes, with reduced night-time awakenings and sleep latency and no change in their time spent in bed. Those in group 2 also increased their total sleep time by 18 to 47 minutes, by spending more time in bed and maintaining a sleep efficiency close to 88%.

CONCLUSION: This study showed that cognitive behavioral therapy coupled with individual sleep evaluation improves sleep duration in elderly people who complain of insufficient sleep. These beneficial effects were accompanied by positive assessments of both subjective sleep quality and morning energy.

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PMID: 17659860 [Indexed for MEDLINE]


Objective investigation of the sleep-wake cycle in adults with intellectual disabilities and autistic spectrum disorders.
BACKGROUND: Disturbances in circadian rhythm functioning, as manifest in abnormal sleep-wake cycles, have been postulated to be present in people with autistic spectrum disorders (ASDs). To date, research into the sleep-wake cycle in people with ASDs has been primarily dependant on third-party data collection.

METHOD: The utilization of non-invasive objective recording technologies such as actigraphy permits investigation of both sleep and circadian rhythm functioning in people with ASDs, together with the collection of data on daytime activity.

RESULTS: Data were collected from 31 participants with intellectual disabilities living in supported community-based residential provision aged between 20 and 58 years, of whom 14 had an ASD. Analysis indicated that there were no significant differences in sleep patterns and circadian rhythm function between those participants with an ASD and those without.

CONCLUSIONS: The mean scores of the participants as a whole indicated abnormalities in the two key circadian rhythm parameters of interdaily stability and intradaily variability. The implications of these findings for both clinical practice and theory are discussed.

DOI: 10.1111/j.1365-2788.2006.00830.x
PMID: 16961699 [Indexed for MEDLINE]
BACKGROUND AND OBJECTIVES: Shorter sleep duration is associated with childhood obesity. Few studies measure sleep quantity and quality objectively or examine cardiometabolic biomarkers other than obesity.

METHODS: This cross-sectional study of 829 adolescents derived sleep duration, efficiency and moderate-to-vigorous physical activity from >5 days of wrist actigraphy recording for >10 hours/day. The main outcome was a metabolic risk score (mean of 5 sex-specific z-scores for waist circumference, systolic blood pressure, high-density lipoprotein cholesterol scaled inversely, and log-transformed triglycerides and homeostatic model assessment of insulin resistance), for which higher scores indicate greater metabolic risk. Secondary outcomes included score components and dual-energy radiograph absorptiometry fat mass. We measured socioeconomic status, race and/or ethnicity, pubertal status, and obesity-related behaviors (television-viewing and fast food and sugar-sweetened beverage consumption) using
RESULTS: The sample was 51.5% girls; mean (SD) age 13.2 (0.9) years, median (interquartile range) sleep duration was 441.1 (54.8) minutes per day and sleep efficiency was 84.0% (6.3). Longer sleep duration was associated with lower metabolic risk scores (−0.11 points; 95% CI: −0.19 to −0.02, per interquartile range). Associations with sleep efficiency were similar and persisted after adjustment for BMI z score and physical activity, television-viewing, and diet quality. Longer sleep duration and greater sleep efficiency were also favorably associated with waist circumference, systolic blood pressure, high-density lipoprotein cholesterol, and fat mass. CONCLUSIONS: Longer sleep duration and higher sleep efficiency were associated with a more favorable cardiometabolic profile in early adolescence, independent of other obesity-related behaviors. These results support the need to assess the role of sleep quantity and quality interventions as strategies for improving cardiovascular risk profiles of adolescents.

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Conflict of interest statement: POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.


Objective Sleep Duration in Older Adults: Results From The Irish Longitudinal Study on Ageing.

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Author information:
OBJECTIVE: This study assessed the distribution and correlates of objective sleep duration in the older population in Ireland.

DESIGN: Cross-sectional study using population-derived data from wave 3 of The Irish Longitudinal Study on Ageing.

SETTING: Community-dwelling adults.

PARTICIPANTS: Adults, aged 50 years and older, who wore an accelerometer for at least 4 days (N = 1533).

MEASUREMENTS: Sleep was measured for at least 4 days in 1533 participants using a GENEActiv wrist-worn accelerometer device. Sleep parameters included total sleep time (TST) and self-reported sleep problems. TST was categorized as short and long sleep duration using US National Sleep Foundation guidelines. Linear and multinomial logistic regression models assessed sociodemographic, health, and behavioral correlates of sleep duration.

RESULTS: Mean TST for the sample was 463 minutes (SD = 72.6 minutes). Of participants, 13.9% and 16.5% measured short and long sleep duration, respectively. TST decreased as sleep problems increased, as did durations recorded in summer compared to winter recordings. Advancing age was associated with longer sleep, as was antidepressant use. Retired/unemployed participants recorded longer TST and were more likely to record long sleep compared to employed participants. Fair/poor self-rated health and separated/divorced participants were more likely to record short sleep. Those reporting moderate or high physical activity were less likely to record short or long sleep, respectively, compared to those reporting low physical activity. Participants reporting a limiting disability were less likely to record long sleep.

CONCLUSION: Average TST was within recommended guidelines; however, a significant subset of older adults recorded sleep duration outside of the
Independent demographic and health correlates of suboptimal sleep were identified, many of which are modifiable. Patients and clinicians should be aware of factors potentially influencing sleep patterns. Longitudinal analyses to confirm directionality of relationships with potential risk factors are warranted. J Am Geriatr Soc 68:120-128, 2019.

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Objective sleep quality and night-time blood pressure in the general elderly population: a cross-sectional study of the HEIJO-KYO cohort.

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OBJECTIVES: Night-time blood pressure (BP) – prognostically more important than circadian BP variability – has not been evaluated for quantitative associations with objective sleep quality in large populations.

METHODS: The cross-sectional study measured actigraphic sleep parameters and night-time BP for two nights in 1101 elderly participants.

RESULTS: Mean age of the participants was 71.8 years, and mean night-time SBP and DBP were 115.9 ± 16.2 and 66.9 ± 8.4 mmHg, respectively. Multivariable analysis controlling for potential confounders revealed that the lowest sleep efficiency quartile group exhibited significantly higher night-time SBP and DBP than the highest quartile group [mean difference: SBP, 4.7 mmHg, 95% confidence
interval (CI), 2.0-7.3; DBP, 2.3 mmHg, 95% CI 0.9-3.7). The longest wake after sleep onset and sleep-onset latency quartile groups exhibited significantly higher night-time SBP (3.1 mmHg, 95% CI 0.3-5.9 and 3.4 mmHg, 95% CI 0.8-6.0) and DBP (2.0 mmHg, 95% CI 0.5-3.5 and 1.9 mmHg 95% CI 0.5-3.3), respectively, than the shortest quartile group. Significantly lower night-time SBP (3.0 mmHg, 95% CI 0.01-6.1) was observed in the longest total sleep time quartile group than in the shortest quartile group. These results were similar on sensitivity analyses excluding participants with possible sleep-disordered breathing (n = 69) or nocturnal hypertension (n = 503).

CONCLUSION: Decreased sleep quality on actigraphy was significantly associated with higher night-time BP in a large general elderly population. Clinically significant increase in night-time BP exists in relation to decreased objective sleep quality.

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Objectively Assessed Sleep Variability as an Acute Warning Sign of Suicidal Ideation in a Longitudinal Evaluation of Young Adults at High Suicide Risk.

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OBJECTIVE: Young adults attempt suicide at disproportionately high rates relative to other groups and demonstrate high rates of sleep disturbance. No study has yet prospectively evaluated disturbed sleep as an acute indicator of risk using an objective index of sleep. We investigated objective and subjective parameters of disturbed sleep as a warning sign of suicidal ideation among young adults over an acute period.

METHODS: A longitudinal study across a 21-day observation period and 3 time points. Fifty of 4,847 participants (aged 18–23 years) were prescreened from a university undergraduate research pool (February 2007–June 2008) on the basis of suicide attempt history and recent suicidal ideation. Actigraphic and subjective sleep parameters were evaluated as acute predictors of suicidal ideation (Beck Scale for Suicide Ideation), with adjustment for baseline symptoms. Hierarchical regression analyses were employed to predict residual change scores.

RESULTS: Ninety-six percent of participants (n = 48) endorsed a suicide attempt history. Mean actigraphy values revealed objectively disturbed sleep parameters; 78% (n = 39) and 36% (n = 18) endorsed clinically significant insomnia and nightmares, respectively. When results were controlled for baseline suicidal and depressive symptoms, actigraphic and subjective sleep parameters predicted suicidal ideation residual change scores at 7- and 21-day follow-ups (P < .001). Specifically, actigraphy-defined variability in sleep timing, insomnia, and nightmares predicted increases in suicidal ideation (P < .05). In a test of competing risk factors, sleep variability outperformed depressive symptoms in the longitudinal prediction of suicidal ideation across time points (P < .05).

CONCLUSIONS: Objectively and subjectively measured sleep disturbances predicted acute suicidal ideation increases in this population, independent of
depressed mood. Self-reported insomnia and nightmares and actigraphically assessed sleep variability emerged as acute warning signs of suicidal ideation. These findings highlight the potential utility of sleep as a proposed biomarker of suicide risk and a therapeutic target.

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Objectively Measured Light Exposure in Emmetropic and Myopic Adults.

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PURPOSE: Light exposure has a close link with numerous aspects of human physiology including circadian rhythm, mood disorders, metabolism, and eye growth. Here, a lightweight wrist-worn device was employed to continuously measure light exposure and activity across seasons and between refractive error groups to assess objectively measured differences and compare with subjectively reported data.

METHODS: Subjects, aged 21-65 years (n = 55), wore an actigraph device (Actiwatch Spectrum) continuously for 14 days to quantify light exposure, activity, and sleep. Subjects were classified as emmetropic (n = 18) or myopic (n = 37), and answered an activity questionnaire. Additionally, devices were calibrated against a lux meter and UV sensor for indoor and outdoor settings, and used to measure ambient illumination in various environmental conditions.

RESULTS: Subjects spent 1:52 ± 0:56 hours outside per day, as measured
objectively. Subjectively reported measures overestimated objective measures by 0:25 ± 1:19 hours per day (range -1:49 to +4:29 hours, P < .05). Subjects spent 1:04 hours more outdoors in summer and received an increased cumulative light dose compared to winter (P < .005). There were no significant differences in objective measurements of time outdoors between myopic and emmetropic subjects.

Ambient illumination measures from the Actiwatch correlated with a lux meter for all locations tested (R = 0.99, P < .001). Ambient illumination was highest in the summer at 176,497 ± 20,310 lux and lowest for indoor artificial light at 142 ± 150 lux.

CONCLUSIONS: Subjects spent more time outdoors and received an increased light dose in summer, with no differences between refractive error groups in this adult population. Various environmental and seasonal measurements revealed significantly different available light in winter versus summer and indoors versus outdoors. Objective devices such as the Actiwatch can be valuable in studies where quantification of environmental factors is critical.

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Objectively measured physical activity, sedentary time and sleep duration: independent and combined associations with adiposity in canadian children.

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OBJECTIVE: To examine independent and combined associations among objectively measured movement/non-movement behaviors (moderate-to-vigorous-intensity physical activity (MVPA), total sedentary time and sleep duration) and adiposity indicators in a sample of Canadian children.

METHODS: A cross-sectional study was conducted on 507 children aged 9-11 years from Ottawa, Canada. Movement/non-movement behaviors were assessed using an Actigraph GT3X+ accelerometer over 7 days (24-h protocol). Outcomes included percentage body fat (bioelectrical impedance) and waist-to-height ratio.

RESULTS: After adjustment for age, sex, ethnicity, maturity offset, fast food consumption, annual household income and highest level of parental education, MVPA was inversely and sedentary time positively associated with adiposity indicators, whereas sleep duration was not. However, only MVPA remained significantly associated with adiposity indicators after additional adjustment for the other movement/non-movement behaviors. Combined associations using tertiles of the three movement/non-movement behaviors showed that higher levels of MVPA were associated with lower adiposity indicators, irrespective of total sedentary time and sleep duration.
CONCLUSIONS: Higher levels of MVPA were associated with lower adiposity in this sample of children regardless of sedentary time and sleep duration. Although correlational in nature, these findings suggest that future efforts of obesity reduction should focus more on increasing MVPA than on reducing sedentary time or increasing sleep duration to maximize the effectiveness of interventions.

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PMID: 24911633


Objectively measured sleep duration and hyperglycemia in pregnancy.

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OBJECTIVE: Our primary purpose was to assess the impact of objectively measured nighttime sleep duration on gestational glucose tolerance. We additionally examined associations of objectively measured daytime sleep duration and nap frequency on maternal glycemic control.

METHODS: Sixty-three urban, low-income, pregnant women wore wrist actigraphs for an average of 6 full days in mid-pregnancy prior to screening for hyperglycemia using the 1-h oral glucose tolerance test (OGTT). Correlations of nighttime and daytime sleep durations with 1-h OGTT values were analyzed. Multivariable logistic regression was used to evaluate independent associations between sleep parameters and hyperglycemia, defined as 1-h OGTT values ≥130 mg/dL.

RESULTS: Mean nighttime sleep duration was 6.9±0.9 h which was inversely correlated with 1-h OGTT values (r=-0.28, P=.03). Shorter nighttime sleep was associated with hyperglycemia, even after controlling for age and body mass index (adjusted odds ratio [OR], 0.2 [95% confidence interval {CI}, 0.1-0.8]). There were no associations of daytime sleep duration and nap frequency with 1-h OGTT values or hyperglycemia.

CONCLUSIONS: Using objective measures of maternal sleep time, we found that women with shorter nighttime sleep durations had an increased risk for gestational hyperglycemia. Larger prospective studies are needed to confirm our negative daytime sleep findings.

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Objectively measured sleep patterns in young adult women and the relationship to adiposity.

Bailey BW, Allen MD, LeCheminant JD, Tucker LA, Errico WK, Christensen WF, Hill MD.

PURPOSE: The purpose of this study was to examine the relationship between sleep patterns and adiposity in young adult women.

DESIGN: Cross-sectional.

SETTING: The study took place at two Mountain West region universities and surrounding communities.

SUBJECTS: Subjects were 330 young adult women (20.2 ± 1.5 years).

MEASURES: Sleep and physical activity were monitored for 7 consecutive days and nights using actigraphy. Height and weight were measured directly. Adiposity was assessed using the BOD POD.

ANALYSIS: Regression analysis, between subjects analysis of variance, and structural equation modeling were used.

RESULTS: Bivariate regression analysis demonstrated that sleep efficiency was negatively related to adiposity and that the 7-day standard deviations of bedtime, wake time, and sleep duration were positively related to adiposity (p < .05). Controlling for objectively measured physical activity strengthened the relationship between sleep duration and adiposity by 84% but had a statistically negligible impact on all other relationships that were analyzed. However, multivariate structural equation modeling indicated that a model including sleep efficiency, sleep pattern inconsistency (latent variable consisting of the 7-day standard deviations of bedtime, wake time, and sleep duration), and
physical activity was the best for predicting percent body fat.

CONCLUSION: Inconsistent sleep patterns and poor sleep efficiency are related to adiposity. Consistent sleep patterns that include sufficient sleep may be important in modifying risk of excess body fat in young adult women.

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Occupational and socioeconomic differences in actigraphically measured sleep.

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Occupational conditions, together with socioeconomic status, may modulate sleep. This study examined the association of occupational conditions and socioeconomic status with actigraphic measures of sleep in workers. Fifty-five employees (40 ± 12 years) wore a wrist actigraph during sleep for seven consecutive nights. Sleep variables addressed included total sleep time, sleep efficiency, mean activity during sleep, sleep-onset latency, and wake after sleep onset. We also measured household income, occupational class, work schedule, weekly work hours, job demand, job control, worksite social support, effort-reward imbalance, organizational justice, and workplace social capital. Multiple linear regression models were used to determine the association of occupational indicators, socioeconomic status, as well as age and gender with each sleep variable. Higher workplace social capital was associated consistently with longer total sleep time (P < 0.001), higher sleep efficiency (P < 0.05) and lower mean activity during
sleep (P < 0.07). Low occupational class (P < 0.01), higher job demand
(P < 0.05) and lower job control (P < 0.05) were associated with longer total
sleep time. No associations were significant for sleep-onset latency or wake after
sleep onset. These preliminary results suggest that enhanced workplace social
capital is closely associated with better quality and quantity of sleep.

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Older schizophrenia patients have more disrupted sleep and circadian
rhythms than age-matched comparison subjects.

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Patient reports and laboratory studies suggest schizophrenia patients have
disrupted sleep across age groups. Studies have not compared overall
sleep/wake patterns or circadian (24-h) activity rhythms of older community
dwelling schizophrenia patients to matched comparison subjects. This study
examined whether older schizophrenia patients had more disrupted sleep/wake
patterns and circadian activity rhythms than age- and gender-matched normal
comparison subjects (NCS). Twenty-eight older schizophrenia patients and 28 age-
and gender-matched NCS were studied with three days of continuous wrist
actigraphy. Nighttime and daytime actigraphically estimated sleep and wake,
circadian activity rhythms and light exposure patterns were compared with and
without years of education as a covariate. Patients spent longer in bed, had more disrupted nighttime sleep, slept more during the day, and had less robust circadian rhythms of activity and light exposure compared to NCS. Differences persisted in education-adjusted analyses. Within patients, working was associated with improved sleep and circadian rhythms. Findings suggest the sleep and circadian rhythm disruption of older schizophrenia patients was more extensive than that of matched NCS suggesting patients' sleep disruption was above and beyond what is attributable to advanced age alone. A need exists to develop multicomponent interventions to address sleep difficulties specific to older schizophrenia patients.

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On the origin and the consequences of circadian abnormalities in patients with cirrhosis.

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OBJECTIVES: Plasma melatonin profile abnormalities have been described in patients with cirrhosis and generally attributed to impaired hepatic melatonin metabolism. The possibility that they might reflect circadian clock dysfunction has not been explored. In addition, the relationship between plasma melatonin profiles and the sleep disturbances observed in these patients remains unclear.
The aims of this study were: (i) to evaluate circadian clock function and hepatic melatonin metabolism in cirrhotic patients, and (ii) to study the relationship between plasma melatonin profiles and sleep-wake behavior.

METHODS: The study population comprised 20 patients with cirrhosis (mean (range) age, 59 (39–77) years) and 9 healthy volunteers (60 (38–84) years). Plasma melatonin/cortisol concentrations were measured hourly, for 24 h, in light/posture-controlled conditions. Urinary 6-sulfatoxymelatonin, the main melatonin metabolite, was measured simultaneously to determine clearance. The ability of light to suppress nocturnal melatonin synthesis was assessed. Habitual sleep quality/timing was evaluated using a questionnaire, actigraphy, and sleep diaries.

RESULTS: There was evidence of central circadian disruption in patients compared with healthy controls: peak plasma melatonin/cortisol times were delayed (04:48+/−02:36 vs. 02:48+/−00:54, P=0.01; 10:18+/−02:54 vs. 08:54+/−01:24, P=0.06) and the plasma melatonin response to light was reduced (12%+/−19% vs. 24%+/−15%, P=0.09). However, the mean 24 h plasma melatonin clearance did not differ significantly between patients and healthy volunteers (0.22+/−0.10 vs. 0.28+/−0.17 l/kg per h, P=0.36). Finally, although patients showed a degree of misalignment between sleep and circadian timings, there was no association between circadian abnormalities and impaired sleep quality.

CONCLUSIONS: Plasma melatonin profile abnormalities, predominantly central in origin, are observed in patients with mild to moderately decompensated cirrhosis. However, they are substantially unrelated to the sleep disturbances prevalent in this population.
Online cognitive behavioral therapy for insomnia (CBT-I) for the treatment of insomnia among individuals with alcohol use disorder: study protocol for a randomized controlled trial.

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Abstract: Alcohol use disorder (AUD) is characterized by problematic drinking that becomes severe. Individuals with AUD often experience insomnia and other sleep disturbances at various phases of recovery. Cognitive behavioral therapy for insomnia (CBT-I) is an efficacious non-pharmacological treatment for insomnia and is recommended as a first-line treatment for adults with chronic insomnia. Internet-based CBT-I could play a key role in the dissemination of this behavioral sleep intervention, given the paucity of trained clinicians able to provide CBT-I in person and other logistical/cost concerns. SHUTi (Sleep Healthy Using The Internet) is the most tested and empirically-sound Internet intervention for insomnia. Despite the promise of Internet-based CBT-I interventions, to date, no randomized controlled trials (RCTs) exist examining the feasibility/efficacy of an Internet-based CBT-I program among treatment-seeking individuals recovering from AUD. This is a two-phase RCT assessing feasibility/acceptability and efficacy of the SHUTi program among individuals with AUD in recovery with insomnia. Phase I will focus on assessing the feasibility and acceptability of program delivery and data
collection
\((n=10)\). Phase II will be an RCT powered to examine preliminary intervention efficacy \((n=30\) per group). Participants for this study must meet criteria for "moderate to severe" insomnia. Individuals randomized to the intervention group will receive the SHUTi intervention (initiated while inpatient and completed while outpatient), and individuals randomized to the control group will receive an educational web-based program. The goals of the study are as follows: (1) assess the feasibility and acceptability of Internet-based CBT-I among individuals with AUD in recovery with insomnia (phase I), (2) compare the preliminary efficacy of CBT-I versus control group with respect to primary and secondary outcome variables (phase II), and (3) explore specific domains associated with improved outcomes, e.g., demographic, psychiatric, and drinking-related factors (phase II). Primary outcome measures include changes in insomnia severity over time and changes in actigraphy-recorded sleep efficiency over time.

Trial registration: NCT#03493958; registered 1 June 2018.

DOI: 10.1186/s40814-018-0376-3
PMCID: PMC6287341
PMID: 30555713

Conflict of interest statement: This study was approved by the NIH Addictions Institutional Review Board in March of 2018. All study participants will provide written informed consent. Not applicable. Drs. Ritterband and Thorndike have equity ownership in BeHealth Solutions, LLC, a company developing and making available products related to the research reported in this publication. Specifically, BeHealth Solutions, LLC has licensed the SHUTi program and the software platform on which it was built from the University of Virginia. The terms of this arrangement have been reviewed and approved by the University of Virginia and the National Institutes of Health in accordance with their conflict of interest
OBJECTIVE: To examine the feasibility, acceptability, and effects of a home-based morning bright light treatment on pain, mood, sleep, and circadian timing in US veterans with chronic low back pain.
DESIGN: An open treatment trial with a seven-day baseline, followed by 13 days of a one-hour morning bright light treatment self-administered at home. Pain, pain sensitivity, mood, sleep, and circadian timing were assessed before, during, and after treatment.
SETTING: Participants slept at home, with weekly study visits and home saliva collections.
PARTICIPANTS: Thirty-seven US veterans with medically verified chronic low back pain.
METHODS: Pain, mood, and sleep quality were assessed with questionnaires. Pain sensitivity was assessed using two laboratory tasks: a heat stimulus and an ischemia stimulus that gave measures of threshold and tolerance. Sleep was objectively assessed with wrist actigraphy. Circadian timing was
assessed with the dim light melatonin onset.

RESULTS: Morning bright light treatment led to reduced pain intensity, pain behavior, thermal pain threshold sensitivity, post-traumatic stress disorder symptoms, and improved sleep quality (P < 0.05). Phase advances in circadian timing were associated with reductions in pain interference (r = 0.55, P < 0.05).

CONCLUSIONS: Morning bright light treatment is a feasible and acceptable treatment for US veterans with chronic low back pain. Those who undergo morning bright light treatment may show improvements in pain, pain sensitivity, and sleep. Advances in circadian timing may be one mechanism by which morning bright light reduces pain. Morning bright light treatment should be further explored as an innovative treatment for chronic pain conditions.

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Optical performance characterization of light-logging actigraphy dosimeters.

Price LL, Lyachev A, Khazova M.

There are several wearable products specially developed or marketed for studying sleep, circadian rhythms, and light levels. However, new recommendations relating to human physiological responses to light have changed what measurements researchers may demand. The performances of 11 light-logging dosimeters from eight manufacturers were compared. The directional and spectral sensitivities, linearity, dynamic range, and resolution were tested for seven models,
and compared along with other published data. The sample mainly comprised light-logging actigraphy dosimeters wearable as badges, in accordance with measurement protocols for larger-scale field studies. A proposed standard for optical performance assessments is set out.

DOI: 10.1364/JOSAA.34.000545
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Optimized Sleep After Brain Injury (OSABI): A Pilot Study of a Sleep Hygiene Intervention for Individuals With Moderate to Severe Traumatic Brain Injury.


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Background. Disrupted sleep is common after traumatic brain injury (TBI) particularly in the inpatient rehabilitation setting where it may affect participation in therapy and outcomes. Treatment of sleep disruption in this setting is varied and largely unexamined. Objective. To study the feasibility of instituting a sleep hygiene intervention on a rehabilitation unit. Methods. Twenty-two individuals admitted to a brain injury unit were enrolled and allocated, using minimization, to either a sleep hygiene protocol (SHP) or standard of care (SOC). All participants wore actigraphs, underwent serial cognitive testing, and had light monitors placed in their hospital rooms for 4 weeks. Additionally, participants in the SHP received 30 minutes of
blue-light therapy each morning, had restricted caffeine intake after noon, and were limited to 30-minute naps during the day. SHP participants had their lights out time set according to preinjury sleep time preference. Both groups were treated with the same restricted formulary of centrally acting medications. Results. Of 258 patients screened, 27 met all study inclusion criteria of whom 22 were enrolled. Nine participants in each group who had at least 21 days of treatment were retained for analysis. The protocol was rated favorably by participants, families, and staff. Actigraph sleep metrics improved in both groups during the 4-week intervention; however, only in the SHP was the change significant. Conclusions. Sleep hygiene is a feasible, nonpharmacologic intervention to treat disrupted sleep in a TBI inpatient rehabilitation setting. A larger study is warranted to examine treatment efficacy. ClinicalTrials.gov Identifier: NCT02838082.

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PMID: 31884895


Outer Retinal Structure and Function Deficits Contribute to Circadian Disruption in Patients With Type 2 Diabetes.

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Purpose: Light transmitted by retinal photoreceptors provides the input for circadian photoentrainment. In diabetes, there is a high prevalence of circadian and sleep disruption but the underlying causes are not well understood. Patients with diabetes can exhibit dysfunctional photoreceptors but their role in circadian health is not known. Here we quantify photoreceptor function and contributions to circadian health and sleep in patients with diabetes without diabetic retinopathy and healthy controls.

Methods: Rod, cone, and melanopsin function was derived using chromatic pupillometry in 47 participants including 23 patients with type 2 diabetes and 24 age-matched healthy controls after an ophthalmic examination including retinal thickness assessment using optical coherence tomography. Circadian health was determined using dim light melatonin onset (DLMO) and sleep questionnaires; light exposure was measured using actigraphy.

Results: Compared with the control group, the patients with diabetes had a significantly earlier DLMO (1 hour) ($P = 0.008$), higher subjective sleep scores ($P < 0.05$), a reduction in pupil constriction amplitude for red stimuli ($P = 0.039$) and for the early postillumination pupil response (PIPR) for blue ($P = 0.024$) stimuli. There were no between-group differences in the light exposure pattern, activity levels, and intrinsic melanopsin-mediated PIPR amplitude ($P > 0.05$). A significant correlation was evident between outer retinal thickness and DLMO ($r = -0.65, P = 0.03$) and the pupil constriction amplitude ($r = 0.63, P = 0.03$); patients with thinner retina had earlier DLMO and lower pupil amplitudes.

Conclusions: We infer that the observed changes in circadian function in patients with no diabetic retinopathy are due to structural and functional outer retinal rod photoreceptor deficits at early stage of diabetic eye disease.
OBJECTIVES: Previous studies of long workhours and their effects on stress, sleep, and health show inconclusive results. This inconclusiveness may be partly due to methodological problems such as the use of between-group designs or comparisons before and after reorganizations. In addition, stress is usually a confounder. A within-person design was used to examine the effects of working 8- or 12-hour shifts in the absence of additional stress.

METHODS: In an experimental field study, 16 white-collar workers [9 women, mean age 45.9 (SD 15) years] undertook one workweek with normal workhours (8 hours) and 1 week of overtime with 4 extra hours of regular worktasks (12 hours). The participants wore actigraphs, rated sleepiness (Karolinska Sleepiness Scale) and stress throughout the day, and rated workload and how exhausted they felt. Saliva samples were collected on Mondays and Thursdays for cortisol analysis. On these days, ambulatory heart rate and blood pressure were also measured for 24 hours.

RESULTS: Overtime was associated with higher levels of exhaustion. Sleepiness showed a significant interaction between conditions, with higher levels at the end of the workweek featuring overtime. Total sleep time was shorter in the overtime week. There were no significant differences between ratings of stress.
and workload. Cortisol showed a circadian variation but no main effect of condition.

CONCLUSIONS: One week of overtime work with a moderate workload produced no main effects on physiological stress markers. Nevertheless, sleep was negatively affected, with shorter sleeps during overtime work and greater problems with fatigue and sleepiness.

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Oxygen-induced retinopathy induces short-term glial stress and long-term impairment of photoentrainment in mice.

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BACKGROUND: Retinopathy of prematurity is a serious potentially blinding disease of pre-term infants. There is extensive vascular remodeling and tissue stress, but data concerning alterations in retinal neurons and glia, and long-term functional sequelae are still incomplete.

METHODS: ROP was induced using the oxygen-induced retinopathy (OIR) mouse model. Postnatal day 7 (P7) 129SVE mice were exposed to hyperoxia (75 ± 0.5 % oxygen) for 5 days, and then returned to normoxia to induce OIR. Exposed animals were euthanized at 5 (P17-OIR) and 14 days (P26-OIR) after return to normal air, together with corresponding age-matched control mice (P17-C and P26-C respectively) raised only in room air. Their retinas were examined by immunohistochemistry using a battery of antibodies against key glial and neuronal
proteins. A further group of OIR mice and controls were examined at 10 weeks of age for their ability to re-entrain to changing 12 h light/12 h dark cycles, assayed by wheel-running actimetry. In this protocol, animals were subjected to three successive conditions of 300 lux, 15 lux and 1 lux ambient light intensity coupled with 6 hours of jetlag. Animals were euthanized at 4 months of age and used in immunoblotting for rhodopsin.

RESULTS: Compared to P17-C, immunohistochemical staining of P17-OIR sections showed up-regulation of stress-related and glutamate-regulatory proteins in astrocytes and Müller glial cells. In contrast, glial phenotypic expression in P26-OIR retinas largely resembled that in P26-C. There was no loss in total retinal ganglion cells (RGC) at either P17-OIR or P26-OIR compared to corresponding controls, whereas intrinsically photosensitive RGC showed significant decreases, with 375 ± 13/field in P26-OIR compared to 443 ± 30/field in P26-C (p < 0.05). Wheel actimetry performed on control and OIR-treated mice at 4 months demonstrated that animals raised in hyperoxic conditions had impaired photoentrainment at low illuminance of 1 lux, as well as significantly reduced levels of rhodopsin compared to age-matched controls.

CONCLUSIONS: OIR leads to transient up-regulation of retinal glial proteins involved in metabolism, and partial degeneration of intrinsically photosensitive RGC and rod photoreceptors. OIR affects circadian photo-entrainment at low illuminance values, possibly by affecting the rod pathway and/or intrinsically photosensitive RGC input to the circadian clock. This study hence shows that retinopathy of prematurity affects light-regulated circadian behavior in an animal model, and may induce similar problems in humans.

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PMID: 24509649 [Indexed for MEDLINE]

Panic disorder and locomotor activity.


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BACKGROUND: Panic disorder is one of the anxiety disorders, and anxiety is associated with some locomotor activity changes such as "restlessness". However, there have been few studies on locomotor activity in panic disorder using actigraphy, although many studies on other psychiatric disorders have been reported using actigraphy. Therefore, the aim of the present study was to investigate the relationship between panic disorder and locomotor activity pattern using a wrist-worn activity monitor. In addition, an ecological momentary assessment technique was used to record panic attacks in natural settings.

METHODS: Sixteen patients with panic disorder were asked to wear a watch-type computer as an electronic diary for recording panic attacks for two weeks. In addition, locomotor activity was measured and recorded continuously in an accelerometer equipped in the watch-type computer. Locomotor activity data were analyzed using double cosinor analysis to calculate mesor and the amplitude and acrophase of each of the circadian rhythm and 12-hour harmonic component. Correlations between panic disorder symptoms and locomotor activity were investigated.

RESULTS: There were significant positive correlations between the frequency of panic attacks and mesor calculated from double cosinor analysis of locomotor activity ($r = 0.55$) and between HAM-A scores and mesor calculated from double cosinor analysis of locomotor activity ($r = 0.62$).
CONCLUSION: Panic disorder patients with more panic attacks and more anxiety have greater objectively assessed locomotor activity, which may reflect the "restlessness" of anxiety disorders.

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This study provided sleep education to parents of children with autism spectrum disorder (ASD) to determine whether an individual or group format was more effective in improving sleep and aspects of daytime behavior and family functioning. Eighty children, ages 2–10 years, with ASD and sleep onset delay completed the study. Actigraphy and parent questionnaires were collected at baseline and 1 month after treatment. Mode of education did not affect outcomes. Sleep latency, insomnia subscales on the Children's Sleep Habits Questionnaire, and other outcomes related to child and family functioning improved with treatment. Parent–based sleep education, delivered in relatively few sessions, was associated with improved sleep onset delay in children with ASD. Group versus individualized education did not affect outcome.

Parent-based sleep education workshops in autism.


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To determine if parents can successfully teach their children with autism spectrum disorders to become better sleepers, we piloted small group parent education workshops focused on behavioral sleep strategies. Workshops consisted of three 2-hour sessions conducted over consecutive weeks by 2 physicians. Curricula included establishing effective daytime and nighttime habits, initiating a bedtime routine, and optimizing parental interactions at bedtime and during night wakings. Baseline and treatment questionnaires and actigraphy were analyzed in 20 children, ages 3 to 10 years. Improvements after treatment were seen in the total scale and several insomnia-related subscales of the Children's Sleep Habits Questionnaire. Actigraphy documented reduced sleep latency in children presenting with sleep onset delay. Improvements were also noted in measures of sleep habits and daytime behavior. Brief parent-based behavioral sleep workshops in children with autism spectrum disorders appear effective in improving subjective and objective measures of sleep, sleep habits, and daytime behavior.

DOI: 10.1177/0883073808331348
BACKGROUND: We used a multi-method and multi-informant design to identify developmental pathways through which parental depressive symptoms contribute to children's sleep problems. Environmental factors including adult inter-partner conflict and parent-child conflict were considered as process variables of this relation.

METHODS: An ethnically and socioeconomically diverse sample of children (n = 268) participated (M age = 9.44 years, SD = 8.61 months). Children wore actigraphs for 7 consecutive nights and also reported on their sleep problems.

RESULTS: Higher levels of maternal depressive symptoms were associated with children's sleep/wake problems. Higher levels of paternal depressive symptoms were associated with shorter time in bed and fewer sleep minutes. Inter-partner conflict and parent-child conflict were mechanisms of effects in the associations between maternal depressive symptoms and children's actigraphy-based and self-reported sleep problems.

CONCLUSIONS: Findings build on this scant literature and highlight the importance of identifying pathways of risk and familial and environmental influences on children's sleep problems.

Parental problem drinking and children's sleep: The role of ethnicity and socioeconomic status.

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We examined relations between mothers' and fathers' problem drinking and school-age children's sleep. Consistent with a health disparities perspective, children's ethnicity and socioeconomic status were examined as moderators of relations between parental problem drinking and children's sleep. Participants were 282 children (M age = 9.44 years) and their parents. Children were from diverse ethnic (65% White, 35% Black) and socioeconomic backgrounds. Using a multi-informant design, parents reported on their own problem drinking and children's sleep was assessed with actigraphs over 7 nights. After controlling for several influential covariates, moderation findings indicated that associations between heightened levels of parental problem drinking (predominately fathers') and children's shorter sleep duration, reduced sleep efficiency, and greater long wake episodes were most evident for Black children and those from lower socioeconomic backgrounds. Findings are among the first to establish relations between parental problem drinking and children's sleep and indicate that not all children are at equal risk for sleep
disturbances in such
domestic environments. Results add to a growing literature that has
examined
children's sleep within the family context and highlight the
importance of
considering the broader sociocultural milieu. (PsycINFO Database
Record
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Passive body heating ameliorates sleep disturbances in patients with
vascular
dementia without circadian phase-shifting.

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OBJECTIVE: This study investigated the sleep-promoting,
thermoregulatory, and
circadian phase-shifting actions of passive body heating (PBH) in
elderly
insomniac patients (IPs) with mild-to-moderate vascular dementia.
METHODS: Thirteen elderly IPs with vascular dementia (mean age 76.9
years;
male/female ratio 2/11) were subjected to a PBH trial session. This
session
comprised a 3-day baseline period, 2-day PBH period, and 1-day post-
PBH period.
In the PBH period, the subjects received PBH (immersion in hot water
about 40.0
degrees C to mid-thorax level) for 30 minutes beginning 2 hours before
bedtime.
Sleep-waking, estimated by actigraph, core body temperature (cBT), and
heart rate
variability were continuously monitored. Dim-light melatonin-onset
time (DLMO)
was determined in the baseline and post-PBH periods.
RESULTS: PBH significantly improved subjects' sleep quality; sleep
latency
decreased; sleep efficiency increased; and wake time after sleep onset
decreased.
These trends were more prominent in the latter half of the sleep time. PBH induced a rapid cBT elevation of approximately 0.80 degrees C, on average, followed by enhanced heat loss (DeltacBT: difference in cBT between just after the PBH and bedtime), lasting 1.5 hours before sleep. There was a significantly positive correlation between DeltacBT and sleep latency. PBH induced no significant phase shift in DLMO. Heart-rate variability data showed that PBH induced parasympathomimetic action during sleep time in the subjects.

CONCLUSION: PBH may have a sleep-promoting effect by intervening in the thermoregulatory and autonomic systems in elderly IPs with vascular dementia.

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Patient room lighting influences on sleep, appraisal and mood in hospitalized people.

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Irregular 24 h light/dark cycles with night-time light exposure and a low amplitude are disruptive for sleep, mood and circadian rhythms.
Nevertheless such lighting conditions are quite common in medical care facilities. A controlled clinical trial among 196 cardiology ward patients (mean age 66.5 ± 13.1 years SD) investigated how a patient room lighting intervention affects sleep, appraisal and mood across hospitalization. Patients were either assigned to a standardly-lit room or to a room with an interventional lighting system offering a dynamic 24 h light/dark cycle with low nocturnal light exposure and 2 h of bright light (1750 lux) during daytime. Measures included wrist actigraphy and questionnaires assessing alertness, sleep quality, anxiety, depression and lighting appraisal. The median length of hospitalization was 5 days in both study arms. Subjective scores on sleep, alertness, anxiety and depression did not differ between arms. Lighting appraisal in intervention rooms was better as compared to standardly-lit rooms, both in patients (P < 0.001) and staff (P < 0.005). Actigraphic sleep duration of patients improved by 5.9 min (95% CI: 0.6–11.2; P = 0.03 intervention × time effect) per hospitalization day with interventional lighting instead of standard lighting. After 5 days of hospitalization, sleep duration in the lighting intervention rooms increased by 29 min, or a relative 7.3%, as compared to standardly-lit rooms. A 24 h lighting system with enhanced daytime brightness and restricted nocturnal light exposure can improve some aspects of appraisal and objective sleep in hospital patients. More clinical research is needed to establish the best lighting strategy to promote healing and wellbeing within healthcare settings.

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Patients previously treated for nonfunctioning pituitary macroadenomas have disturbed sleep characteristics, circadian movement rhythm, and subjective sleep quality.


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CONTEXT AND OBJECTIVE: Fatigue and excessive sleepiness have been reported after treatment of nonfunctioning pituitary macroadenomas (NFMA). Because these complaints may be caused by disturbed nocturnal sleep, we evaluated objective sleep characteristics in patients treated for NFMA.

DESIGN: We conducted a controlled cross-sectional study.

SUBJECTS AND METHODS: We studied 17 patients (8 women; mean age, 54 yr) in remission of NFMA during long-term follow-up (8 yr; range, 1-18 yr) after surgery (n = 17) and additional radiotherapy (n = 5) without comorbidity except for hypopituitarism and 17 controls matched for age, gender, and body mass index. Sleep was assessed by nocturnal polysomnography, sleep and diurnal movement patterns by actigraphy, and quality of life and subjective sleep characteristics by questionnaires.

RESULTS: Compared to controls, patients had reduced sleep efficiency, less rapid eye movement sleep, more N1 sleep, and more awakenings in the absence of excessive apnea or periodic limb movements. Actigraphy revealed a longer sleep duration and profound disturbances in diurnal movement patterns, with more awakenings at night and less activity during the day. Patients scored higher on
fatigue and reported impaired quality of life. CONCLUSION: Patients previously treated for NFMA suffer from decreased subjective sleep quality, disturbed distribution of sleep stages, and disturbed circadian movement rhythm. These observations indicate that altered sleep characteristics may be a factor contributing to impaired quality of life and increased fatigue in patients treated for NFMA.

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Patterns of circadian activity rhythms and their relationships with fatigue and anxiety/depression in women treated with breast cancer adjuvant chemotherapy.

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PURPOSE: The purpose of this study was to examine patterns of circadian activity rhythms and their relationship with fatigue, anxiety/depression, and demographic/medical variables in women receiving breast cancer adjuvant therapy treatments (Tx) at three times within a randomized clinical trial (RCT) designed to improve sleep and modify fatigue.

METHODS: A RCT enrolled 219 women with stage I-IIIA breast cancer who were randomized 2 days prior to starting chemotherapy to a behavioral therapy sleep intervention or healthy eating control group. All cases with available data (n = 190) were included in a descriptive, correlational, repeated measures analysis. Activity data were collected continuously by wrist actigraphy for 7 days at three times: the start (Tx 1), continuation (Tx 3), and recovery (30 days
after last Tx) of chemotherapy. Circadian activity rhythm parameters were generated using Action4 software (Ambulatory Monitoring, Inc.). Measures collected simultaneously included Piper Fatigue Scale, Hospital Anxiety and Depression Scale, and demographic/medical variables.

RESULTS: Circadian activity rhythm parameters at three times in both groups were disrupted compared to healthy adults, but similar to values of cancer patients. Significant changes in mesor, amplitude, peak activity, and 24 h autocorrelation values were found over time in both groups. The intervention group's amplitude and circadian quotient values were significantly more robust. More robust activity rhythms were associated with lower fatigue, depressive symptoms, body mass index, and higher performance status in both groups.

CONCLUSIONS: Disrupted patterns of circadian activity rhythms were prevalent and associated with distressing fatigue and depressive symptoms during chemotherapy and at recovery. The intervention resulted in more robust rhythms.

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Pediatric sleep difficulties after moderate–severe traumatic brain injury.

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The objective of this study is to systematically investigate sleep following moderate–severe pediatric traumatic brain injury (TBI). School-aged children with moderate–severe TBI identified via hospital records were invited to
participate, along with a school-age sibling. Subjective reports and objective actigraphy correlates of sleep were recorded: Children's Sleep Habits Questionnaire (CSHQ), Sleep Self-Report questionnaire (SSR), and 5-night actigraphy. TBI participants (n = 15) and their siblings (n = 15) participated. Significantly more sleep problems were parent-reported (CSHQ: p = 0.003; d = 1.57), self-reported (SSR: p = 0.003; d = 1.40), and actigraph-recorded in the TBI group (sleep efficiency: p = 0.003; d = 1.23; sleep latency: p = 0.018; d = 0.94). There was no evidence of circadian rhythm disorders, and daytime napping was not prevalent. Moderate-severe pediatric TBI was associated with sleep inefficiency in the form of sleep onset and maintenance problems. This preliminary study indicates that clinicians should be aware of sleep difficulties following pediatric TBI, and their potential associations with cognitive and behavioral problems in a group already at educational and psychosocial risk.

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PMID: 23601180 [Indexed for MEDLINE]


Peer Victimization and Adolescent Adjustment: The Moderating Role of Sleep.

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The present study examined multiple indices of sleep as moderators of the association between peer victimization and adjustment among typically developing
adolescents. Participants included 252 adolescents (M = 15.79 years; 66 % European American, 34 % African American) and their parents. A multi-method, multi-informant design was employed to address the research questions. Sleep was assessed objectively with actigraphy (sleep minutes and sleep efficiency) and subjectively with self-reports. Adolescents reported on peer victimization and internalizing symptoms. Externalizing behaviors were examined with mother and father reports. Subjective sleep/wake problems moderated the associations between peer victimization and internalizing and externalizing symptoms. A stronger relation emerged between peer victimization and internalizing symptoms among adolescents who reported higher versus lower levels of sleep/wake problems. Adolescents with elevated sleep/wake problems had higher levels of externalizing symptoms across the range of peer victimization. However, for those with fewer sleep/wake problems, a positive relation between peer victimization and externalizing symptoms was observed. Actigraphy-based sleep minutes and sleep efficiency also moderated the relations between peer victimization and internalizing symptoms. Although peer victimization was associated with higher levels of internalizing symptoms for all youth, those who reported the lowest levels of such symptoms had longer and more efficient sleep in conjunction with low levels of peer victimization. Findings are novel and highlight the importance of considering both bioregulatory processes and peer relations in the prediction of adolescents' adjustment.

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PMID: 26002848 [Indexed for MEDLINE]

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PER2 rs2304672 polymorphism moderates circadian-relevant reward circuitry activity in adolescents.


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BACKGROUND: Reward behavior in animals is influenced by circadian genes, including clock-pathway genes such as Period2 (PER2). Several forms of psychiatric illness are associated with both altered reward function and disturbances in circadian function. The PER2 single nucleotide polymorphism (SNP) rs2304672 has been associated with psychiatric illnesses involving reward dysfunction. Associations among circadian genes, function in neural reward circuits, and circadian-influenced behavior have not yet been studied in humans, however.

METHODS: 90 healthy adolescents underwent functional magnetic resonance imaging during a guessing task with monetary reward, genotyping for two PER2 SNPs (rs2304672, rs2304674), and actigraphy to measure sleep in their home environments. Weekend sleep midpoint, a behavioral index of circadian function, was derived from actigraphy. Puberty was measured by physical exam.

RESULTS: The rs2304672 SNP predicted blood oxygenation level-dependent response to monetary reward as constrained by sleep midpoint. Later sleep midpoint was associated with reduced activity in a key component of reward circuitry, medial prefrontal cortex (mPFC; Brodmann area 9/10/32), to reward outcome (p(corrected) < .05). G allele carriers showed reduced activity in mPFC relative to CC homozygotes.

CONCLUSIONS: Our findings are the first to indicate that circadian genes have a significant impact upon circadian-relevant reward circuitry in humans. These
findings have the potential to elucidate gene-brain-behavior relationships underlying reward processing and psychopathology.

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Perceived sleep quality is worse than objective parameters of sleep in pregnant women with a mental disorder.

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OBJECTIVE: Disturbed sleep during pregnancy is associated with adverse obstetric outcomes and less mental well-being. In pregnant women with a mental disorder, who frequently suffer from sleep problems, it is unknown whether predominantly objective or subjective sleep quality is more affected. To clarify this, we compared objective and subjective parameters of sleep quality between patients and healthy controls during pregnancy.
METHODS: This observational study was embedded in an ongoing study among pregnant women with a mental disorder at the department of Psychiatry of Erasmus University Medical Center Rotterdam, the Netherlands. We compared 21 pregnant women with a confirmed mental disorder with 33 healthy controls (gestational age, 23–29 weeks). To measure objective parameters of sleep quality, all participants continuously wore a wrist actigraph for 7 days and nights. Subjective sleep quality was retrospectively assessed using the Pittsburgh Sleep Quality Index (PSQI) and on a daily basis with the Subjective Sleep Quality-scale (SSQ). Differences in parameters of sleep between patients and controls were tested using a multivariate linear regression analysis adjusted for parity, gestational age, educational level, and employment status.

RESULTS: Objective parameters of sleep quality and subjective sleep quality as assessed by the PSQI did not differ significantly between patients and controls. Daily sleep reports showed that, relative to controls, patients had a significantly worse average SSQ-score (5.2 vs. 7.6, adjusted β = 0.12, 95%CI = 0.03–0.53, p < 0.01).

CONCLUSIONS: Our exploratory study suggests that perceived sleep quality reported on a daily basis by pregnant women with a mental disorder is worse than the sleep quality as measured by wrist actigraphy.

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PMCID: PMC4173092
PMID: 25317095 [Indexed for MEDLINE]
BACKGROUND: Biological rhythm disturbances are widely associated with the pathophysiology of mood disorders. The Biological Rhythms Interview for Assessment in Neuropsychiatry (BRIAN) is a self-report that indexes rhythm disturbance in sleep, activity, social and eating patterns. The aim of this study was to perform an Item Response Theory (IRT) analysis of the BRIAN and investigate its associations with objective sleep and rhythm disturbance measures.

METHODS: 103 subjects (31 bipolar, 32 major depression and 40 healthy volunteers) wore an actiwatch for fifteen days, and completed a first morning urine sample and the BRIAN on day 15. IRT analysis assessed individual BRIAN items and their relationship to total score. Individual actiwatch records were processed to produce a sequence of transitions between rest/activity, and a likelihood of transitioning between states was calculated to investigate sleep–wake dynamics. Cosinor analysis produced daily activity rhythms (DARs). Spearman
correlations were used to assess the association between sleep/DAR variables and the BRIAN.

RESULTS: IRT analyses showed that 11 of 18 BRIAN items displayed a high level of discrimination between item options across a range of BRIAN total scores. Total BRIAN score correlated with wake after sleep onset, total activity count during sleep, and urinary 6-sulphatoxymelatonin. BRIAN Activity domain correlated with the daytime transition probability from rest to activity.

LIMITATIONS: The sample size may have been underpowered for the graded-response model employed in IRT. The study lacked an objective comparison for BRIAN eating and social domain.

CONCLUSION: The present study reveals the BRIAN displays promising external validity compared to objective parameters of circadian rhythmicity.

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Periodic fatigue symptoms due to desynchronization in a patient with non-24-h sleep-wake syndrome.

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A 43-year-old man complaining of recurrent fatigue symptoms and sleep disorders occurring periodically every 4 weeks was studied. Using a wrist worn actigraphy and an ambulatory rectal temperature monitoring apparatus, his sleep-wake cycle and rectal temperature were measured continuously for 4 months, while diagnostic evaluation and therapeutic interventions were conducted. It was found that after
he gave up an attempt to keep to a 24-h-day, a free-running sleep wake pattern appeared but his fatigue symptoms disappeared. An analysis of the relationship between his sleep-wake cycle and the rectal temperature rhythm found that his fatigue symptoms did not appear when both rhythms were synchronized with each other. Artificial bright light therapy entrained him to a 24-h day without relapsing of fatigue symptoms. Desynchronization between a 24-h sleep-wake schedule and his circadian pacemaker may have caused his periodically appearing fatigue symptoms.

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Periodic limb movement in a community population detected by a new actigraphy technique.

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BACKGROUND: Periodic limb movements (PLMs) have been studied in both community and sleep clinic populations using polysomnography. An alternative detection method is actigraphy. Our aims were to determine the frequency of PLMs, measured by actigraphy in a community sample, and to assess the relationships of PLMs with age, gender, and reported sleep-related symptoms.

METHODS: Volunteers had bilateral foot actigraphy (Cambridge Neurotechnology) at home and completed sleep questionnaires. Actigraphy was scored for PLMs per hour in bed (PLMI) and statistical analysis performed to assess possible
associations.
RESULTS: PLMI (mean of two nights) ranged from 0 to 60.3 and 37% of the sample had a PLMI≥5. Men had significantly higher PLMIs than females (P=0.003) but PLMI was not correlated with age. There was a modest but significant correlation between subjectively reported restless leg severity and PLMI (r=0.238; P=0.003), but none with reported sleepiness.
CONCLUSIONS: This actigraphy technique is a practical and reliable tool for community studies. A large proportion of this community sample, particularly men, had PLMs. PLMI was not correlated with age or Epworth Sleepiness Score.

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PMID: 14592143

The periodicity of sleep duration - an infradian rhythm in spontaneous living.

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The sleep-wake cycle is a process not only dictated by homeostatic and circadian factors but also by social and environmental influences. Thus, the total sleep time partly reflects sleep need, which is integral to the dynamics of sleep loss recovery. This study explored the nature of the observed oscillations in total sleep time in healthy adults under spontaneous living conditions. Actigraph-measured sleep data for 13 healthy young male adults were collected over 14 consecutive days and analyzed for habitual sleep duration. The total sleep time periodicity was modeled using the cosinor method for each individual across the 14 days. The findings confirm the existence of periodicity
in habitual sleep duration as there were clear periodic patterns in the majority of the participants. Although exclusive to each individual, the observed oscillations may be a resultant response of homeostatic sleep need, circadian timing, and/or social and environmental influences. These findings instigate further indepth studies into the periodicity of sleep duration in healthy individuals to provide a better understanding of sleep need in short versus long sleepers, in predicting work performance, and reducing sleepiness-related accidents following shift work, and how this periodicity may impact sleep treatment outcome in clinical populations.

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PMID: 23616728


Persistence of social jetlag and sleep disruption in healthy young adults.

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Sleep disruption has been associated with increased risks for several major chronic diseases that develop over decades. Differences in sleep/wake timing between work and free days can result in the development of social jetlag (SJL), a chronic misalignment between a person's preferred sleep/wake schedule and sleep/wake timing imposed by his/her work schedule. Only a few studies have examined the persistence of SJL or sleep disruption over time. This prospective investigation examined SJL and sleep characteristics over a 2-year period to evaluate whether SJL or poor sleep were chronic conditions during the study period. SJL and sleep measures (total sleep time [TST], sleep onset latency [SOL], wake after sleep onset [WASO]), and sleep efficiency [SE]), were derived from armband monitoring among 390 healthy men and women 21–35 years old. Participants wore the armband for periods of 4–10 days at 6-month intervals during the follow-up period (N = 1431 repeated observations). The consistency of SJL or sleep disruption over time was analyzed using generalized linear mixed models (GLMMs) for repeated measures. Repeated measures latent class analysis (RMLCA) was then used to identify subgroups among the study participants with different sleep trajectories over time. Individuals in each latent group were compared using GLMMs to identify personal characteristics that
differed among the latent groups. Minor changes in mean SJL, chronotype, or TST were observed over time, whereas no statistically significant changes in SOL, WASO, or SE were observed during the study period. The RMLCA identified two groups of SJL that remained consistent throughout the study (low SJL, mean ± SE: 0.4 ± 0.04 h, 42% of the study population; and high SJL, 1.4 ± 0.03 h, 58%). Those in the SJL group with higher values tended to be employed and have an evening chronotype. Similarly, two distinct subgroups were observed for SOL, WASO, and SE; one group with a pattern suggesting disrupted sleep over time, and another with a consistently normal sleep pattern. Analyses of TST identified three latent groups with relatively short (5.6 ± 1.0 h, 21%), intermediate (6.5 ± 1.0 h, 44%), and long (7.3 ± 1.0 h, 36%) sleep durations, all with temporally stable, linear trajectories. The results from this study suggest that sleep disturbances among young adults can persist over a 2 year period. Latent groups with poor sleep tended to be male, African American, lower income, and have an evening chronotype relative to those with more normal sleep characteristics. Characterizing the persistence of sleep disruption over time and its contributing factors could be important for understanding the role of poor sleep as a chronic disease risk factor.

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PMID: 29231745 [Indexed for MEDLINE]


Persistent and new-onset daytime sleepiness in pregnant women: A prospective observational cohort study.
BACKGROUND: Daytime sleepiness is a frequent complaint in women during pregnancy. It has also been linked to negative obstetric consequences. Although high prevalence of excessive daytime sleepiness throughout pregnancy is well-documented, neither the causes of persistent daytime sleepiness nor new-onset daytime sleepiness during pregnancy have been investigated. Identifying predictive factors may play an important role in the management of daytime sleepiness in pregnant women and improve prenatal care and maternal-fetal outcomes.

OBJECTIVES: To examine first-trimester maternal characteristics associated with the persistence and new-onset daytime sleepiness in pregnant women.

DESIGN: A longitudinal, prospective cohort design.

SETTING: One medical center in Taipei, Taiwan and participating women's homes.

PARTICIPANTS: A total of 204 pregnant women.

METHODS: First-trimester pregnant women recruited from an outpatient obstetric clinic at a medical center provided socio-demographic and health information, wore an actigraphy monitor for 7 days, and completed sleep, mood, and daytime sleepiness questionnaires. Data were collected again when the women were in the second and third trimester.

RESULTS: Thirty-one (15.2%) women experienced excessive daytime sleepiness that
persisted across all three trimesters. Nulliparous women and women who snored in the first trimester were 2.28 and 2.10 times more at risk of being classified of persistent daytime sleepiness than multiparous women and women who did not snore in the first trimester, respectively. Thirty-one (15.2%) women developed new-onset daytime sleepiness with advancing gestation. Women were more likely to develop new-onset daytime sleepiness if they worked longer hours per week (OR=1.04, p<0.001), if they reported snoring (OR=6.75, p<0.001), and if they had elevated depressive symptoms in the first trimester of pregnancy (OR=1.09, p=0.01).

CONCLUSIONS: Snoring in the first trimester is involved in both the persistence and new-onset of daytime sleepiness with elevated depressive symptoms related to new-onset daytime sleepiness in pregnant women. Findings suggest that intervention strategies for alleviating daytime sleepiness in pregnant women should focus on managing snoring and symptoms of depression in early trimesters with special attention to nulliparous and employed women.

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Phase Relationship between DLMO and Sleep Onset and the Risk of Metabolic Disease among Normal Weight and Overweight/Obese Adults.

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Circadian misalignment is hypothesized to contribute to increased
diabetes and obesity among shift workers and individuals with late sleep timing. Accordingly, the goal of our study was to identify—among normal and overweight/obese adults—associations between circadian timing (dim light melatonin onset; DLMO) and circadian misalignment (the interval between DLMO and sleep onset) with metabolic disease risk. This was a secondary analysis of data from a larger study. Participants ages 18 to 50 years without depression, diabetes, or shift work, with sleep duration 6.5 h or more, completed the following evaluations: 7 days of wrist actigraphy, circadian timing assessment (DLMO), and a fasting blood draw to measure glucose and insulin and calculate the Homeostatic Model of Assessment—Insulin Resistance (HOMA-IR). Data were analyzed using correlation and regression analyses controlling for age, sex, DLMO, and sleep duration. Analyses were conducted for the entire sample (n = 54) and stratified by normal weight (n = 36) and overweight/obese groups (n = 18). Mean age was 26.4 years (SD = 7.1 years). Average sleep duration was 436.2 min (SD = 55.1 min), DLMO was 2250h (SD = 01:31), and interval between DLMO and sleep onset was 2 h 18 min (SD = 53 min). Average BMI was 24.3 kg/m2 (SD = 4.5 kg/m2). Circadian timing and interval between DLMO and sleep onset were not associated with glucose, insulin, or HOMA-IR in the main analyses. Among overweight/obese participants, a shorter interval between DLMO and sleep onset was associated with higher insulin (B(SE) = -5.12 [2.24], p = 0.04) and HOMA-IR (B(SE) = -1.32 [0.57], p = 0.04). Results of our multivariable model indicated that among overweight/obese participants, insulin was 5.1 pmol/L higher and HOMA was 1.3 µU/mL higher for every hour closer that sleep onset was to DLMO. The strengths of this study include the use of objective measures of circadian timing, but results should be considered hypothesis generating due to the small sample size and use of subgroup
Phase relationship between skin temperature and sleep-wake rhythms in women with vascular dysregulation and controls under real-life conditions.

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The aim of the study was to investigate whether women with primary vascular dysregulation (VD; main symptoms of thermal discomfort with cold extremities) and difficulties initiating sleep (DIS) exhibit a disturbed phase of entrainment (Ψ) under everyday life conditions. The authors predicted a phase delay of the distal-proximal skin temperature gradient and salivary melatonin rhythms with respect to the sleep-wake cycle in women with VD and DIS (WVD) compared to controls (CON), similar to that found in their previous constant-routine laboratory data. A total of 41 young healthy women, 20 with WVD and 21 matched CON without VD and normal sleep onset latency (SOL), were investigated under ambulatory conditions (following their habitual bedtimes) during 7 days of continuous recording of skin temperatures, sleep-wake cycles monitored by actimetry and sleep-wake diaries, and single evening saliva collections for determining the circadian marker of dim light melatonin onset (DLMO). Compared to CON, WVD showed increased distal vasoconstriction at midday and in the evening,

analyses.

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PMID: 29262758 [Indexed for MEDLINE]
as indicated by lower distal (DIST; hands and feet) and foot-calf skin temperatures, and distal-proximal skin temperature gradients (p< .05). WVD manifested distal vasoconstriction before lights-off that also lasted longer after lights-off than in CON. In parallel, WVD exhibited a longer SOL (p< .05).

To define internal phase-relationships, cross-correlation analyses were performed using diurnal rhythms of wrist activity and foot skin temperature. WVD showed a phase delay in foot skin temperature (CON versus WVD: 3.57 ± 17.28 min versus 38.50 ± 16.65 min; p< .05) but not in wrist activity. This finding was validated by additional within-subject cross-correlation analyses using the diurnal wrist activity pattern as reference. DLMO and habitual sleep times did not differ between CON and WVD. The authors conclude that WVD exhibit a phase delay of distal vasodilatation with respect to their habitual sleep-wake cycle and other circadian phase markers, such as DLMO. A full factorial design will have to show whether the finding is specific to primary vascular dysregulation, to DIS, or to their interaction.

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Phase relationships between sleep-wake cycle and underlying circadian rhythms in Morningness–Eveningness.

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A shorter phase angle between habitual wake time and underlying circadian rhythms has been reported in evening types (E types) compared to morning-types (M types).
In this study, phase angles were compared between 12 E types and 12 M types to verify if this difference was observed when the sleep schedule was relatively free from external social constraints. Subjects were selected according to their Morningness-Eveningness Questionnaire score (MEQ score). There were 6 men and 6 women in each group (ages 19–34 years), and all had a habitual sleep duration between 7 and 9 h. Sleep schedule was recorded by actigraphy and averaged over 7 days. Circadian phase was estimated by the hour of temperature minimum (T(min)) in a 26-h recording and by the timing of the onset of melatonin secretion (dim-light melatonin onset [DLMO]) measured in saliva samples. Phase angles were defined as the interval between phase markers and averaged wake time. Results showed that, in the present experimental conditions, phase angles were very similar in the 2 groups of subjects. However, results confirmed the previously reported correlation between phase and phase angle, showing that a later circadian phase was associated with a shorter phase angle. Gender comparisons showed that for a same MEQ score, women had an earlier DLMO and a longer phase angle between DLMO and wake time. Despite a significant difference in the averaged circadian phases between E-type and M-type groups, there was an overlap in the circadian phases of the subjects of the 2 groups. Further comparisons were made between the 2 circadian types, separately for the subgroups with overlapping or nonoverlapping circadian phases. In both subgroups, the significant difference between MEQ scores, bedtimes, and wake times were maintained in the expected direction. In the subgroup with nonoverlapping circadian phases, phase angles were shorter in E-type subjects, in accordance with previous studies. However, in the overlapping subgroup, phase angles were significantly longer in E types compared to M types. Results suggest that the morningness–eveningness preference
identified by the MEQ score refers to 2 distinct mechanisms, 1 associated with a difference in circadian period and phase of entrainment and the other associated with chronobiological aspects of sleep regulation.

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Phase-synchronization of daily motor activities can reveal differential circadian patterns.

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The aim of the study was to determine any alteration of the 24 h motor activity pattern of a bipolar patient in different mood states. Actigraphic records were collected on an outpatient basis for a total of 387 days. The daily actograms were synchronized in phase to the time of morning awakening before averaging, which significantly enhanced the structure of the averaged traces. The actograms were divided into three groups based on total daily count. The daily motor activity patterns of the low- and high-activity days have a different circadian pattern. We propose it may have a relevance to the different mood states. The phase-synchronization of the 24h actograms to the patient's sleep-wake cycle, specifically to the time of awaking from the nighttime sleep, may help reveal differences in the daily temporal patterns of motor activity.

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PHIT for Duty, a Mobile Application for Stress Reduction, Sleep Improvement, and Alcohol Moderation.


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Post-traumatic stress and other problems often occur after combat, deployment, and other military operations. Because techniques such as mindfulness meditation show efficacy in improving mental health, our team developed a mobile application (app) for individuals in the armed forces with subclinical psychological problems as secondary prevention of more significant disease. Based on the Personal Health Intervention Toolkit (PHIT), a mobile app framework for personalized health intervention studies, PHIT for Duty integrates mindfulness-based relaxation, behavioral education in sleep quality and alcohol use, and psychometric and psychophysiological data capture. We evaluated PHIT for Duty in usability and health assessment studies to establish app quality for use in health research. Participants (N = 31) rated usability on a 1 (very hard) to 5 (very easy) scale and also completed the System Usability Scale (SUS) questionnaire (N = 9). Results were (mean ± SD) overall (4.5 ± 0.6), self-report instruments
(4.5 ± 0.7), pulse sensor (3.7 ± 1.2), sleep monitor (4.4 ± 0.7), sleep monitor comfort (3.7 ± 1.1), and wrist actigraphy comfort (2.7 ± 0.9). The average SUS score was 85 ± 12, indicating a rank of 95%. A comparison of PHIT-based assessments to traditional paper forms demonstrated a high overall correlation (r = 0.87). These evaluations of usability, health assessment accuracy, physiological sensing, system acceptability, and overall functionality have shown positive results and affirmation for using the PHIT framework and PHIT for Duty application in mobile health research.

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PMID: 29635566  [Indexed for MEDLINE]


Physical activity, and not fat mass is a primary predictor of circadian parameters in young men.

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Circadian rhythms are ≈24 h oscillations in physiology and behavior, and disruptions have been shown to have negative effects on health. Wrist skin temperature has been used by several groups as a valid method of assessing circadian rhythms in humans. We tested the hypothesis that circadian temperature amplitude (TempAmp) and stability (TempStab) would significantly differ among groups of healthy young men of varying adiposities, and that we could identify physiological and behavioral measures that were significantly associated with
these temperature parameters. Wrist skin temperatures taken at 10 min intervals for 7 consecutive days were determined in 18 optimal (OGroup), 20 fair (FGroup) and 21 poor (PGroup) %Fat grouped young men and subsequently analyzed using available validated software. Body composition, cardiorespiratory fitness, actigraphy, daily nutritional and sleep data, and fasting lipid, insulin and glucose concentration measures were also determined. Significant changes in TempAmp and TempStab parameters in subjects with a single metabolic syndrome (MetS) risk factor compared to those with no MetS factors was observed. In addition, stepwise multivariate regression analyses showed that 50% of the variance in TempAmp was explained by actigraphy (mean steps taken per day; MSTPD), cardiorespiratory fitness, and late night eating per week (#LNE); and 57% in TempStab by MSTPD, time spent in moderate-to-vigorous activity per day, fat mass, and #LNE. Overwhelmingly, physical activity was the most important measure associated with the differences in circadian rhythm parameters. Further research is warranted to determine the effects of increasing the amount and timing of physical activity on the status of the circadian system in a variety of populations.

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Physical activity intensity of patient's with traumatic brain injury during inpatient rehabilitation.

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Author information:
OBJECTIVE: Use actigraphy to (1) describe the intensity of physical activity completed by patients with traumatic brain injury (TBI) during inpatient rehabilitation, and (2) examine the association between physical activity intensity and demographic, injury, and programmatic characteristics. DESIGN: Observational. METHOD: Fifty individuals with TBI undergoing inpatient rehabilitation wore accelerometers for an average of 8.7 ± 1.8 days to capture physical activity intensity that was summarized using activity counts (ACs). Intensity of activity was described for categories of the participant's day including physical and occupational therapy, non-active therapy, recreation, and sleep. Descriptive statistics, Pearson's correlations, and general linear regression were computed. RESULTS: Participants average physical activity intensity was considered "inactive" during physical (M = 242.7 ± 105.2 AC/min) and occupational therapy (M = 244 ± 105), non-active therapy (M = 142.2 ± 74.1), and recreation (M = 112.8 ± 59.5), and "sedentary" during sleep (M = 26.7 ± 14.8). Significant positive associations were identified between physical activity intensity and categories of the participant's day suggesting that participants who complete more intense activity in therapy also complete more intense activity during non-active therapy and recreation time. General linear regression indicated that age significantly predicted physical activity intensity. CONCLUSIONS: Findings demonstrate that patients with TBI undergoing inpatient rehabilitation are largely inactive or sedentary. Strategies to
Physical activity is a determinant of circadian blood pressure variation in chronic kidney disease.

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BACKGROUND: Circadian variation in blood pressure (BP), which is commonly blunted among patients with chronic kidney disease (CKD), has been associated with increased cardiovascular risk. The causes of this blunted circadian variation remain incompletely understood.

METHODS: We hypothesized that physical activity is a determinant of circadian BP variation. Accordingly, we studied 101 patients with CKD (mean age 69 years, mostly men) with 24-hour ambulatory BP monitoring and simultaneous monitoring of physical activity on 2 occasions 4 weeks apart.

RESULTS: Measured by wrist actigraphy, a higher level of physical activity was associated with lower overall mean BP. A higher level of activity also altered the circadian systolic BP rhythm; this alteration was characterized by both a higher amplitude of variation (and thus greater dipping) and restoration of acrophase (time at peak BP) to a less vulnerable period for cardiovascular events. Among the most sedentary participants, both systolic and pulse pressure acrophases were seen in the early hours of the morning which is also
the most vulnerable period for cardiovascular events.

CONCLUSION: Physical activity is an independent determinant of circadian variation in BP. We speculate that among patients with CKD, a sedentary lifestyle, rather than non-dipping, mediates increased cardiovascular risk.

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Physical activity, sedentary behavior, and academic performance in Finnish children.

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Comment in

PURPOSE: This study aimed to determine the relationships between objectively measured and self-reported physical activity, sedentary behavior, and academic performance in Finnish children.

METHODS: Two hundred and seventy-seven children from five schools in the Jyväskylä school district in Finland (58% of the 475 eligible students, mean age = 12.2 yr, 56% girls) participated in the study in the spring of 2011.
Self-reported physical activity and screen time were evaluated with questions used in the WHO Health Behavior in School-Aged Children study. Children's physical activity and sedentary time were measured objectively by using an ActiGraph GT1M/GT3X accelerometer for seven consecutive days. A cutoff value of 2296 counts per minute was used for moderate-to-vigorous physical activity (MVPA) and 100 counts per minute for sedentary time. Grade point averages were provided by the education services of the city of Jyväskylä. ANOVA and linear regression analysis were used to analyze the relationships among physical activity, sedentary behavior, and academic performance. RESULTS: Objectively measured MVPA (P = 0.955) and sedentary time (P = 0.285) were not associated with grade point average. However, self-reported MVPA had an inverse U-shaped curvilinear association with grade point average (P = 0.001), and screen time had a linear negative association with grade point average (P = 0.002), after adjusting for sex, children's learning difficulties, highest level of parental education, and amount of sleep. CONCLUSIONS: In this study, self-reported physical activity was directly, and screen time inversely, associated with academic achievement. Objectively measured physical activity and sedentary time were not associated with academic achievement. Objective and subjective measures may reflect different constructs and contexts of physical activity and sedentary behavior in association with academic outcomes.

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Physical exercise, fitness and dietary pattern and their relationship with circadian blood pressure pattern, augmentation index and endothelial dysfunction
biological markers: EVIDENT study protocol.


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BACKGROUND: Healthy lifestyles may help to delay arterial aging. The purpose of this study is to analyze the relationship of physical activity and dietary pattern to the circadian pattern of blood pressure, central and peripheral blood pressure, pulse wave velocity, carotid intima-media thickness and biological markers of endothelial dysfunction in active and sedentary individuals without arteriosclerotic disease.

METHODS/DESIGN:
DESIGN: A cross-sectional multicenter study with six research groups.
SUBJECTS: From subjects of the PEPAF project cohort, in which 1,163 who were sedentary became active, 1,942 were sedentary and 2,346 were active. By stratified random sampling, 1,500 subjects will be included, 250 in each group.

PRIMARY MEASUREMENTS: We will evaluate height, weight, abdominal circumference, clinical and ambulatory blood pressure with the Radial Pulse Wave Acquisition Device (BPro), central blood pressure and augmentation index with Pulse Wave Application Software (A-Pulse) and SphymgoCor System Px (Pulse Wave Analysis), pulse wave velocity (PWV) with SphymgoCor System Px (Pulse Wave Velocity), nutritional pattern with a food intake frequency questionnaire, physical activity with the 7-day PAR questionnaire and accelerometer (Actigraph GT3X), physical fitness with the cycle ergometer (PWC-170), carotid intima-media thickness by ultrasound (Micromax), and endothelial dysfunction biological markers (endoglin and osteoprotegerin).

DISCUSSION: Determining that sustained physical activity and the change from sedentary to active as well as a healthy diet improve circadian pattern, arterial elasticity and carotid intima-media thickness may help to propose lifestyle intervention programs. These interventions could improve the cardiovascular risk profile in some parameters not routinely assessed with traditional risk scales. From the results of this study, interventional approaches could be obtained to delay vascular aging that combine physical exercise and diet.

TRIAL REGISTRATION: ClinicalTrials.gov Identifier: NCT01083082.

DOI: 10.1186/1471-2458-10-233
PMCID: PMC2881095
PMID: 20459634 [Indexed for MEDLINE]


Pilot fatigue: relationships with departure and arrival times, flight duration,
INTRODUCTION: Flight timing is expected to influence pilot fatigue because it determines the part of the circadian body clock cycle that is traversed during a flight. However, the effects of flight timing are not well-characterized because field studies typically focus on specific flights with a limited range of departure times and have small sample sizes. The present project combined data from four studies, including 13 long-range and ultra-long range out-and-back trips across a range of departure and arrival times (237 pilots in 4-person crews, 730 flight segments, 1-3 d layovers).

METHODS: All studies had tripartite support and underwent independent ethical review. Sleep was monitored (actigraphy) from 3 d prior to ≥ 3 d post-trip. Preflight and at top of descent (TOD), pilots rated their sleepiness (Karolinska Sleepiness Scale) and fatigue (Samn-Perelli scale), and completed a psychomotor vigilance task (PVT) test. Mixed model ANOVA identified independent associations between fatigue measures and operational factors (domicile times of departure and arrival, flight duration and direction, landing versus relief crew).

RESULTS: Preflight subjective fatigue and sleepiness were lowest for flights departing 14:00-17:59. Total in-flight sleep was longest on flights departing 18:00-01:59. At TOD, fatigue and sleepiness were higher and PVT response speeds were slower on flights arriving 06:00-09:59 than on flights arriving later. PVT response speed at TOD was also faster on longer flights.

DISCUSSION: The findings indicate the influence of flight timing (interacting with the circadian body clock cycle), as well as flight duration, on in-flight...
OBJECTIVE: To explore feasibility and potential efficacy of on-line interventions for sleep quality following a traumatic brain injury (TBI).

DESIGN: A two parallel-group, randomized controlled pilot study.

SETTING: Community-based.

SUBJECTS: In all, 24 participants (mean age: 35.9 ± 11.8 years) who reported experiencing sleep difficulties between 3 and 36 months after a mild or moderate TBI.

INTERVENTIONS: Participants were randomized to receive either a cognitive behaviour therapy or an education intervention on-line. Both interventions were self-completed for 20–30 minutes per week over a six-week period.

MAIN MEASURES: The Pittsburgh Sleep Quality Index assessed self-reported sleep quality with actigraphy used as an objective measure of sleep quality.
The CNS Vital Signs on-line neuropsychological test assessed cognitive functioning and the Rivermead Post-concussion Symptoms and Quality of Life after Brain Injury questionnaires were completed pre and post intervention.

RESULTS: Both programmes demonstrated feasibility for use post TBI, with 83.3% of participants completing the interventions. The cognitive behaviour therapy group experienced significant reductions (F = 5.47, p = 0.04) in sleep disturbance (mean individual change = -4.00) in comparison to controls post intervention (mean individual change = -1.50) with a moderate effect size of 1.17. There were no significant group differences on objective sleep quality, cognitive functioning, post-concussion symptoms or quality of life.

CONCLUSION: On-line programmes designed to improve sleep are feasible for use for adults following mild-to-moderate TBI. Based on the effect size identified in this pilot study, 128 people (64 per group) would be needed to determine clinical effectiveness.

DOI: 10.1177/0269215517736671
PMID: 29072086 [Indexed for MEDLINE]


Pilot Sleep in Long-Range and Ultra-Long-Range Commercial Flights.

Lamp A, McCullough D, Chen JMC, Brown RE, Belenky G.

INTRODUCTION: Despite the clear need for understanding how pilot sleep affects performance during long-range (LR; 12-16h) and ultra-long-range (ULR; 16+h) flights, the scientific literature on the effects of sleep loss and circadian desynchronization on pilots' sleep in commercial aviation is sparse. METHODS: We assessed pilots' sleep timing, duration, and post-trip recovery on two LR and two ULR nonstop California to Australasia routes. Pilot's sleep/wake history was measured with actigraphy and verified by logbook across 8–9 d. RESULTS:
Pilots averaged $8.210 \pm 1.687$ SD hours of sleep per 24 h across the study period. A logistic model of the circadian timing of sleep indicated that time of day and phase of trip are significant predictors of pilots being asleep. Significant two- and three-way interactions were found between time of day, phase of trip, and route. A significant difference in average sleep time was observed between baseline and recovery day 1 for one route. All other recovery days and routes were not significantly different from baseline.

**DISCUSSION:** For the four routes, the average amount of sleep per 24-h period during the study period was within the normal range with the circadian rhythm aligned to home-base time pre- and post-trip. Flight segments and layover conditions were associated with a misalignment of sleep relative to circadian rhythm, with layover sleep appearing to shift toward the local night. Full post-trip sleep duration recovery appears to occur for all routes within 1–2 d.


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Pilot study aiming to support sleep quality and duration during hospitalizations.


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BACKGROUND: Sleep is a vital part to healing and recovery, hence poor sleep during hospitalizations is highly undesirable. Few studies have assessed interventions to optimize sleep among hospitalized patients.

OBJECTIVE: To assess the effect of sleep-promoting interventions on sleep quality and duration among hospitalized patients.

DESIGN: Quasi-experimental prospective study.

SETTING: Academic medical center.

PARTICIPANTS: Adult patients on the general medicine ward.

INTERVENTION: Nurse-delivered sleep-promoting interventions augmented by sleep hygiene education and environmental control to minimize sleep disruption.

MEASUREMENTS: Objective and subjective measurement of sleep parameters using validated sleep questionnaires, daily sleep diary, and actigraphy monitor.

RESULTS: Of the 112 patients studied, the mean age was 58 years, 55% were female, the mean body mass index was 32, and 43% were in the intervention group. Linear mixed models tested mean differences in 7 sleep measures and group differences in slopes representing nightly changes in sleep outcomes over the course of hospitalization between intervention and control groups. Only total sleep time, computed from sleep diaries, demonstrated significant overall mean difference of 49.6 minutes (standard error [SE] = 21.1, P < 0.05). However, significant differences in average slopes of subjective ratings of sleep quality (0.46, SE = 0.18, P < 0.05), refreshing sleep (0.54, SE = 0.19, P < 0.05), and sleep interruptions (-1.6, SE = 0.6, P < 0.05) indicated improvements during hospitalization within intervention patients compared to controls.

CONCLUSION: This study demonstrated that there is an opportunity to
identify patients not sleeping well in the hospital. Sleep-promoting initiatives, both at the unit level as well as individualized offerings, may improve sleep during hospitalizations, particularly over the course of the hospitalization. Journal of Hospital Medicine 2016;11:467-472. © 2016 Society of Hospital Medicine.

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Pineal volume and evening melatonin in young people with affective disorders.


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Affective disorders in young people have been associated with disruptions in circadian rhythms, including abnormalities in secretion of the pineal hormone melatonin. Previous research reports relationships between pineal gland volumes, melatonin secretion, and sleep-wake cycles, but the relationship between these
factors has not been explored in affective disorders. This study aimed to characterize these factors and explore associations with mood symptoms and functioning in a sample of young people with affective disorders. Pineal volume from magnetic resonance imaging and melatonin assay from evening dim-light saliva collection were evaluated in 50 individuals (15-30 years old; 72% female) with bipolar, depressive, or anxiety disorders. Actigraphy monitoring was also conducted for approximately two weeks to derive sleep-wake measures. Pineal volume was associated with melatonin secretion across the evening, replicating previous findings in psychiatrically healthy individuals. Pineal volume was smaller in participants in which melatonin onset was not detected. Timing of melatonin secretion was related to sleep timing, but amount of melatonin and pineal volume were not related to any sleep-wake measures. A shorter phase angle between onset of melatonin secretion and sleep onset was associated with longer total sleep time. Lower melatonin levels were associated with poorer social and occupational functioning. Although pineal volume is not directly related to sleep disturbances or symptoms, melatonin may influence both sleep-wake cycles and functioning in the early stages of affective disorder. Causal links remain to be established, however, treatments that target circadian rhythms may be useful in improving functioning in young people with affective disorders.

DOI: 10.1007/s11682-016-9650-2
PMID: 27812851 [Indexed for MEDLINE]


The Pittsburgh Sleep Diary.

Monk TH(1), Reynolds CF, Kupfer DJ, Buysse DJ, Coble PA, Hayes AJ, MacHen MA, Petrie SR, Ritenour AM.
Increasingly, there is a need in both research and clinical practice to document and quantify sleep and waking behaviors in a comprehensive manner. The Pittsburgh Sleep Diary (PghSD) is an instrument with separate components to be completed at bedtime and waketime. Bedtime components relate to the events of the day preceding the sleep, waketime components to the sleep period just completed. Two-week PghSD data is presented from 234 different subjects, comprising 96 healthy young middle-aged controls, 37 older men, 44 older women, 29 young adult controls and 28 sleep disorders patients in order to demonstrate the usefulness, validity and reliability of various measures from the instrument. Comparisons are made with polysomnographic and actigraphic sleep measures, as well as personality and circadian type questionnaires. The instrument was shown to have sensitivity in detecting differences due to weekends, age, gender, personality and circadian type, and validity in agreeing with actigraphic estimates of sleep timing and quality. Over a 12–31 month delay, PghSD measures of both sleep timing and sleep quality showed correlations between 0.56 and 0.81 (n = 39, P < 0.001).

PMID: 10607115


The Pittsburgh Sleep Diary.

Monk TH(1), Reynolds CF 3rd, Kupfer DJ, Buysse DJ, Coble PA, Hayes AJ, Machen MA, Petrie SR, Ritenour AM.

Collaborators: Monk TH(2).

Author information:
Increasingly, there is a need in both research and clinical practice to document and quantify sleep and waking behaviors in a comprehensive manner. The Pittsburgh Sleep Diary (PghSD) is an instrument with separate components to be completed at bedtime and waketime. Bedtime components relate to the events of the day preceding the sleep, waketime components to the sleep period just completed. Two-week PghSD data is presented from 234 different subjects, comprising 96 healthy young middle-aged controls, 37 older men, 44 older women, 29 young adult controls and 28 sleep disorders patients in order to demonstrate the usefulness, validity and reliability of various measures from the instrument. Comparisons are made with polysomnographic and actigraphic sleep measures, as well as personality and circadian type questionnaires. The instrument was shown to have sensitivity in detecting differences due to weekends, age, gender, personality and circadian type, and validity in agreeing with actigraphic estimates of sleep timing and quality. Over a 12–31 month delay, PghSD measures of both sleep timing and sleep quality showed correlations between 0.56 and 0.81 (n = 39, P < 0.001).

PMID: 11537903  [Indexed for MEDLINE]


Placebo effect of acupuncture on insomnia: a systematic review and meta-analysis.

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BACKGROUND: Acupuncture is a common alternative therapy for clinical treatment of insomnia. As the underlying mechanism is yet unclear, its efficacy is often considered as placebo effect. To clarify whether acupuncture treatment of insomnia is only due to its placebo effect, a systematic review and a meta-analysis were designed based on the comparison between acupuncture and sham acupuncture.

METHODS: Four English (PubMed, Embase, Web of Science, and The Cochrane Library) and three Chinese (CNKI, VIP, and Wanfang) databases were searched, and the validity of the eligible studies was critically appraised. Thirteen eligible randomized controlled trials of moderate-to-high quality that employed polysomnography (PSG), actigraphy, or self-assessment sleep quality tools were included in the present study. A meta-analysis was conducted using a random-effects model with the Pittsburgh Sleep Quality Index (PSQI) as the primary outcome measure (911 adult patients, 13 trials) for trials investigating the effects of acupuncture as compared to the sham acupuncture. Then, a subgroup analysis was performed to detect the sources of heterogeneity, identify the selection of sham acupuncture methods and different crowd characteristics, and explore its contributions to the total score change of PSQI.

RESULTS: Compared to the sham groups, acupuncture significantly decreased the PSQI score (P<0.0001). A subgroup analysis showed that the selection of sham acupuncture methods did not affect the results of PSQI. A subgroup of two trials with a total of 141 participants with major depressive disorder did
not show any significant reductions in total PSQI scores (P=0.11). In addition, a significant difference was detected in the change of Insomnia Severity Index (ISI) scores (362 adult patients, 4 trials) between acupuncture and sham acupuncture (P<0.0001). The PSG and actigraphy data from acupuncture and the sham did not reveal any significant differences in the sleep structure changes.

CONCLUSIONS: Acupuncture treatment of insomnia is efficacious, not because of its placebo effect. For the selection of sham acupuncture, both methods performed similarly in a clinical setting. Moreover, insomnia patients with major depression disorder were not recommended to use only acupuncture treatment.

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PMID: 32005059


PLM detection by actigraphy compared to polysomnography: a validation and comparison of two actigraphs.

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OBJECTIVE: To compare periodic leg movement (PLM) counts obtained with polysomnography (PSG) to those obtained from actigraphy with two devices (Actiwatch and PAM-RL).

METHODS: Twenty-four patients underwent full night actigraphy with Actiwatch from both legs and simultaneous PSG. Out of these patients, 10 had additional actigraphy with PAM-RL. Bilateral and unilateral PLM indices (PLMI) for both actigraphs were calculated for time in bed and compared to
RESULTS: PLMI obtained with Actiwatch were significantly lower than those obtained with PSG (21.2+/−25.6/h versus 34.4+/−30.7/h; p<0.001), whereas the PLMI from PAM–RL were significantly higher than in PSG (63.6+/−39.3/h versus 37.0+/−33.5/h; p=0.009). In direct comparison, Actiwatch gave significantly lower PLMI than the PAM–RL (p=0.005). The correlations between Actiwatch and PSG (rho=0.835, p<0.001), PAM–RL and PSG (rho=0.939, p<0.001), and Actiwatch and PAM–RL (rho=0.915, p<0.001) were significant. Unilateral actigraphy compared to standard PSG gave less consistent findings. When comparing different settings of the PAM–RL, manual threshold setting resulted in PLMI that were no longer different from PSG (p=0.074), in contrast to the default threshold setting.

CONCLUSIONS: The Actiwatch underestimated and the PAM–RL overestimated PLMI compared to PSG. Whereas PLMI obtained with two actigraphs and PSG were highly correlated, they differed in mean values. Therefore, PSG, actigraphy and also the different actigraphs cannot be interchanged in longitudinal studies, and actigraphy should not be used for diagnostic decision making based on PLM indices. The best approximation to PSG PLMI was achieved by using manual threshold setting with the PAM–RL.

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PMID: 18656421  [Indexed for MEDLINE]


PNI Biomarkers and Health Outcomes in College Women.

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Sleep disturbance has been found to trigger a stress response with a subsequent activation of the psychoneuroimmunological (PNI) pathway associated with adverse health outcomes. This study aimed to assess the association among selected PNI biomarkers, sleep disturbances, and adverse health outcomes (depressive symptoms, physical symptoms). A stratified, quota sample (14 poor sleepers and 15 good sleepers) was drawn from a pool of healthy college women from a larger scale of study. The participants reported their sleep, stress, depressive, and physical symptoms. Wrist actigraphy was used to collect objective sleep data, and the Enzyme-Linked ImmunoSorbent Assay was used to assess PNI biomarkers. Poor sleep quality, higher stress perception, elevated serum serotonin, and lower serum interleukin-10 explained 75.3% of the variances for the depressive symptoms. Poor sleep quality along with delayed peak activity rhythms accounted 31.4% of the physical symptoms. High serotonin and tumor necrosis factor-α were the significant predictors for poor sleep efficiency, and serotonin was the single significant predictor for poor daytime functioning. Stress and sleep disturbances negatively impact the health of college women and should be as part of
regular check-ups on campus. PNI effects on health outcomes should be further explored. Educational materials in the areas of sleep hygiene, health impacts from sleep disturbances, and strategies to maintain synchronized circadian rhythms should be mandatorily included in the college curriculum.

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PMID: 27429271


Polymorphonuclear leucocyte priming in long intermittent nocturnal haemodialysis patients--is melatonin a player?

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BACKGROUND: The relationships between sleep quality, melatonin circadian rhythm and polymorphonuclear leucocyte (PMNL) priming during the night of dialysis treatment compared with a night without dialysis were studied in a group of nocturnal haemodialysis (HD) patients.

METHODS: Twenty-eight long intermittent nocturnal HD patients were included. Sleep quality was assessed by a questionnaire and wrist actigraphy. Plasma melatonin levels were assayed every 2 h, from 9 p.m. to 5 a.m. PMNL priming was assessed by the rate of superoxide release from separated PMNLs at 9 p.m. and 5 a.m., on a night of dialysis and a night with sleepover in the dialysis unit without being dialysed.

RESULTS: Melatonin levels increased similarly during a night with and
without dialysis, reaching peak level at 5 a.m. Most (73%) of the patients had severe sleep disturbances. A significant negative correlation was found between the sleep quality score, the rate of superoxide release from separated PMNLs and melatonin levels. While during a night without dialysis a significant reduction of the rate of superoxide release was found at 5 a.m. (compared with 9 p.m.), no significant reduction was observed when the patients were dialysed. Patients with flat melatonin curves, with <10 pg/ml, showed a faster rate of superoxide release than those with higher levels.

CONCLUSIONS: The nocturnal HD process does not affect plasma melatonin levels or rhythms, suggesting that melatonin is not dialysed. Higher endogenous melatonin levels are associated with better sleep and lower PMNL priming. The lower PMNL priming in patients with higher plasma melatonin levels suggests that melatonin overrides the oxidative burden induced by the dialysis process.

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Polysomnographic and actigraphic characteristics of patients with H1N1-vaccine-related and sporadic narcolepsy.

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OBJECTIVE: After the pandemic H1N1 influenza AS03-adjuvanted vaccine, Pandemrix®, was used in late 2009 and early 2010, the incidence of narcolepsy increased in many European countries. This incidence mainly increased in children and adolescents and, to a lesser degree, in adults.

PATIENTS/METHODS: 125 unmedicated patients, aged 4 to 61 years, were included in this case-series study. Of these, 69 were diagnosed to have an H1N1-vaccine-related narcolepsy and 57 had sporadic narcolepsy. Most of these patients had: an actigraphy recording of 1-2 weeks, polysomnography, a Multiple Sleep Latency Test (MSLT), and cerebrospinal fluid hypocretin-1 concentration analysis.

RESULTS: Patients with H1N1-vaccine-related narcolepsy had shorter diagnostic delays, lower periodic leg movement index during sleep, earlier sleep-wake rhythm, and were younger in age at diagnosis, compared with sporadic cases. They also had shorter sleep latency and more sleep onset REM periods in MSLT, but these results were strongly age-dependent. Actigraphy showed quantitatively less sleep and more sleep fragmentation than polysomnography.

CONCLUSION: Regarding polysomnographic and actigraphic characteristics, there were no dramatic deviations between H1N1-vaccine-related and sporadic narcolepsy. Circadian rhythms indicated some interesting new findings with respect to the H1N1-vaccine-related disease. An actigraphy recording of 1-2 weeks is useful when studying the nocturnal aspects of narcolepsy and sleep-wake rhythms of narcoleptic patients.
Poor actigraphic and self-reported sleep patterns predict delinquency and daytime impairment among at-risk adolescents.

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OBJECTIVE: To evaluate associations between actigraphic sleep patterns, subjective sleep quality, and daytime functioning (ie, sleepiness, symptoms of depression, and delinquency and other conduct problems) in at-risk adolescents.

DESIGN: Prospective, observational cohort study.

SETTING: Providence, RI, predominantly home and school and 2 visits to the Brown Center for the Study of Children at Risk.

PARTICIPANTS: A diverse group of low-income 13-year-olds (n = 49) with and without prenatal drug exposure.

INTERVENTIONS: None.

MEASUREMENTS: Actigraphy, sleep diaries, and sleep and health questionnaires.

RESULTS: Above and beyond the effects of prenatal drug exposure and postnatal adversity, actigraphic daytime sleep was a significant predictor of daytime sleepiness and delinquency. Subjective sleep quality was a significant predictor of daytime sleepiness, delinquency, and depressive symptoms. Later bed times predicted increased delinquency.
CONCLUSIONS: There was a unique effect of actigraphic daytime sleep duration, subjective nighttime sleep quality, and bedtime on daytime functioning (ie, sleepiness, symptoms of depression, and delinquency and other conduct problems) of at-risk adolescents. In these vulnerable youth, these problematic sleep patterns may contribute to feeling and behaving poorly. Intervention studies with at-risk teens should be conducted to further explore the role of these sleep parameters on daytime functioning.

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Poor sleep and cardiovascular function in children.


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We investigated whether sleep quantity and quality were related to 24-hour ambulatory blood pressure and cardiovascular reactivity in children. We studied term-born, healthy 8.0-year olds (SD: 1.4 years) without sleep-disordered breathing (231 and 265 children provided valid data for analyses of ambulatory blood pressure and cardiovascular reactivity, respectively). Sleep was registered with an actigraph for 6 nights on average (SD: 1.2; range: 3 to 13 nights). Ambulatory blood pressure was measured for 24-hours (41% nonschool days) with an
oscillometric device. The children underwent the Trier Social Stress Test for
Children, during which blood pressure, electrocardiography, and thoracic
impedance were recorded and processed offline to give measures of cardiovascular
and autonomic function. Neither quantity nor quality of sleep was related to
24-hour ambulatory blood pressure or cardiovascular reactivity after accounting
for major covariates (sex, age, height, body mass index, and parental education).
Although lower sympathetic nervous system activation and higher cardiac
activation under stress were found in the group of children who slept for short
duration when they were compared with the average sleep duration group, these
associations were not significant after correction for multiple testing and were
not seen in linear regression models of the effects of sleep duration. These
findings do not support the mainstream of epidemiological findings, derived from
samples more heterogeneous in age, sociodemographic characteristics, and health,
suggesting that poor sleep is associated with an unhealthy cardiovascular
phenotype.

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Jul 17.

Poor sleep moderates the relationship between daytime napping and inflammation in
Black and White men.

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OBJECTIVES: To test whether napping was associated with 2 inflammatory markers with known relationships to cardiovascular disease: high-sensitivity C-reactive protein (hsCRP) and interleukin-6 (IL-6). Because IL-6 is known to impact central inflammatory processes that relate to sleep regulation, including subjective fatigue, we tested whether this relationship was moderated by sleep duration, sleep efficiency, and self-reported sleep quality.

DESIGN: Cross-sectional.

PARTICIPANTS: A community sample of Black and White men (N=253) completed a week of actigraphy and diary measures of sleep and napping and provided a fasting blood sample.

MEASUREMENTS/ANALYSIS: Napping was measured as the proportion of days with at least 30 minutes napped and the average minutes napped per day. Linear regressions adjusted for race, socioeconomic status, employment, body mass index, smoking, medications that affect sleep or inflammation, working the nightshift, and day-sleeping status, followed by interaction terms between napping and sleep duration, efficiency, and quality, respectively.

RESULTS: There were no significant main effects of actigraphy- or diary-measured napping on IL-6 or hsCRP. Moderation analyses indicated elevated IL-6 values among men who napped more days (by actigraphy) and demonstrated short sleep duration (P=.03). Moderation analyses also indicated elevated IL-6 among men who demonstrated greater average minutes napped (by actigraphy) and short sleep duration (P<.001), low efficiency (P=.03), and poor quality (P=.03). Moderation analyses involving diary napping or hsCRP were not significant.

CONCLUSIONS: Actigraphy-assessed daytime napping is related to higher IL-6 in men who demonstrate worse sleep characteristics. Daytime napping may pose additional risk for inflammation beyond the known risk conferred by short sleep.
Postmenopausal hormones and sleep quality in the elderly: a population based study.


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BACKGROUND: Sleep disturbance and insomnia are commonly reported by postmenopausal women. However, the relationship between hormone therapy (HT) and sleep disturbances in postmenopausal community-dwelling adults is understudied. Using data from the multicenter Study of Osteoporotic Fractures (SOF), we tested the relationship between HT and sleep-wake estimated from actigraphy. METHODS: Sleep-wake was ascertained by wrist actigraphy in 3,123 women aged 84 +/- 4 years (range 77-99) from the Study of Osteoporotic Fractures (SOF). This sample represents 30% of the original SOF study and 64% of participants seen at this visit. Data were collected for a mean of 4 consecutive 24-hour periods. Sleep parameters measured objectively included total sleep time, sleep efficiency (SE), sleep latency, wake after sleep onset (WASO), and nap time. All analyses were adjusted for potential confounders (age, clinic site, race, BMI, cognitive function, physical activity, depression, anxiety, education, marital status, age
RESULTS: Actigraphy measurements were available for 424 current, 1,289 past, and 1,410 never users of HT. Women currently using HT had a shorter WASO time (76 vs. 82 minutes, \( P = 0.03 \)) and fewer long-wake (> or = 5 minutes) episodes (6.5 vs. 7.1, \( P = 0.004 \)) than never users. Past HT users had longer total sleep time than never users (413 vs. 403 minutes, \( P = 0.002 \)). Women who never used HT had elevated odds of SE <70% (OR,1.37;95%CI,0.98-1.92) and significantly higher odds of WASO > or = 90 minutes (OR,1.37;95%CI,1.02-1.83) and > or = 8 long-wake episodes (OR,1.58;95%CI,1.18-2.12) when compared to current HT users. CONCLUSIONS: Postmenopausal women currently using HT had improved sleep quality for two out of five objective measures: shorter WASO and fewer long-wake episodes. The mechanism behind these associations is not clear. For postmenopausal women, starting HT use should be considered carefully in balance with other risks since the vascular side-effects of hormone replacement may exceed its beneficial effects on sleep.

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PMID: 20441593  [Indexed for MEDLINE]


Posttraumatic delayed sleep phase syndrome.

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Comment in

Circadian rhythm sleep disorders may occur after traumatic brain injury. We describe a 48-year-old man who presented with sleep onset insomnia and
cognitive
dysfunction after a car accident. A diagnosis of delayed sleep phase
syndrome (DSPS) was confirmed by sleep logs and actigraphy, which revealed
sleep onset in the early morning hours and awakening around noon.

DOI: 10.1212/wnl.54.1.250
PMID: 10636163 [Indexed for MEDLINE]

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Postural impairments in Parkinson's disease are not associated with changes in circadian rhythms changes.

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Parkinson's disease (PD) is a progressive neurodegenerative disease, with a worldwide incidence of 1% in individuals >60 years of age. Its primary characteristics include postural impairments and changes in circadian rhythms.

The authors investigated the association between postural impairment and changes in circadian rhythms in 24 PD subjects diagnosed with stages 1 to 3 on the Hoehn-Yard (HY) scale and regularly used dopaminergic medication for at least 1 year (experimental group - EG) and 24 healthy elderly individuals without a history of neurological impairment as the control group (CG). Static balance tests using a force plate were performed, and activity/rest rhythm, according to
the relative amplitude of L5 and M10 values, was monitored for seven consecutive
days using actimetry. The results indicated differences in posturographic
indicators of mediolateral displacement (ML) [EG, 4.71 ± 0.85 mm; CG, 2.79 ± 0.53
mm (p < .0001)] and anteroposterior displacement of the center of pressure (COP)
[EG, 5.61 ± 2.43 mm; CG, 8.23 ± 1.72 mm (< 0.0001)], ML velocity of the COP [EG,
2.39 ± 0.83 mm/s; CG, 1.40 ± 0.18 mm/s (p < .0001)], and total distance of the
COP in the tandem stance condition [EG, 227.6 ± 75 mm; CG, 53.4 ± 6.1
mm (p <
.0001)] between the EG and CG. There was no correlation between relative
amplitude and posturographic data for the EG. Postural impairments were verified
in comparing the EG and CG; however, there was no association between posturographic indicators and activity/rest rhythm.

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The Potential of Actigraphy to Assess Agitation in Dementia.

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Actigraphy is a method used to study sleep-wake patterns and circadian rhythms by assessing movement, most commonly of the wrist. These evidence-based practice parameters are an update to the Practice Parameters for the Use of Actigraphy in the Clinical Assessment of Sleep Disorders, published in 1995. These practice parameters were developed by the Standards of Practice Committee and reviewed and approved by the Board of Directors of the American Academy of Sleep Medicine. Recommendations are based on the accompanying comprehensive review of the medical literature regarding the role of actigraphy, which was developed by a task force commissioned by the American Academy of Sleep Medicine. The following recommendations serve as a guide to the appropriate use of actigraphy. Actigraphy is reliable and valid for detecting sleep in normal, healthy populations, but less reliable for detecting disturbed sleep. Although actigraphy is not indicated for the routine diagnosis, assessment, or management of any of the sleep disorders, it may serve as a useful adjunct to routine clinical evaluation of
insomnia, circadian-rhythm disorders, and excessive sleepiness, and may be helpful in the assessment of specific aspects of some disorders, such as insomnia and restless legs syndrome/periodic limb movement disorder. The assessment of daytime sleepiness, the demonstration of multiday human-rest activity patterns, and the estimation of sleep-wake patterns are potential uses of actigraphy in clinical situations where other techniques cannot provide similar information (e.g., psychiatric ward patients). Superiority of actigraphy placement on different parts of the body is not currently established. Actigraphy may be useful in characterizing and monitoring circadian rhythm patterns or disturbances in certain special populations (e.g., children, demented individuals), and appears useful as an outcome measure in certain applications and populations. Although actigraphy may be a useful adjunct to portable sleep apnea testing, the use of actigraphy alone in the detection of sleep apnea is not currently established. Specific technical recommendations are discussed, such as using concomitant completion of a sleep log for artifact rejection and timing of lights out and on; conducting actigraphy studies for a minimum of three consecutive 24-hour periods; requiring raw data inspection; permitting some preprocessing of movement counts; stating that epoch lengths up to 1 minute are usually sufficient, except for circadian rhythm assessment; requiring interpretation to be performed manually by visual inspection; and allowing automatic scoring in addition to manual scoring methods.

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BACKGROUND: Actigraphy is increasingly used in sleep research and the clinical care of patients with sleep and circadian rhythm abnormalities. The following practice parameters update the previous practice parameters published in 2003 for the use of actigraphy in the study of sleep and circadian rhythms.

METHODS: Based upon a systematic grading of evidence, members of the Standards of Practice Committee, including those with expertise in the use of actigraphy, developed these practice parameters as a guide to the appropriate use of actigraphy, both as a diagnostic tool in the evaluation of sleep disorders and as an outcome measure of treatment efficacy in clinical settings with appropriate patient populations.

RECOMMENDATIONS: Actigraphy provides an acceptably accurate estimate of sleep patterns in normal, healthy adult populations and inpatients suspected of certain sleep disorders. More specifically, actigraphy is indicated to assist in the evaluation of patients with advanced sleep phase syndrome (ASPS), delayed sleep phase syndrome (DSPS), and shift work disorder. Additionally, there is some evidence to support the use of actigraphy in the evaluation of patients suspected of jet lag disorder and non-24hr sleep/wake syndrome (including that associated with blindness). When polysomnography is not available, actigraphy is indicated to estimate total sleep time in patients with obstructive sleep apnea. In patients with insomnia and hypersomnia, there is evidence to support the use of actigraphy in the characterization of circadian rhythms and sleep patterns/disturbances. In assessing response to therapy, actigraphy
has proven useful as an outcome measure in patients with circadian rhythm disorders and insomnia. In older adults (including older nursing home residents), in whom traditional sleep monitoring can be difficult, actigraphy is indicated for characterizing sleep and circadian patterns and to document treatment responses. Similarly, in normal infants and children, as well as special pediatric populations, actigraphy has proven useful for delineating sleep patterns and documenting treatment responses.

CONCLUSIONS: Recent research utilizing actigraphy in the assessment and management of sleep disorders has allowed the development of evidence-based recommendations for the use of actigraphy in the clinical setting. Additional research is warranted to further refine and broaden its clinical value.

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Pre-awake light exposure and sleep disturbances: findings from the HEIJO-KYO cohort.

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OBJECTIVES: To evaluate the associations between pre-awake light (PAL) exposure and subjective and objective measures of sleep quality.

METHODS: In this cross-sectional study of 1108 elderly participants (mean age,
71.9 years), we measured bedroom light intensity using a bedside light meter for two nights and sleep quality using actigraphy and a questionnaire. PAL was determined as the 2h-average light intensity before rise time, and sleep disturbance was defined as the Pittsburgh sleep quality index score ≥6.

RESULTS: Sleep disturbance prevalence increased with increased PAL exposure (P = 0.002). In multivariable models adjusted for potential confounders, the odds ratio (OR) for sleep disturbances was significantly higher in the highest quartile PAL group (Q4) than in the lowest quartile group (Q1) (OR, 1.65; 95% CI, 1.16–2.34). This association occurred independent of post-bedtime light exposure; and was stronger in the later chronotype group (n = 556) (OR, 1.80; 95% CI, 1.05–3.09) than in the earlier chronotype group (n = 552) (OR, 1.64; 95% CI, 1.01–2.64). Actigraphic sleep efficiency in the Q4 group was significantly lower by 2.6% (95% CI, 1.3–3.8) than that in the Q1 group. Moreover, longer wake after sleep onset by 7.5 min (95% CI, 2.8–12.2) and sleep onset latency by 0.2 log min (95% CI, 0.1–0.4) were observed in the Q4 group than the Q1 group.

CONCLUSIONS: Higher PAL exposure was significantly associated with a higher prevalence of sleep disturbances, independent of post-bedtime light exposure. Consistent results were observed in the actigraphy analysis.

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Predicting performance and safety based on driver fatigue.

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Fatigue causes decrements in vigilant attention and reaction time and is a major safety hazard in the trucking industry. There is a need to quantify the relationship between driver fatigue and safety in terms of operationally relevant measures. Hard-braking events are a suitable measure for this purpose as they are relatively easily observed and are correlated with collisions and near-crashes.

We developed an analytic approach that predicts driver fatigue based on a biomathematical model and then estimates hard-braking events as a function of predicted fatigue, controlling for time of day to account for systematic variations in exposure (traffic density). The analysis used de-identified data from a previously published, naturalistic field study of 106 U.S. commercial motor vehicle (CMV) drivers. Data analyzed included drivers' official duty logs, sleep patterns measured around the clock using wrist actigraphy, and continuous recording of vehicle data to capture hard-braking events. The curve relating predicted fatigue to hard-braking events showed that the frequency of hard-braking events increased as predicted fatigue levels worsened. For each
increment on the fatigue scale, the frequency of hard-braking events increased by 7.8%. The results provide proof of concept for a novel approach that predicts fatigue based on drivers' sleep patterns and estimates driving performance in terms of an operational metric related to safety. The approach can be translated to practice by CMV operators to achieve a fatigue risk profile specific to their own settings, in order to support data-driven decisions about fatigue countermeasures that cost-effectively deliver quantifiable operational benefits.

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Predicting the actigraphy-based acrophase using the Morningness-Eveningness Questionnaire (MEQ) in college students of North Italy.


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Actigraphy is the reference objective method to measure circadian rhythmicity. One simpler subjective approach to assess the circadian typology is the Morningness-Eveningness Questionnaire (MEQ) by Horne and Ostberg. In this study, we compared the MEQ score against the actigraphy-based circadian parameters MESOR, amplitude and acrophase in a sample of 54 students of the University of
Milan in Northern Italy. MEQ and the acrophase resulted strongly and inversely associated \((r = -0.84, p < 0.0001)\), and their relationship exhibited a clear-cut linear trend. We thus used linear regression to develop an equation enabling us to predict the value of the acrophase from the MEQ score. The parameters of the regression model were precisely estimated, with the slope of the regression line being significantly different from 0 \((p < 0.0001)\). The best-fit linear equation was: \(\text{acrophase (min)} = 1238.7 - 5.49 \cdot \text{MEQ}\), indicating that each additional point in the MEQ score corresponded to a shortening of the acrophase of approximately 5 min. The coefficient of determination, \(R^2\), was 0.70. The residuals were evenly distributed and did not show any systematic pattern, thus indicating that the linear model yielded a good, balanced prediction of the acrophase throughout the range of the MEQ score. In particular, the model was able to accurately predict the mean values of the acrophase in the three chronotypes (Morning-, Neither-, and Evening-types) in which the study subjects were categorized. Both the confidence and prediction limits associated to the regression line were calculated, thus providing an assessment of the uncertainty associated with the prediction of the model. In particular, the size of the two-sided prediction limits for the acrophase was about ±100 min in the midrange of the MEQ score. Finally, k-fold cross-validation showed that both the model's predictive ability on new data and the model's stability to changes in the data set used for parameter estimation were good. In conclusion, the actigraphy-based acrophase can be predicted using the MEQ score in a population of college students of North Italy.

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Prediction Accuracy in Multivariate Repeated-Measures Bayesian Forecasting Models with Examples Drawn from Research on Sleep and Circadian Rhythms.

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In study designs with repeated measures for multiple subjects, population models capturing within- and between-subjects variances enable efficient individualized prediction of outcome measures (response variables) by incorporating individuals response data through Bayesian forecasting. When measurement constraints preclude reasonable levels of prediction accuracy, additional (secondary) response variables measured alongside the primary response may help to increase prediction accuracy. We investigate this for the case of substantial between-subjects correlation between primary and secondary response variables, assuming negligible within-subjects correlation. We show how to determine the accuracy of primary response predictions as a function of secondary response observations. Given measurement costs for primary and secondary variables, we determine the number of observations that produces, with minimal cost, a fixed average prediction accuracy for a model of subject means. We illustrate this with estimation of subject-specific sleep parameters using polysomnography and wrist
actigraphy. We also consider prediction accuracy in an example time-dependent, linear model and derive equations for the optimal timing of measurements to achieve, on average, the best prediction accuracy. Finally, we examine an example involving a circadian rhythm model and show numerically that secondary variables can improve individualized predictions in this time-dependent nonlinear model as well.

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Prediction of melatonin efficacy by pretreatment dim light melatonin onset in children with idiopathic chronic sleep onset insomnia.

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Research has shown efficacy of melatonin treatment to advance sleep-wake rhythms in insomnia. In healthy adults, direction and magnitude of the phase shift depends on the timing of administration relative to the phase position of the circadian system. Therefore, in the present study we investigated whether in children with chronic sleep onset insomnia (SOI) efficacy of melatonin treatment in the early evening could be predicted from dim light melatonin onset (DLMO), a phase marker of the circadian system. We combined data of two previously published double blind, randomized, placebo-controlled trials in 110 participants, aged 6-12 years. Sleep was actigraphically estimated, and saliva
collected, at baseline and in the third week of a 4-week treatment period with 5 mg melatonin or placebo at 18:00 or 19:00 hours. Primary outcome measures were pre- to post-treatment changes in dim light melatonin onset (DeltaDLMO), sleep onset (DeltaSO), sleep latency (DeltaSL), and total sleep duration (DeltaTSD).

Melatonin advanced DLMO with +1:12 h (P < 0.001), SO with +0:42 h (P = 0.004), SL decreased with 25 min (P = 0.019), and TSD did not change significantly, as compared with placebo. In the melatonin-treated group, but not in the placebo-treated group, pretreatment DLMO was significantly related to DeltaDLMO \([F(1, 29) = 7.28, P = 0.012]\) and DeltaSO \([F(1, 25) = 7.72, P = 0.010]\). The time interval between treatment administration and pretreatment DLMO (INT) was only significantly related to DeltaSO \([F(1,26) = 5.40, P = 0.028]\). The results suggest that in children with SOI, the efficacy of early evening melatonin to advance sleep onset and endogenous melatonin onset increases the later the pretreatment DLMO is.

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Prediction of overall survival through circadian rest-activity monitoring during chemotherapy for metastatic colorectal cancer.


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The clinical relevance of circadian rhythm modifications in patients on
Chemotherapy is unknown. Even so, circadian parameter I<0 before chemotherapy independently predicted overall survival. This study investigates the relevance of I<0 measured during chemotherapy for survival and symptoms. The circadian rest-activity pattern was monitored for 3 days using a wristwatch actigraph while 77 patients were receiving a chemotherapy course within an international randomized Phase III trial. Treatment consisted of first-line chronomodulated or conventional delivery of 5-fluorouracil, leucovorin and oxaliplatin for metastatic colorectal cancer. I<0 was computed as the percentage of minutes of activity counts in bed which were below the median of activity out of bed.

Circadian disruption was defined by I<0 equal to or less than 97.5%. Circadian disruption occurred in 39 patients (51%) on chemotherapy. It was associated with a significantly shorter overall survival, independently of other prognostic factors (multivariate Hazard Ratio: 2.12; p = 0.004). The median survival of patients with a robust circadian rhythm was 22.3 months as compared to 14.7 months in those with circadian disruption during chemotherapy. No toxicity was significantly associated with circadian disruption, but the incidence of grade ≥ 2 fatigue and of body weight loss ≥ 5% was two and threefold higher, respectively, in patients with disrupted circadian rhythm on chemotherapy. Chemotherapy disrupted circadian activity rhythm in nearly 50% of the patients. Circadian disruption on chemotherapy predicted for shorter overall survival. The prevention of chemotherapy-induced circadian disruption might reduce toxicity and improve efficacy in cancer patients.

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Preflight adjustment to eastward travel: 3 days of advancing sleep with and without morning bright light.

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Jet lag is caused by a misalignment between circadian rhythms and local destination time. As humans typically take longer to re-entrain after a phase advance than a phase delay, eastward travel is often more difficult than westward travel. Previous strategies to reduce jet lag have focused on shaping the perceived light-dark cycle after arrival, in order to facilitate a phase shift in the appropriate direction. Here we tested treatments that travelers could use to phase advance their circadian rhythms prior to eastward flight. Thus, travelers would arrive with their circadian rhythms already partially re-entrained to local time. We determined how far the circadian rhythms phase advanced, and the associated side effects related to sleep and mood. Twenty-eight healthy young subjects participated in 1 of 3 different treatments, which all phase advanced each subject's habitual sleep schedule by 1 h/day for 3 days. The 3 treatments differed in morning light exposure for the 1st 3.5 h after waking on each of the 3 days: continuous bright light (> 3000 lux), intermittent bright light (> 3000 lux, 0.5 h on, 0.5 off, etc.), or ordinary dim indoor light (< 60 lux). A phase assessment in dim light (< 10 lux) was conducted before and after the treatments to determine the endogenous salivary dim light melatonin onset (DLMO). The mean DLMO phase advances in the dim, intermittent, and continuous light groups were 0.6, 1.5, and 2.1 h, respectively. The intermittent and continuous light groups
advanced significantly more than the dim light group (p < 0.01) but were not significantly different from each other. The side effects as assessed with actigraphy and logs were small. A 2-h phase advance may seem small compared to a 6- to 9-h time zone change, as occurs with eastward travel from the USA to Europe. However, a small phase advance will not only reduce the degree of re-entrainment required after arrival, but may also increase postflight exposure to phase-advancing light relative to phase-delaying light, thereby reducing the risk of antidromic re-entrainment. More days of preflight treatment could be used to produce even larger phase advances and potentially eliminate jet lag.

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Pregnancy Induces an Earlier Chronotype in Both Mice and Women.

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Daily rhythms generated by endogenous circadian mechanisms and synchronized to the light-dark cycle have been implicated in the timing of birth in a wide variety of species. Although chronodisruption (e.g., shift work or clock gene...
mutations) is associated with poor reproductive outcomes, little is known about circadian timing during pregnancy. This study tested whether daily rhythms change during full-term pregnancies in mice and women. We compared running wheel activity continuously in both nonpregnant (n = 14) and pregnant (n = 13) 12- to 24-week-old C57BL/6NJ mice. We also monitored wrist actigraphy in women (N = 39) for 2 weeks before conception and then throughout pregnancy and measured daily times of sleep onset. We found that on the third day of pregnancy, mice shift their activity to an earlier time compared with nonpregnant dams. Their time of daily activity onset was maximally advanced by almost 4 h around day 7 of pregnancy and then shifted back to the nonpregnant state approximately 1 week before delivery. Mice also showed reduced levels of locomotor activity during their last week of pregnancy. Similarly, in women, the timing of sleep onset was earlier during the first and second trimesters (gestational weeks 4-13 and 14-27) than before pregnancy and returned to the prepregnant state during the third trimester (weeks 28 until delivery). Women also showed reduced levels of locomotor activity throughout pregnancy. These results indicate that pregnancy induces changes in daily rhythms, altering both time of onset and amount of activity. These changes are conserved between mice and women.

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Pregnancy rest–activity patterns are related to salivary cortisol rhythms and maternal–fetal health indicators in women from a disadvantaged population.

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Irregular rest-activity patterns can disrupt metabolic and hormonal physiology and potentially lead to disease. Little is known regarding rest-activity patterns during gestation and their association with hormonal rhythms and health in pregnant women. We conducted a pilot study to determine if 24 h rest-activity was related to saliva cortisol rhythms and maternal-fetal health in an economically disadvantaged population. Primiparous women wore a wrist actigraphy device for a week to record activity during gestational weeks 22 (G22; n = 50) and 32 (G32; n = 46) and postpartum week one (PPW1; n = 39). Participants collected saliva samples every 4 hr over a 24 hr period during G22 (n = 22), G32 (n = 20) and 24-48 hr postnatal (n = 20), and cortisol concentrations were measured with ELISA. Circadian rhythmicity was assessed using autocorrelation coefficient ($r^{24}$) and cosinor analysis. Blood glucose levels, body mass index (BMI), gestational disease data, and gestational age of infant at birth were abstracted from medical charts. Time of cortisol peak (acrophase) during G22 was related with
acrophase of activity ($r = 0.66; p = 0.001$) and blood glucose levels ($r = 0.58; p = 0.006$).
During G22, minutes of wake after sleep onset was positively related to cortisol mesor and AUC ($p < 0.05$). Rest–activity r24, R2, and mesor during G32 were positively ($p < 0.05$) associated with gestational age of infant at birth. Across all three time points r24 of activity was related with cortisol amplitude ($r = 0.33; p = 0.01$). Findings support a relationship between rest–activity patterns and saliva cortisol rhythms during pregnancy. The association of less robust activity rhythms with earlier gestational age of infant at birth indicates a potential link between circadian system disruption and maternal–fetal health outcomes.

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Conflict of interest statement: The authors have declared that no competing interests exist.


Preliminary examination of the orexin system on relapse-related factors in cocaine use disorder.

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RATIONALE: Current evidence and literature reviews provide a strong justification for examining the orexin receptor (OXR) system as a therapeutic target in substance use disorders, including cocaine and other psychostimulants. OBJECTIVES: In this preliminary, proof-of-concept examination of orexin modulation in humans with cocaine use disorder, we measured changes in domains tied to relapse: stress, sleep, cue reactivity, and inhibitory control. Additionally, mood symptoms (anxiety, depression), medication compliance, and side effects were assessed.

METHODS: Twenty non-treatment seeking subjects with cocaine use disorder (CUD) received either the OX1R / OX2R antagonist suvorexant PO or placebo at 10 PM daily for two weeks (10 mg week 1, 20 mg week 2). Using psychometrics, smart-watch actigraphy, a cold-pressor stress challenge, and eye-tracking technology, the following domains were examined: sleep, stress/anxiety, cue-reactivity (attentional bias, craving), and inhibitory control. Psychometric data were collected every M/W/F (7 time points). Laboratory data were collected weekly (3 time points).

RESULTS: Bayesian and frequentist generalized linear models were
employed in parallel to examine the effects of suvorexant compared to placebo, with a Bayesian posterior probability threshold >80% as evidence of a signal for suvorexant. Notable results favoring suvorexant over placebo included fewer total anti-saccade errors, improved sleep actigraphy (sleep/awake periods), pre/post cold-pressor change in heart rate and salivary cortisol (all posterior probabilities >94%), and craving (posterior probability >87%).

CONCLUSIONS: Initial but restricted evidence is provided supporting the orexin system as a modulator of relapse-related processes in cocaine use disorder. Baseline differences in the main outcome variables were not experimentally controlled and differences in craving were observed at baseline. This, in combination with a limited sample size, constrain the nature of the project. The results may serve to inform more comprehensive future research.

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Preliminary report; Comparison of the circadian rest-activity rhythm of elderly Japanese community-dwellers according to sarcopenia status.

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We investigated in a preliminarily study the circadian rest-activity rhythm of elderly Japanese community-dwellers according to sarcopenia status based upon the 2019 updated classification criteria of the Asian Working Group for Sarcopenia. A total of 30 participants were recruited from a single rehabilitation center in northern Japan between July and November 2019. The rest-activity rhythm of those with and without sarcopenia was assessed for 7 consecutive 24 h spans by wrist actigraphy in free-living condition and gait performance in the clinic. As group phenomena, the circadian activity rhythm of the sarcopenia cohort (N = 11) was of significantly lower amplitude and more fragmented than the non-sarcopenia cohort (N = 19). The nonparametric circadian rest activity (RAR) parameters of intra-daily variability (IV), relative amplitude (RA), most active 10-h span (M10), and the least active 5-h span (L5), but not interdaily stability (IS), of the sarcopenia group, were all significantly worse than those of the non-sarcopenia group. Gait performance for the sarcopenia group correlated strongly with the fragmentation and altered amplitude of the RAR. These preliminary findings motivated future longitudinal investigation both to improve the detection of sarcopenia in community dwelling elderly and to inform novel preventive or rehabilitative strategies.

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A preliminary study of a composite sleep health score: associations
with psychological distress, body mass index, and physical functioning in a low-income African American community.

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OBJECTIVES: Although multiple individual sleep measures (e.g., sleep duration, satisfaction) have been linked to a wide range of physical and mental health conditions, scant research has examined how individual sleep dimensions may act independently or additively to influence health. The current study investigates associations of 5 sleep dimensions (duration, satisfaction, efficiency, timing, and regularity), analyzed separately and simultaneously, with psychological distress, body mass index, and physical functioning among a low-income, predominantly African American population.

DESIGN: We constructed a composite sleep health (SH) score from the sum of scores, representing "good" and "poor" ranges of 5 sleep measures (range 0-5).

SETTING: Two low-income, predominantly African American neighborhoods in Pittsburgh.

PARTICIPANTS: Participants included 738 community-dwelling adults (78% female and 98% black).
MEASUREMENTS: Actigraphy-based measures of sleep duration, regularity, timing, and efficiency, and self-reported sleep satisfaction. Outcomes included self-reported psychological distress, physical functioning, and measured body mass index (BMI).
RESULTS: Each 1-unit higher SH score was associated with 0.55-unit lower psychological distress score (range 0-24) and 2.23-unit higher physical functioning score. Participants with at least 2, 3, or 4 sleep dimensions in the "healthy" range, vs fewer, had lower psychological distress scores. Greater sleep satisfaction was associated with higher physical functioning, and longer sleep duration was associated with lower physical functioning. Neither the composite SH score nor any of the individual sleep dimensions were associated with BMI.
CONCLUSIONS: Assessing multiple sleep dimensions may provide a more comprehensive understanding of associations of sleep with psychological distress than assessing any single sleep dimension. Although no sleep measures were related to BMI in the current sample, analyses should be replicated in other samples to determine generalizability.

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Preliminary support for the role of reward relevant effort and chronotype in the depression/insomnia comorbidity.

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BACKGROUND: The presence of insomnia in the context of depression is linked to a number of poor outcomes including reduced treatment response, increased likelihood of relapse, and greater functional impairment. Given the frequent co-occurrence of depression and insomnia, research into systems and processes relevant to both disorders, specifically reward processing and circadian rhythm disruption, may help parse this complex comorbidity.

METHODS: A pilot study was conducted on a sample of 10 veterans with clinically significant depression and insomnia symptoms. Participants completed objective (actigraphy) and subjective (sleep diary) assessments of sleep, self-reports of chronotype, and behavioral tasks assessing reward relevant effort before and after 6 sessions of Cognitive Behavioral Therapy for Insomnia.

RESULTS: Insomnia and depression significantly improved following CBT-I. Subjective sleep parameters significantly improved with large effect sizes. Actigraphy results were nonsignificant, but effect sizes for sleep efficiency and onset latency were in the medium range. Chronotype shifted significantly toward morningness following CBT-I, and an earlier chronotype at baseline was associated with increased reward effort following treatment. Changes in chronotype,
depression and insomnia were not associated with changes in effort. LIMITATIONS: Findings are limited by small sample size and lack of randomized control group. CONCLUSIONS: Findings should be interpreted as hypothesis generating in the service of furthering research aimed at uncovering potential mechanisms underlying the depression/insomnia comorbidity. Analyses of sleep data in extant datasets of reward processing impairments in depression as well as original projects aimed at exploring potential sleep, circadian rhythm, and reward interactions in depression are encouraged.

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Premature birth and circadian preference in young adulthood: evidence from two birth cohorts.


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A preference for eveningness (being a "night owl") and preterm birth (<37 weeks of gestation) are associated with similar adversities, such as elevated blood pressure, impaired glucose regulation, poorer physical fitness, and lower mood.

Yet, it remains unclear if and how preterm birth is associated with circadian preference. The aim of this study was to assess this association across the whole gestation range, using both objective and subjective measurements of circadian preference. Circadian preference was measured among 594 young adults (mean age 24.3 years, SD 1.3) from two cohorts: the ESTER study and the Arvo Ylppö Longitudinal Study. We compared 83 participants born early preterm (<34 weeks) and 165 late preterm (34 to <37 weeks) with those born at term (≥37 weeks, n = 346). We also compared very low birth weight (VLBW, <1500 g) participants with term-born controls. We obtained objective sleep data with actigraphs that were worn for a mean period of 6.8 (SD 1.4) nights. Our primary outcome was sleep midpoint during weekdays and weekend. The sleep midpoint is the half-way time between falling asleep and waking up, and it represents sleep timing. We also investigated subjective chronotype with the Morningness–Eveningness Questionnaire (MEQ) in 688 (n = 138/221/329) ESTER participants. The MEQ consists of 19 questions, which estimates the respondent to be of a "morning",
"evening," or "intermediate" chronotype, based on the Morningness-Eveningness Score (MES). We analyzed the data from the actigraphs and the MES with three linear regression models, and analyzed distribution of the chronotype class with Pearson $\chi^2$. There were no consistent differences across the study groups in sleep midpoint. As compared with those born at term, the mean differences in minutes:seconds and 95% confidence intervals for the sleep midpoint were: early preterm weekdays 11:47 (-8:34 to 32:08), early preterm weekend 4:14 (-19:45 to 28:13), late preterm weekdays -10:28 (-26:16 to 5:21), and late preterm weekend -1:29 (-20:36 to 17:37). There was no difference in sleep timing between VLBW-participants and controls either. The distribution of chronotype in the MEQ among all participants was 12.4% morningness, 65.4% intermediate, and 22.2% eveningness. The distribution of the subjective chronotype class did not differ between the three gestational age groups ($p = 0.98$). The linear regression models did not show any influence of gestational age group or VLBW status on the MES (all $p > 0.5$). We found no consistent differences between adults born early or late preterm and those born at term in circadian preference. The earlier circadian preference previously observed in those born smallest is unlikely to extend across the whole range of preterm birth.

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Prenatal origins of poor sleep in children.


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STUDY OBJECTIVES: We examined whether small body size at birth and prenatal tobacco or alcohol exposure predict poor sleep and more sleep disturbances in children.

DESIGN: An epidemiologic cohort study of 289 eight-year-old children born at term.

MEASUREMENTS AND RESULTS: Sleep duration and efficiency were measured by actigraphy for 7 consecutive nights (mean = 7.1, SD = 1.2). We used both continuous measures of poor sleep and binary variables of short sleep and low sleep efficiency ( < or = 10th percentiles). Parents completed the Sleep Disturbance Scale for Children. Lower birth weight and shorter length at birth were associated with lower sleep efficiency. For every 1-SD decrease in weight and length at birth, the odds for low sleep efficiency increased by 1.7 fold (95% confidence interval [CI]: 1.1 to 2.7) and 2.2 fold (95% CI: 1.3 to 3.7), respectively. For every 1-SD decrease in ponderal index at birth, the risk of parent-reported sleep disorders increased by 1.4 fold (95% CI: 1.0 to 2.0). Moreover, children exposed prenatally to alcohol had a 2.9-fold (95% CI: 1.1 to 7.6) and 3.6-fold (95% CI: 1.3 to 10.0) increased risk for having short sleep and low sleep efficiency, respectively. The associations were not confounded by sex, gestational length, prenatal and perinatal complications, body mass index at 8 years, asthma, allergies, or parental socioeconomic status.

CONCLUSIONS: Poor sleep in children may have prenatal origins. Possible mechanisms include alcohol consumption during pregnancy and other conditions associated with small body size at birth.

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Prenatal particulate air pollution exposure and sleep disruption in preschoolers:
Windows of susceptibility.


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BACKGROUND: The programming of sleep architecture begins in pregnancy and depends upon optimal in utero formation and maturation of the neural connectivity of the brain. Particulate air pollution exposure can disrupt fetal brain development but associations between fine particulate matter (PM2.5) exposure during pregnancy and child sleep outcomes have not been previously explored.

METHODS: Analyses included 397 mother-child pairs enrolled in a pregnancy cohort in Mexico City. Daily ambient prenatal PM2.5 exposure was estimated using a validated satellite-based spatio-temporally resolved prediction model. Child sleep periods were estimated objectively using wrist-worn, continuous actigraphy over a 1-week period at age 4-5 years. Data-driven advanced statistical methods (distributed lag models (DLMs)) were employed to identify sensitive windows whereby PM2.5 exposure during gestation was significantly associated with changes in sleep duration or efficiency. Models were adjusted for maternal education, season, child's age, sex, and BMI z-score.

RESULTS: Mother's average age was 27.7 years, with 59% having at least a high school education. Children slept an average of 7.7 h at night, with mean 80.1% efficiency. The adjusted DLM identified windows of PM2.5 exposure between 31 and 35 weeks gestation that were significantly associated with decreased sleep duration in children. In addition, increased PM2.5 during weeks 1-8 was associated with decreased sleep efficiency. In other exposure windows (weeks 39-40), PM2.5 was associated with increased sleep duration.

CONCLUSION: Prenatal PM2.5 exposure is associated with altered sleep in preschool-aged children in Mexico City. Pollutant exposure during
sensitive windows of pregnancy may have critical influence upon sleep programming.

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Prevalence and correlates of adherence to movement guidelines among urban and rural children in Mozambique: a cross-sectional study.

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BACKGROUND: Insufficient physical activity, short sleep duration, and excessive recreational screen time are increasing globally. Currently, there are little to no data describing prevalences and correlates of movement behaviours among children in low-middle-income countries. The few available reports do not include both urban and rural respondents, despite the large proportion of rural
populations in low-middle-income countries. We compared the prevalence of meeting 24-h movement guidelines and examined correlates of meeting the guidelines in a sample of urban and rural Mozambican schoolchildren. METHODS: This is a cross-sectional study of 9–11 year-old children (n = 683) recruited from 10 urban and 7 rural schools in Mozambique. Moderate-to-vigorous-intensity physical activity (MVPA) and sleep duration were measured by waist-worn Actigraph GT3X+ accelerometers. Accelerometers were worn 24 h/day for up to 8 days. Recreational screen time was self-reported. Potential correlates of meeting 24-h movement guidelines were directly measured or obtained from validated items of context-adapted questionnaires. Multilevel multivariable logit models were used to determine the correlates of movement behaviours. Meeting 24-h movement guidelines was defined as ≥60 min/day of MVPA, ≤2 h/day of recreational screen time, and between 9 and 11 h/night of sleep. RESULTS: More rural (17.7%) than urban (3.6%) children met all three 24-h movement guidelines. Mean MVPA was lower (82.9 ± 29.5 min/day) among urban than rural children (96.7 ± 31.8 min/day). Rural children had longer sleep duration (8.9 ± 0.7 h/night) and shorter recreational screen time (2.7 ± 1.9 h/day) than their urban counterparts (8.7 ± 0.9 h/night and 5.0 ± 2.3 h/day respectively). Parental education (OR: 0.37; CI: 0.16–0.87), school location (OR: 0.21; CI: 0.09–0.52), and outdoor time (OR: 0.67; CI: 0.53–0.85) were significant correlates of meeting all three 24-h movement guidelines. CONCLUSIONS: Prevalence and correlates of meeting movement guidelines differed between urban and rural schoolchildren in Mozambique. On average, both groups had higher daily MVPA minutes, shorter sleep duration, and higher recreational screen time than the 24-h movement guidelines recommend. These findings (e.g., higher than recommended mean daily MVPA minutes) differ from those from high-income countries and highlight the need to sample from both urban and rural
Prevalence and correlates of obstructive sleep apnea among African Americans: the Jackson Heart Sleep Study.


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Study Objectives: African Americans have been under-represented in obstructive sleep apnea (OSA) research. This study determined the prevalence and correlates of OSA overall and by sex among African Americans in the Jackson Heart Sleep Study.

Methods: Participants (N = 852) underwent a type 3 in-home sleep apnea study, 7 day wrist actigraphy and completed standardized measurements and questionnaires. OSA was defined as an apnea-hypopnea index (AHI) of ≥15, where hypopneas were defined as ≥ 4% associated desaturation. Physician diagnosis of OSA was self-reported. Logistic regression models were fit to determine the associations of demographics, socioeconomic status, sleep symptoms, actigraphy-based sleep, body mass index (BMI), and comorbidities with OSA.

Results: Average age was 63.1 (standard deviation = 10.7), 66% were female, and mean BMI was 32.0 (6.9) kg/m2. Approximately 24% had an AHI ≥ 15; of those, 5% had a physician diagnosis of OSA. Prevalence of OSA increased across
BMI categories, but not age groups. Men had a 12% higher prevalence of OSA compared with women, p < 0.01. Older age, male sex, higher BMI, larger neck circumference, and report of habitual snoring were independently associated with higher odds of OSA, all p < 0.05. Associations between sleep symptoms and OSA were similar for men and women. Sleepiness and waist circumference were not associated with OSA.

Conclusions: There was a high prevalence of objectively measured but undiagnosed OSA in this sample of African Americans. Snoring, BMI, and neck circumference were important markers of OSA for men and women. Our results suggest that screening tools that incorporate information on sleepiness and waist circumference may be suboptimal in this population.

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The prevalence and impact of anergia (lack of energy) in subjects with heart failure and its associations with actigraphy.

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BACKGROUND: Anergia (lack of energy) is a newly delineated, criterion-based geriatric syndrome. Because heart failure (HF) is a common chronic condition among older adults and a because a cardinal symptom of HF is reduced energy, we characterized the degree of anergia in subjects with HF and evaluated its
relevance to disease severity, functional performance, and quality of life.
METHODS AND RESULTS: Prospective 3-month cohort study among a convenience sample of 61 subjects (61 +/- 15 years, 48% women, ejection fraction 41 +/- 16%) with New York Heart Association (NYHA) Class I-III HF were studied. The criterion for anergia was based on the major criterion "sits around for lack of energy" and any 2 of 6 minor criteria. Principal measures in addition to demographic and clinical characteristics included functional performance (NYHA class, 6-minute walk, cardiopulmonary exercise testing), plasma B-type natriuretic peptide, and quality of life (SF-12 and Minnesota Living with Heart Failure Questionnaire). To evaluate the relevance of anergia to daily function, each subject wore an Actigraph, a watch-like wrist device that continuously and automatically monitors patient activity levels and energy expenditure, for 3 months. Anergia was prevalent in 39% of this population. Anergia was associated with decrements in functional capacity (higher NYHA Class and lower 6-minute walk distance) as well as reduction in quality of life, but was not associated with ejection fraction. Actigraphy data demonstrated that HF subjects with anergia spent significantly less time performing moderate physical activity and the peak activity counts per day were significantly lower than HF subjects without anergia. Additionally, the amplitude of circadian rhythm was lower, suggesting altered sleep and activity patterns in HF subjects with anergia compared with those without anergia. Over the 3 months of follow-up, there was a significant association between anergia and intercurrent hospitalization.
CONCLUSIONS: Anergia is significantly associated with several of the cardinal domains of HF. Its presence is associated with demonstrable differences in both physical activity and circadian rhythm as measured by actigraphy and an increased risk of hospitalizations. Accordingly, anergia may be a target for
Prevalence and risk factors for disrupted circadian rhythmicity in children with optic nerve hypoplasia.

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BACKGROUND/AIMS: Children with optic nerve hypoplasia (ONH) have visual impairment and may have hypopituitarism and developmental delay. Children with ONH have also been reported to have abnormal sleep-wake cycles. We assessed the incidence and nature of sleep-wake abnormalities in children with ONH.

METHODS: Rest-activity patterns were assessed in 23 children with ONH using actigraphy, which is a non-invasive method for continuously monitoring activity. The children also had formal assessment of pituitary function, visual acuity measurements, assessment of papillary responsiveness, MRI scans of the head and assessment of neurocognitive function.

RESULTS: Sufficient actigraphy data were obtained on 19 of the children. Analysis of expressed rhythmicity revealed normal rest-activity patterns in 13 children (68%). Of the six children (32%) with abnormal rhythmicity, three had fragmented sleep, one had free-running rest-activity cycles and two were arrhythmic. Of the children with normal rhythmicity, the following were found: hypoplastic corpus callosum in 30%, growth hormone deficiency in 53%, hypothyroidism in
23%, adrenal insufficiency in 30%, diabetes insipidus in 0% and developmental delay in 15%. Of the children with abnormal rhythmicity, the following were found: hypoplastic corpus callosum in 66% (p>0.05), severe visual impairment in 100% (p=0.006), abnormal pupillary responsiveness in 85% (p=0.0084), cognitive impairment in 100% (p=0.04) and multiple hormonal deficiencies in 66% (p=0.03).

CONCLUSIONS: Abnormal rest–activity rhythmicity patterns are present in 30% of children with ONH. The best predictors of abnormal rhythmicity are severe vision impairment, abnormal pupillary responsiveness, developmental delay and multiple hormonal deficiencies.

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Prior night sleep duration is associated with psychomotor vigilance in a healthy sample of police academy recruits.


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Aviation, military, police, and health care personnel have been particularly interested in the operational impact of sleep restriction and work schedules given the potential severe consequences of making fatigue-related errors. Most studies examining the impact of sleep loss or circadian manipulations have been conducted in controlled laboratory settings using small sample sizes. This study examined whether the relationship between prior night sleep duration and
performance on the psychomotor vigilance task could be reliably detected in a field study of healthy police academy recruits. Subjects (N = 189) were medically and psychiatrically healthy. Sleep-wake activity was assessed with wrist actigraphy for 7 days. Subjects performed the psychomotor vigilance task (PVT) for 5 min on a personal digital assistant (PDA) device before and after their police academy workday and on comparable times during their days off. Mixed-effects logistic regression was used to estimate the probability of having > or =1 lapse on the PVT as a function of the previous night sleep duration during the 7 days of field testing. Valid estimates of sleep duration were obtained for 1082 nights of sleep. The probability of a lapse decreased by 3.5%/h sleep the night prior to testing. The overall probability of having a lapse decreased by 0.9%/h since awakening, holding hours of sleep constant. Perceived stress was not associated with sleep duration or probability of performance lapse. These findings demonstrate the feasibility of detecting sleep and circadian effects on cognitive performance in large field studies. These findings have implications regarding the daytime functioning of police officers.

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Prolonged Sitting is Associated with Attenuated Heart Rate Variability during Sleep in Blue-Collar Workers.

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Prolonged sitting is associated with increased risk for cardiovascular diseases and mortality. However, research into the physiological determinants underlying this relationship is still in its infancy. The aim of the study was to determine the extent to which occupational and leisure-time sitting are associated with nocturnal heart rate variability (HRV) in blue-collar workers. The study included 138 blue-collar workers (mean age 45.5 (SD 9.4) years). Sitting-time was measured objectively for four days using tri-axial accelerometers (Actigraph GT3X+) worn on the thigh and trunk. During the same period, a heart rate monitor (Actiheart) was used to sample R-R intervals from the electrocardiogram. Time and frequency domain indices of HRV were only derived during nighttime sleep, and used as markers of cardiac autonomic modulation. Regression analyses with multiple adjustments (age, gender, body mass index, smoking, job-seniority, physical work-load, influence at work, and moderate-to-vigorous physical activity) were used to investigate the association between sitting time and nocturnal HRV. We found that occupational sitting-time was negatively associated (p < 0.05) with time and frequency domain HRV indices. Sitting-time explained up to 6%
of the variance in HRV, independent of the covariates. Leisure-time sitting was not significantly associated with any HRV indices (p > 0.05). In conclusion, objectively measured occupational sitting-time was associated with reduced nocturnal HRV in blue-collar workers. This indicates an attenuated cardiac autonomic regulation with increasing sitting-time at work regardless of moderate-to-vigorous physical activity. The implications of this association for cardiovascular disease risk warrant further investigation via long-term prospective studies and intervention studies.

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Prospective evaluation of residents on call: before and after duty-hour reduction.

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BACKGROUND: On July 1, 2009, in Ontario the maximum period of continuous duty that residents were permitted to work was reduced from 28 to 24 hours. We evaluated the effect of regulation on residents in 3 eras: 2 before (2005 and early 2009) and 1 after (late 2009) the duty-hour reduction.

METHODS: On-call pediatric residents on pediatric medicine rotations prospectively recorded the numbers of patients (assigned and admitted) and the durations of direct patient care, documentation, staff supervision, and education attended. Sleep was measured with actigraphy.
RESULTS: The 51 residents worked 180 duty periods, were assigned a median of 6 (interquartile range: 4–12) daytime patients and 24 (interquartile range: 19–30) overnight patients. Residents reported spending means of 239 minutes providing direct patient care, 235 minutes documenting, and 243 minutes sleeping and receiving 73 minutes of staff supervision and 52 minutes of education. From early 2009 to after duty-hour reduction, residents provided 47 fewer (19.6%) minutes of direct patient care (P = .056) and received 44 fewer minutes (60.3%) of supervision (P = .0005) but spent similar times documenting, receiving education, and sleeping. In early 2009, residents provided 73 more minutes (30.5%) of direct patient care (P = .0016), spent 63 more minutes (26.8%) documenting, and slept 105 fewer minutes (43.0%) (P = .0062) than in 2005.

DISCUSSION: After duty-hour reduction in 2009, we found reduced supervision and direct patient care. Comparison of the 2 periods before duty-hour reduction showed less sleep and longer patient contact in early 2009, which suggests that changes occurred without regulation.

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Melatonin is secreted systemically from the pineal gland maximally at night but is also produced locally in many tissues. Its chronobiological function is mainly exerted by pineal melatonin. It is a feedback regulator of the main circadian pacemaker in the hypothalamic suprachiasmatic nuclei and of many peripheral oscillators. Although exogenous melatonin is approved for circadian rhythm sleep disorders and old-age insomnia, research on endogenous melatonin in humans is hindered by the great interindividual variability of its amount and circadian rhythm. Single case studies on pinealectomized patients report on disrupted but also hypersomnic sleep. This is the first systematic prospective report on sleep with respect to pinealectomy due to pinealocytoma World Health Organization grade I without chemo- or radiotherapy. Before and after pinealectomy, 8 patients completed questionnaires on sleep quality and circadian rhythm (Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, and Morningness–Eveningness Questionnaire), 2 nights of polysomnography, salivary evening melatonin profiles, and qualitative assessment of 2 weeks of actigraphy and sleep logs. Six patients were assessed retrospectively up to 4 years after pinealectomy. Before pinealectomy, all but 1 patient showed an evening melatonin rise typical for indifferent chronotypes. After pinealectomy, evening saliva melatonin was markedly diminished, mostly below the detection limit of the assay (0.09 pg/mL). No systematic change in subjective sleep quality or standard measures...
of polysomnography was found. Mean pre- and postoperative sleep efficiency was 94% and 95%, and mean sleep-onset latency was 21 and 17 min, respectively. Sleep–wake rhythm during normal daily life did not change. Retrospective patients had a reduced sleep efficiency (90%) and more stage changes, although this was not significantly different from prospective patients. In conclusion, melatonin does seem to have a modulatory, not a regulatory, effect on standard measures of sleep. Study output is limited by small sample size and because only evening melatonin profiles were assessed.

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Protective Effect of Aerobic Physical Activity on Sleep Behavior in Breast Cancer Survivors.


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HYPOTHESES: Sleep disorders are associated with an increased risk of cancer, including breast cancer (BC). Physical activity (PA) can produce beneficial effects on sleep.

STUDY DESIGN: We designed a randomized controlled trial to test the
Effect of 3 months of physical activity on sleep and circadian rhythm activity level evaluated by actigraphy.

METHODS: 40 BC women, aged 35-70 years, were randomized into an intervention (IG) and a control group (CG). IG performed a 3 month of aerobic exercise. At baseline and after 3 months, the following parameters were evaluated both for IG and CG: anthropometric and body composition measurements, energy expenditure and motion level; sleep parameters (Actual Sleep Time-AST, Actual Wake Time-AWT, Sleep Efficiency-SE, Sleep Latency-SL, Mean Activity Score-MAS, Movement and Fragmentation Index-MFI and Immobility Time-IT) and activity level circadian rhythm using the Actigraph Actiwatch.

RESULTS: The CG showed a deterioration of sleep, whereas the IG showed a stable pattern. In the CG the SE, AST and IT decreased and the AWT, SL, MAS and MFI increased. In the IG, the SE, IT, AWT, SL, and MAS showed no changes and AST and MFI showed a less pronounced change in the IG than in the CG. The rhythmometric analysis revealed a significant circadian rhythm in two groups. After 3 months of PA, IG showed reduced fat mass %, while CG had improved weight and BMI.

CONCLUSION: Physical activity may be beneficial against sleep disruption. Indeed, PA prevented sleep worsening in IG. PA can represent an integrative intervention therapy able to modify sleep behaviour.

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Psychological Outcomes in Parents of Critically Ill Hospitalized Children.

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Parents of children in pediatric intensive care units (PICUs) are subjected to significant psychological stress. The purpose of this study was to determine the prevalence of, and factors associated with anxiety, depressive symptoms and decisional conflict in parents of children hospitalized in the PICU. The study employed a descriptive, cross-sectional design to investigate the psychological status of 118 parents of 91 children (74 mothers and 44 fathers) admitted to the PICU, using measures of anxiety (STAI), depression (CES-D), and decisional conflict (DCS). Using hospital data and self-administered questionnaires, information on child and parent characteristics and psychological outcomes were collected. Objective measures of parental sleep also were examined using actigraphy and sleep diaries. The research findings indicated that 24% of parents achieved scores characteristic of severe anxiety. Proportions of parents with symptoms indicative of major depression and significant decisional conflict were 51% and 26% respectively. For all psychological outcomes, higher levels of social support were protective. Inconsistency in sleep schedule and sleep location affected psychological outcomes and are possible targets for future interventions. Given evidence that parents of children admitted to the PICU are at risk for developing post-traumatic stress symptoms, future studies should examine the effects of hospitalization on long-term parental psychological outcomes. Screening for those at risk and implementing interventions to promote
coping strategies and reduce decisional conflict may be beneficial. Pediatric nurses have a critical role in assessing parents' psychological distress and promoting family health during a child's hospitalization.

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A psychometric investigation of the sleep, circadian rhythms, and mood (SCRAM) questionnaire.

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The sleep, circadian rhythms, and mood (SCRAM) questionnaire (Byrne, Bullock et al., 2017) was designed to concurrently measure individual differences in three clinically important functions: diurnal preference, sleep quality, and mood. The 15-item questionnaire consists of three 5-item scales named Morningness, Good Sleep, and Depressed Mood. The overarching aim of the current project was to investigate the validity and reliability of the questionnaire. Here, we report on associations investigated in three data sets. Study 1 (N = 70, 80% females) was used to examine the test-retest reliability of the questionnaire, finding strong test-retest reliability of the three scales over a 2-week period (r's ranging from 0.73 to 0.86). Study 2 (N = 183, 80% females) enabled us to examine the construct validity of the SCRAM scales against well-validated self-report measures of diurnal preference, sleep quality, and depression. Strong
correlations were found between each SCRAM scale and their respective measure in bivariate analyses, and associations were robust after the inclusion of the remaining two SCRAM scales as predictors in regression analyses. Data from Study 3 (N = 42, 100% males) were used to measure the extent to which SCRAM scores correlated with objective measures of sleep-wake behavior using actigraphy. Morningness was found to be related to earlier sleep onset and offset times, and Good Sleep was related to higher sleep efficiency but to no other measures of sleep quality; Depressed Mood was not related to actigraphy measures. The findings provide provisional support for construct validity and reliability of the SCRAM questionnaire as a measure of diurnal preference, sleep quality, and depressed mood. Future research into the psychometrics of SCRAM should test the questionnaire's discriminant and predictive validity in clinical samples.

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Pupillometry evaluation of melanopsin retinal ganglion cell function and sleep-wake activity in pre-symptomatic Alzheimer's disease.

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BACKGROUND: Melanopsin-expressing retinal ganglion cells (mRGCs), intrinsically photosensitive RGCs, mediate the light-based pupil response and the light entrainment of the body's circadian rhythms through their connection to the pretectal nucleus and hypothalamus, respectively. Increased awareness of circadian rhythm dysfunction in neurological conditions including Alzheimer's disease (AD), has led to a wave of research focusing on the role of mRGCs in these diseases. Postmortem retinal analyses in AD patients demonstrated a significant loss of mRGCs, and in vivo measurements of mRGC function with chromatic pupillometry may be a potential biomarker for early diagnosis and progression of AD.

METHODS: We performed a prospective case-control study in 20 cognitively healthy study participants: 10 individuals with pre-symptomatic AD pathology (pre-AD), identified by the presence of abnormal levels of amyloid β42 and total Tau proteins in the cerebrospinal fluid, and 10 age-matched controls with normal CSF amyloid β42 and Tau levels. To evaluate mRGC function, we used a standardized protocol of chromatic pupillometry on a Ganzfeld system using red (640 nm) and blue (450 nm) light stimuli and measured the pupillary light response (PLR). Non-invasive wrist actigraphy and standardized sleep questionnaires
were also completed to evaluate rest–activity circadian rhythm.
RESULTS: Our results did not demonstrate a significant difference of the PLR between pre–AD and controls but showed a variability of the PLR in the pre–AD group compared with controls on chromatic pupillometry. Wrist actigraphy showed variable sleep–wake patterns and irregular circadian rhythms in the pre–AD group compared with controls.
CONCLUSIONS: The variability seen in measurements of mRGC function and sleep–wake cycle in the pre–AD group suggests that mRGC dysfunction occurs in the pre–symptomatic AD stages, preceding cognitive decline. Future longitudinal studies following progression of these participants can help in elucidating the relationship between mRGCs and circadian rhythm dysfunction in AD.

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Conflict of interest statement: The authors have declared that no competing interests exist.


Purification of masked temperature data from humans: some preliminary observations on a comparison of the use of an activity diary, wrist actimetry, and heart rate monitoring.


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Fourteen ambulatory subjects, varying in their amount of habitual physical activity, were studied for 24 h during a total of 25 "typical" days. Rectal temperature was recorded every 6 minutes, an activity diary was filled
in every half hour, and wrist activity and heart rate were monitored every minute.

Actimetry and heart rate data generally showed close parallelism with each other and with the masking effects on body temperature. Psychological stressors such as public speaking produced a greater effect on heart rate and body temperature than on wrist movement, while typing produced high values for wrist movement, but affected heart rate and temperature much less. When data for the circadian rhythm of body temperature were purified, the diary, actimetry, and measurement of heart rate were all useful in reducing masking effects, but the present evidence indicates that heart rate can be more successful than actimetry—as judged by the closeness of the purified data to a sinusoid. This superiority of heart rate monitoring over wrist activity as a method of purification might be because core temperature can be increased by stressor-induced thermogenesis, as well as by physical activity, and because wrist movement can, with some activities, give an inaccurate estimate of the factors that contribute to whole-body thermogenesis.

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Quantifying the effect of body mass index, age, and depression severity on 24-h activity patterns in persons with a lifetime history of affective disorders.


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BACKGROUND: Patients with affective disorders of different ages have been found to present weight changes and different circadian activity patterns. This study assessed the effects of age, Body Mass Index (BMI) and depression severity on the activity-rest cycle in persons with affective disorders using a novel multifactorial 24-h analysis method.

METHODS: Two hundred and thirty-six participants aged between 14 and 85 years underwent 5 to 22 days of actigraphy monitoring (mean duration = 14 days). BMI was also recorded and symptom severity was assessed with the Hamilton Depression Rating Scale (HDRS). Participants were divided into two groups: healthy controls (n = 68) and participants with a lifetime diagnosis of affective disorders (n = 168). First, the multiple regression method was employed to formulate the circadian activity pattern in term of the factors age, BMI and HDRS. For each group, the functional linear analysis method was applied to assess the relative effects of the factors. Finally, Wald-tests were used to assess the contribution of each factor on the circadian activity pattern.

RESULTS: In the affective disorders group, higher BMI was associated with higher activity levels from 3 am until 5.30 am and with lower activity levels from 10 am until 10.30 pm. Older age was associated with less activity across the day, evening, and night - from 11 am until 5.30 am. Higher HDRS scores were associated with higher activity around 1:30 am. In healthy controls, the effects of BMI and age on activity patterns were less pronounced and affected a narrower portion of the 24-h period.

CONCLUSION: These findings suggest that older age and higher BMI are
linked to lower daytime activity levels. Higher BMI and worse symptom severity were also associated with nocturnal activity patterns suggestive of sleep disturbances. The influence of age and BMI on 24-h activity profiles appear to be especially pronounced in people with affective disorders.

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Quick to berate, slow to sleep: interpartner psychological conflict, mental health, and sleep.

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OBJECTIVE: Relations between interpartner psychological conflict (IPC) and the sleep of men and women were examined, and depression and anxiety symptoms were assessed as intervening variables of these associations.

METHOD: Participants were 135 cohabiting or married couples. The mean age was 36.50 (SD = 5.93) for women and 39.37 (SD = 7.33) for men. Most women (76%) and men (78%) were European American (EA) and the rest were predominantly African American (AA); there was a wide socioeconomic representation. Men and women reported on IPC used by their partner against them. Sleep was examined objectively with actigraphs, and multiple sleep quantity and quality measures were derived.

RESULTS: Dyadic path analysis in which both actor and partner effects were assessed was conducted. For women, greater IPC by the partner was related to elevated levels of anxiety, which in turn was associated with shorter sleep duration and worse sleep efficiency; anxiety was an intervening
variable. For men, IPC by the partner was related to greater symptoms of anxiety and depression; the latter was an intervening variable linking IPC with sleep quality (lower efficiency, longer latency). Some partner effects were observed and indicate that for both men and women, one's perpetration of IPC is related to increased anxiety in the partner, which in turn is related to longer sleep latency for the actor.

CONCLUSION: Results build on this scant literature, and using objective well-validated measures of sleep highlight the importance of relationship processes and mental health for the sleep of men and women.

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Racial disparities in sleep: the role of neighborhood disadvantage.

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OBJECTIVE: Disparities in sleep duration and efficiency between Black/African American (AA) and White/European American (EA) adults are well-
The objective of this study was to examine neighborhood disadvantage as an explanation for race differences in objectively measured sleep. METHODS: Data were from 133 AA and 293 EA adults who participated in the sleep assessment protocol of the Midlife in the United States (MIDUS) study (57% female; Mean Age = 56.8 years, SD = 11.4). Sleep minutes, onset latency, and waking after sleep onset (WASO) were assessed over seven nights using wrist actigraphy. Neighborhood characteristics were assessed by linking home addresses to tract-level socioeconomic data from the 2000 US Census. Multilevel models estimated associations between neighborhood disadvantage and sleep, and the degree to which neighborhood disadvantage mediated race differences in sleep controlling for family socioeconomic position and demographic variables. RESULTS: AAs had shorter sleep duration, greater onset latency, and higher WASO than EAs (ps < 0.001). Neighborhood disadvantage was significantly associated with WASO (B = 3.54, p = 0.028), but not sleep minutes (B = -2.21, p = 0.60) or latency (B = 1.55, p = 0.38). Furthermore, race was indirectly associated with WASO via neighborhood disadvantage (B = 4.63, p = 0.035), which explained 24% of the race difference. When measures of depression, health behaviors, and obesity were added to the model, the association between neighborhood disadvantage and WASO was attenuated by 11% but remained significant. CONCLUSION: Findings suggest that neighborhood disadvantage mediates a portion of race differences in WASO, an important indicator of sleep efficiency.
Disorder (ADHD).

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OBJECTIVES: This study evaluated the efficacy of ramelteon for insomnia in adult subjects with ADHD.

EXPERIMENTAL DESIGN: For this randomized, double-blind, placebo-controlled crossover trial, 8 mg of ramelteon was given nightly, within three hours of bedtime, to ADHD-insomnia subjects confirmed by DSM-IV-TR, ADHD-RS, MINI, and clinical interview. All subjects underwent two weeks each of ramelteon and placebo. Objective sleep measures were obtained by actigraphy. Subjective measures included: the Epworth Sleepiness Scale (ESS) and ADHD-RS.

PRINCIPAL OBSERVATIONS: Of 36 subjects entering the study, 58% met criteria for circadian rhythm sleep disorder (CRSD), delayed sleep phase type. During
ramelteon period, mid-sleep time, an indicator of circadian phase, occurred significantly earlier, by ~45 minutes compared to placebo period. An association was noted between the magnitude of the sleep phase advance and the timing of ramelteon administration in relationship to sleep start time, but did not reach statistical significance; maximal efficacy was noted 1.5 hours before bedtime. Paradoxically, ramelteon marginally, but significantly increased sleep fragmentation and ESS scores compared to the placebo state.

CONCLUSIONS: Ramelteon is efficacious in maintaining an earlier sleep/wake cycle in adults with ADHD and CRSD but can have paradoxical fragmenting effects on sleep and exacerbate daytime sleepiness. In the presence of a circadian rhythm disorder, the usual dosing and timing parameters for ramelteon need to be carefully considered.

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Randomised controlled trial of the efficacy of a blue-enriched light intervention to improve alertness and performance in night shift workers.


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OBJECTIVES: Night workers often experience high levels of sleepiness due to misalignment of the sleep–wake cycle from the circadian pacemaker, in addition to acute and chronic sleep loss. Exposure to light, in particular short wavelength light, can improve alertness and neurobehavioural performance. This randomised controlled trial examined the efficacy of blue-enriched polychromatic light to improve alertness and neurobehavioural performance in night workers.

DESIGN: Participants were 71 night shift workers (42 males; 32.8±10.5 years) who worked at least 6 hours between 22:00 and 08:00 hours. Sleep–wake logs and wrist actigraphy were collected for 1–3 weeks, followed by 48-hour urine collection to measure the circadian 6-sulphatoxymelatonin (aMT6s) rhythm. On the night following at least two consecutive night shifts, workers attended a simulated night shift in the laboratory which included subjective and objective assessments of sleepiness and performance. Workers were randomly assigned for exposure to one of two treatment conditions from 23:00 hours to 07:00 hours: blue-
enriched white light (17 000 K, 89 lux; n=36) or standard white light (4000 K, 84 lux; n=35).

RESULTS: Subjective and objective sleepiness increased during the night shift in both light conditions (p<0.05, ηp²=0.06–0.31), but no significant effects of light condition were observed. The 17 000 K light, however, did improve subjective sleepiness relative to the 4000 K condition when light exposure coincided with the time of the aMT6s peak (p<0.05, d=0.41–0.60).

CONCLUSION: This study suggests that, while blue-enriched light has potential to improve subjective sleepiness in night shift workers, further research is needed in the selection of light properties to maximise the benefits.


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Conflict of interest statement: Competing interests: TLS reports that her institution has received equipment donations or other support from Philips Lighting, Philips Respironics, Optalert and Compumedics. She serves as a Project Leader in the Cooperative Research Centre for Alertness, Safety and Productivity. SFt serves as a Project Leader in the Cooperative Research Centre for Alertness, Safety and Productivity. RRG serves as a Program Leader in the Cooperative Research Centre for Alertness, Safety and Productivity which provides equipment and other in-kind support for research from Philips. In the past 5 years, SWL has received consulting fees from Blackrock, Carbon Limiting Technologies
(on behalf of PhotonStar LED), Cowen & Co, Endurant Capital Management, Far West Capital Management, Fidelity, Frankel Group, Impax Laboratories, Kearney Venture Partners, Lazard Capital Markets, Naturebright, New Horizon Capital, Perceptive Advisors, Polar Capital, ResearchWorks, Serrado Capital, Thomas Jefferson University and Wyvern Funds; has current consulting contracts with Akili Interactive, Delos Living LLC, Environmental Light Sciences LLC, Focal Point LLC, Headwaters, Hintsa Performance AG, OpTerra Energy Services, Pegasus Capital Advisors LP, PlanLED, Wyle Integrated Science and Engineering; has received unrestricted equipment gifts from Bioilluminations LLC, Bionetics Corporation and Philips Lighting; a fellowship gift from Optalert; advance author payment and royalties from Oxford University Press; payment for editing a textbook section from Elsevier; honoraria from the National Sleep Foundation and for an article in the Wall Street Journal; honoraria plus travel, accommodation or meals for invited seminars, conference presentations or teaching from Brookline Adult Education, Brown University, Estee Lauder, Harvard University (CME), MediCom Worldwide (CME); travel, accommodation and/or meals only (no honoraria) for invited seminars, conference presentations or teaching from the 8th International Conference on Managing Fatigue, 14th Annual Tennessee Perfusion Conference, American Society for Photobiology, Cantifix, Connecticut Business & Industry Association Health and Safety Conference, Emergency Services Steering Committee, FASEB, Harvard University, Hintsa Performance AG, Illuminating Engineering Society, Lightfair, Massachusetts General Hospital, Midwest Lighting Institute, New England College of Occupational and Environmental Medicine, Ontario Association of Fire Chiefs, Rio Tinto, UMass Memorial, University of Manchester, University of Texas Medical Branch and Woolcock Institute of Medical
Research; ongoing investigator-initiated research grants from Biological Illuminations LLC and Respironics; completed service agreements with Rio Tinto Iron Ore and Vanda Pharmaceuticals; three completed sponsor-initiated clinical research contracts with Vanda Pharmaceuticals; and one completed investigator-initiated research grant from Vanda Pharmaceuticals. SWL also holds a process patent for the use of short-wavelength light for resetting the human circadian pacemaker and improving alertness and performance which is assigned to the Brigham and Women’s Hospital per hospital policy and has received revenue from a patent on the use of short-wavelength light, which is assigned to the University of Surrey. SWL has also served as a paid expert witness on behalf of eight public bodies and one union for arbitration and cases related to sleep, circadian rhythms and work hours. SWL also serves as a Program Leader in the Cooperative Research Centre for Alertness, Safety and Productivity. SMWR reports that he has served as a consultant through his institution to Vanda Pharmaceuticals, Philips Respironics, EdanSafe, The Australian Workers’ Union, National Transport Commission and Transport Accident Commission and has through his institution received research grants and/or unrestricted educational grants from Vanda Pharmaceuticals, Takeda Pharmaceuticals North America, Philips Lighting, Philips Respironics, Cephalon and ResMed Foundation and reimbursements for conference travel expenses from Vanda Pharmaceuticals. His institution has received equipment donations or other support from Optalert, Compumedics and Tyco Healthcare. He has also served as an expert witness and/or consultant to shift work organisations. SMWR also serves as a Program Leader in the Cooperative Research Centre for Alertness, Safety and Productivity.
BACKGROUND: Hypoxemia and bradycardia occur frequently in preterm infants, but are incompletely understood. They are more prevalent during infections and following immunization. Data on adults suggested an increased immune response if subjects slept following vaccination, suggesting an interaction between circadian rhythm and the immune system. Whether this holds true for preterm infants with their less well-established circadian rhythm is unclear.

OBJECTIVE: Do infants born at 26–30 weeks' gestation and having received their first routine hexavalent vaccination in the morning have a lower cardiorespiratory event rate (CER) after vaccination than those receiving it in the evening?

METHODS: Twenty-six infants were randomized to an evening versus morning vaccination group in a pilot and main study with 10 and 16 participants, respectively. Pulse oximeter saturation, actigraphy, and rectal temperature were obtained for 24 h before and after vaccination. Blood samples for vaccination titers were taken before vaccination and during a follow-up examination in our outpatient clinic; another blood sample was taken 24 h after vaccination to determine inflammatory markers.

RESULTS: Vaccination led to an increase in CER in both groups, but there was no difference in CER between the morning and evening groups. Vaccination
titers for Bordetella pertussis were increased in both groups, with no difference in inflammatory markers 24 h after vaccination. Body temperature increased in both groups after vaccination. Participants in the evening group slept longer after vaccination.

CONCLUSIONS: We did not identify a difference in CER between morning and evening vaccination but could confirm increased body temperatures and vaccination titers following vaccination.

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A randomized controlled trial with bright light and melatonin for delayed sleep phase disorder: effects on subjective and objective sleep.

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Delayed sleep phase disorder (DSPD) is assumed to be common amongst adolescents, with potentially severe consequences in terms of school attendance and daytime functioning. The most common treatment approaches for DSPD are based on the administration of bright light and/or exogenous melatonin with or without adjunct behavioural instructions. Much is generally known about the chronobiological effects of light and melatonin. However, placebo-controlled treatment studies for DSPD are scarce, in particular in adolescents and young adults, and no
standardized guidelines exist regarding treatment. The aim of the present study was, therefore, to investigate the short- and long-term effects on sleep of a DSPD treatment protocol involving administration of timed bright light and melatonin alongside gradual advancement of rise time in adolescents and young adults with DSPD in a randomized controlled trial and an open label follow-up study. A total of 40 adolescents and young adults (age range 16-25 years) diagnosed with DSPD were recruited to participate in the study. The participants were randomized to receive treatment for two weeks in one of four treatment conditions: dim light and placebo capsules, bright light and placebo capsules, dim light and melatonin capsules or bright light and melatonin capsules. In a follow-up study, participants were re-randomized to either receive treatment with the combination of bright light and melatonin or no treatment in an open label trial for approximately three months. Light and capsules were administered alongside gradual advancement of rise times. The main end points were sleep as assessed by sleep diaries and actigraphy recordings and circadian phase as assessed by salivary dim light melatonin onset (DLMO). During the two-week intervention, the timing of sleep and DLMO was advanced in all treatment conditions as seen by about 1 h advance of bed time, 2 h advance of rise time and 2 h advance of DLMO in all four groups. Sleep duration was reduced with approximately 1 h. At three-month follow-up, only the treatment group had maintained an advanced sleep phase. Sleep duration had returned to baseline levels in both groups. In conclusion, gradual advancement of rise time produced a phase advance during the two-week intervention, irrespective of treatment condition. Termination of treatment caused relapse into delayed sleep times, whereas long-term treatment with bright light and melatonin (three months)
allowed maintenance of the advanced sleep phase.

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Randomized, double-blind, placebo-controlled study of clonidine in restless legs syndrome.

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Ten patients with idiopathic restless leg syndrome (RLS) were asked to rate their symptoms at baseline during 2 weeks of placebo and 2 weeks of clonidine treatment by using a four-point scale. On two consecutive nights each treatment period, polysomnography (PSG) and actigraphic studies were performed. Patients subjectively reported improvement in leg sensations (p = 0.02) and motor restlessness (p = 0.001) while receiving clonidine (mean = 0.05 mg/day). On PSG testing, sleep onset occurred faster with clonidine (12 minutes) compared with placebo (30 minutes) and baseline (47 minutes) (p = 0.006). Adverse findings associated with clonidine treatment included decreased percent REM sleep in the clonidine group (4%) compared with placebo (16%) and baseline (16%) (p = 0.001) and increased REM latency in the clonidine group (195 minutes) compared to the placebo (70 minutes) and baseline groups (89 minutes) (p = 0.028). There were no significant changes in total sleep time, stage 1 and 2 sleep, sleep efficiency, awakenings, arousals or periodic limb movements in sleep. There was a nonstatistical trend toward and increase in stage 3 and 4 sleep and a decrease in motor activity as measured by actigraphic recordings. Globally, seven out of 10
patients felt clonidine was more effective than placebo. Four patients chose to continue clonidine after the study. Clonidine may be an effective treatment for RLS patients who don't have large numbers of sleep-disrupting periodic limb movements but have delayed sleep onset due to leg sensations and subsequent motor restlessness.

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A randomized double-blind placebo-controlled trial of treatment as usual plus exogenous slow-release melatonin (6 mg) or placebo for sleep disturbance and depressed mood.

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Sleep disturbance is common in major depressive disorder (MDD), and is often characterized by early-morning waking. Melatonin is a hypnotic and synchronizes circadian rhythms. It may also be an antidepressant. The melatonin agonists, ramelteon and agomelatine, have hypnotic and antidepressant properties, but there is a dearth of trials investigating the use of melatonin in MDD. This randomized, controlled trial aimed to determine whether exogenous melatonin is a sleep promoter and antidepressant. Thirty-three participants with a Diagnostic and Statistical Manual of Mental Disorders (fourth edition) diagnosis of MDD and early-morning waking were selected for a 4-week, randomized, double-blind trial of slow-release melatonin (6 mg; vs. placebo) given at bedtime over 4 weeks.
Sleep was measured subjectively using sleep diaries and the Leeds Sleep Evaluation Questionnaire and objectively using wrist actigraphy. Of the 33 participants, 31 completed the trial. General Linear Modelling showed significant improvements in depression and sleep over time, but this was not specific to melatonin. However, there was a trend towards an improvement in mood with melatonin, and no adverse side effects were observed. In conclusion, melatonin may be beneficial for treating MDD, it seems to be safe and well tolerated, but its potential for treating depression in people who do not wish to take antidepressants requires further evaluation.

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Randomized, Placebo-Controlled Trial of Ferrous Sulfate to Treat Insomnia in Children With Autism Spectrum Disorders.

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BACKGROUND: Insomnia and low iron stores are common in children with autism spectrum disorders, and low iron stores have been associated with sleep disturbance.

METHODS: We performed a randomized placebo-controlled trial of oral ferrous sulfate to treat insomnia in children with autism spectrum disorders and low normal ferritin levels. Twenty participants who met inclusion criteria and whose insomnia did not respond to sleep education were randomized to 3 mg/kg/day of ferrous sulfate (n = 9) or placebo (n = 11) for three months.

RESULTS: Iron supplementation was well tolerated, and no serious adverse events were reported. Iron supplementation improved iron status (+18.4 ng/mL active versus −1.6 ng/mL placebo, P = 0.044) but did not significantly improve the primary outcome measures of sleep onset latency (−11.0 minutes versus placebo, 95% confidence interval −28.4 to 6.4 minutes, P = 0.22) and wake time after sleep onset (−7.7 minutes versus placebo, 95% confidence interval −22.1 to 6.6 min, P = 0.29) as measured by actigraphy. Iron supplementation was associated with improvement in the overall severity score from the Sleep Clinical Global Impression Scale (−1.5 points versus placebo, P = 0.047). Changes in measures of daytime behavior did not differ between groups.

CONCLUSION: This trial demonstrated no improvement in primary outcome measures of insomnia in subjects treated with ferrous sulfate compared with placebo. Interpretation was limited by low enrollment.

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Randomized trial of a cognitive-behavioral intervention for insomnia in breast cancer survivors.

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Comment in Evid Based Nurs. 2008 Apr;11(2):54.

PURPOSE/OBJECTIVES: To determine the efficacy of a cognitive-behavioral intervention for treating insomnia in breast cancer survivors.
DESIGN: Randomized controlled trial.
SETTING: University and medical center settings.
SAMPLE: 72 women at least three months after primary treatment for breast cancer with sleep-onset or sleep maintenance insomnia at least three nights per week for at least three months as determined through daily sleep diaries.
METHODS: Random assignment to a multicomponent intervention (stimulus control instructions, sleep restriction, and sleep education and hygiene) or a single-component control group (sleep education and hygiene).
MAIN RESEARCH VARIABLES: Sleep-onset latency, wake after sleep onset, total sleep time, time in bed, sleep efficiency, and sleep quality.
FINDINGS: After the intervention, both groups improved on sleep-onset latency, wake after sleep onset, total sleep time, time in bed, sleep efficiency, and sleep quality based on daily sleep diaries. A between-group difference existed for time in bed. Wrist actigraph data showed significant pre- to postintervention changes for sleep-onset latency, wake after sleep onset, total sleep time, and time in bed. When compared to the control group, the multicomponent intervention group rated overall sleep as more improved.
CONCLUSIONS: A nonpharmacologic intervention is effective in the treatment of insomnia in breast cancer survivors.
IMPLICATIONS FOR NURSING: Breast cancer survivors can benefit from a cognitive-behavioral intervention for chronic insomnia. Sleep
education and hygiene, a less complex treatment than a multicomponent intervention, also is effective in treating insomnia.

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Rapid counterclockwise shift rotation in air traffic control: effects on sleep and night work.

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INTRODUCTION: In Air Traffic Control, counterclockwise rapidly rotating shift schedules are often employed but may result in significant sleep loss. This has potential consequences for performance, particularly if a night shift is worked. As part of a large-scale field study, the pattern of sleep across a 4-d counterclockwise, rapidly rotating schedule (afternoon, day, morning, night shift) was documented and relationships between prior sleep and performance during the night shift were investigated.

METHODS: There were 28 controllers who completed 4 periods of data collection which included 2 d before and 2 d after a 4-d shift cycle. Sleep was recorded using an actigraph and sleep diary, and performance on each night shift was measured three times using the Psychomotor Vigilance Task.

RESULTS: Across the work week, sleep duration decreased largely due to earlier rise times associated with shift start times moving backward. In the short turn-around between the morning and night shift, 90% of controllers slept for an average of 2.2 h. Improved performance on the night shift was related only to
longer periods of sleep the night prior.

**DISCUSSION:** This study demonstrates that a 4-d counterclockwise, rapidly rotating schedule results in a progressive reduction in sleep and consequently the rapid accumulation of a sleep debt. To help maintain their performance on the night shift, it is recommended that controllers attempt to obtain at least 6 h sleep the night before a night shift. It is also recommended that ATC providers educate their workforce about this issue.

PMID: 17891898  [Indexed for MEDLINE]


Rapid Eye Movement Sleep-related Parasomnias.

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Among the rapid eye movement (REM) sleep-related parasomnias, the most common and important disorder for which patients present is REM sleep behavior disorder (RBD). Rapid eye movement sleep behavior disorder is often undiagnosed for many years, despite the sometimes bizarre and harmful behaviors involved. Complete evaluation and accurate diagnosis are essential for proper management. This includes medical, sleep/wake, psychiatric, and neurologic histories. Although they may raise feelings of guilt or shame, questions related to sexual and violent behaviors should be directed towards the identified patient as well as their bed partners. Objective studies should include nocturnal polysomnogram with audiovisual monitoring of behavior, electromyography (EMG) of all limbs, and seizure montage. Brain imaging, clinical electroencephalogram (EEG), neuropsychometric testing, and actigraphy may be used adjunctively.
Clinicians should have a high index of suspicion for other neurologic conditions, especially neurodegenerative disorders and narcolepsy, because many patients with RBD have these conditions. Rapid eye movement sleep behavior disorder may actually precede symptoms and signs associated with other neurologic disorders, so close follow-up is recommended. Medications that may be causing or exacerbating RBD should be withdrawn, if possible. Clonazepam is very effective in reducing the symptoms of RBD. This treatment is generally well tolerated and may be used long-term. Discontinuation of clonazepam usually leads to relapse of symptoms. Safety-related issues should be discussed with patients and their families.

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Reciprocal relations between children's sleep and their adjustment over time.

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Child sleep and adjustment research with community samples is on the rise with a recognized need of explicating this association. We examined reciprocal relations between children's sleep and their internalizing and externalizing symptoms using 3 waves of data spanning 5 years. Participants included 176 children at Time 1 (M = 8.68 years; 69% European American, 31% African American), 141 children at Time 2 (M = 10.70 years), and 113 children at Time 3 (M = 13.60 years). Children were from a wide range of socioeconomic backgrounds. Sleep was measured subjectively via self-reports and objectively via actigraphy and adjustment was
assessed with parent and child reports. Cross-lagged panel models indicated that reduced sleep duration and worse sleep quality predicted greater depression, anxiety, and externalizing symptoms over time. To a lesser extent but supportive of reciprocal relations, adjustment predicted changes in sleep. Findings illustrate the reciprocal nature of relations between sleep and adjustment difficulties in otherwise typically developing youth.

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DOI: 10.1037/a0034501
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Reciprocal Relations Between Parental Problem Drinking and Children's Sleep: The Role of Socioeconomic Adversity.

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Reciprocal relations between parental problem drinking (PPD) and children's sleep were examined longitudinally, and socioeconomic status was considered as a moderating variable. At Wave 1, 280 children (Mage = 10.33) and their parent(s) participated, and 275 families returned 1 year later. At both waves, parent(s) reported on PD and children wore actigraphs that measured established sleep parameters. After controlling for autoregressive effects, fathers' PD predicted reduced sleep duration and efficiency in children over time. Supportive of reciprocal effects, more frequent long wake episodes predicted greater PPD. Fathers' PD was a more robust risk factor for lower than higher income children.
Results build on a growing literature that has considered children's sleep in a family context.

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Recovery after uncomplicated laparoscopic cholecystectomy.
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BACKGROUND: After laparoscopic cholecystectomy, the duration of convalescence is 2 to 3 weeks with an unclear pathogenesis. This study was undertaken to analyze postoperative recovery after uncomplicated elective laparoscopic cholecystectomy.

METHODS: Twenty-four consecutive unselected employed patients were followed up prospectively from 1 week before to 1 week after outpatient laparoscopic cholecystectomy. Daily computerized monitoring of physical motor activity and sleep duration and night sleep fragmentation (actigraphy), subjective sleep quality, pulmonary function, pain, and fatigue were registered. Treadmill exercise performance (preoperatively and at postoperative days 2 and 8) and nocturnal pulse oximetry at the patients' homes (preoperatively and postoperative nights 1-3) were completed.

RESULTS: Median age was 41 years (range, 21-56). Compared with preoperatively, levels of physical motor activity, fatigue, and pain scores were normalized 2 days after operation. Subjective sleep quality was significantly worsened on the first postoperative night, and sleep duration was significantly
increased on the first 2 postoperative nights. There were no significant perioperative changes in actigraphy night sleep fragmentation, incidence of self-reported awakenings or nightmares/distressing dreams, exercise performance, or nocturnal oxygenation. Pulmonary peak flow measurements were normalized the day after operation.

CONCLUSION: After uncomplicated outpatient laparoscopic cholecystectomy, there is no pathophysiologic basis for recommending a postoperative convalescence of more than 2 to 3 days in otherwise healthy younger patients.

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Reducing the use of screen electronic devices in the evening is associated with improved sleep and daytime vigilance in adolescents.


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The use of screen electronic devices in the evening negatively affects sleep. Yet, sleep is known to be essential for brain maturation and a key
factor for good academic performance, and thus is particularly critical during childhood and adolescence. Although previous studies reported associations between screen time and sleep impairment, their causal relationship in adolescents remains unclear. Using actigraphy and daily questionnaires in a large sample of students (12 to 19 years old), we assessed screen time in the evening and sleep habits over 1 month. This included a 2 week baseline phase, followed by a 40 min sleep education workshop and a 2 week interventional phase, in which participants were asked to stop using screen devices after 9 pm during school nights. During the interventional phase, we found that the reduction of screen time after 9 pm correlated with earlier sleep onset time and increased total sleep duration. The latter led to improved daytime vigilance. These findings provide evidence that restricting screen use in the evening represents a valid and promising approach for improving sleep duration in adolescents, with potential implications for daytime functioning and health.

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Regional Neocortical Gray Matter Structure and Sleep Fragmentation in Older Adults.

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STUDY OBJECTIVES: To test the hypothesis that greater sleep fragmentation is associated with regionally decreased cortical gray matter volume in older community-dwelling adults without cognitive impairment.

METHODS: We studied 141 community-dwelling older adults (median age 82.9; 73% female) without cognitive impairment or stroke, and not using sedative/hypnotic medications, participating in the Rush Memory and Aging Project. We quantified sleep fragmentation from 7 d of actigraphy using the metric kRA and related this to total cortical gray matter volume, and regional gray matter volume in 34 cortical regions quantified by automated segmentation of magnetic resonance imaging data. We determined statistical significance and accounted for multiple comparisons by empirically estimating the false discovery rate by permutation.

RESULTS: Lower total cortical gray matter volume was associated with higher sleep fragmentation (coefficient +0.23, standard error [SE] 0.11, P = 0.037). Lower gray matter volumes in four cortical regions were accompanied by higher sleep fragmentation with a false discovery rate < 0.05: the left (coefficient +0.36, SE 0.10, P = 2.7 × 10(-4)) and right (coefficient +0.31, SE 0.10, P = 4.0 × 10(-3)) lateral orbitofrontal cortices, and the adjacent left (coefficient +0.31, SE 0.10, 5.4 × 10(-4)) and right (coefficient +0.39, SE 0.10, P = 1.2 × 10(-4)) inferior frontal gyri pars orbitalis. These associations were unchanged after
accounting for age, sex, education, depression, cognitive function, and a number of medical comorbidities.

CONCLUSIONS: Lower cortical gray matter volume in the lateral orbitofrontal cortex and inferior frontal gyrus pars orbitalis is associated with greater sleep fragmentation in older community-dwelling adults. Further work is needed to clarify whether this is a consequence of or contributor to sleep fragmentation.

COMMENTARY: A commentary on this article appears in this issue on page 15.

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Relation between ambulatory actigraphy and laboratory polysomnography in insomnia practice and research.

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Actigraphy is increasingly used in practice and research studies because of its relative low cost and decreased subject burden. How multiple nights of at-home actigraphy compare to one independent night of in-laboratory polysomnography (PSG) has not been examined in people with insomnia. Using event markers (MARK) to set time in bed (TIB) compared to automatic program analysis (AUTO) has not been systematically evaluated. Subjects (n = 30) meeting DSM-5 criteria for insomnia and in-laboratory PSG sleep efficiency (SE) of <85% were
studied. Subjects were free of psychiatric, sleep or circadian disorders, other chronic conditions and medications that effect sleep. Subjects had an in-laboratory PSG, then were sent home for 7 nights with Philips Actiwatch Spectrum Plus. Data were analysed using Philips Actiware version 6. Using the mean of seven nights, TIB, total sleep time (TST), SE, sleep-onset latency (SOL) and wake after sleep onset (WASO) were examined. Compared to PSG, AUTO showed longer TIB and TST and less WASO. MARK only differed from PSG with decreased WASO. Differences between the PSG night and the following night at home were found, with better sleep on the first night home. Actigraphy in people with insomnia over seven nights is a valid indicator of sleep compared to an independent in-laboratory PSG. Event markers increased the validity of actigraphy, showing no difference in TIB, TST, SE and SOL. AUTO was representative of SE and SOL. Increased SE and TST without increased TIB suggests possible compensatory sleep the first at night home after in-laboratory PSG.

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PMID: 30941838


Relationship between activity levels and circadian blood pressure variations.

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In 17 healthy Japanese students (14 males and 3 females) an ambulatory activity level monitoring instrument (Actigraph) was attached to the wrist for
48-hour measurement of wrist movement (with 0.01G or higher acceleration). At the same time, an ambulatory blood pressure monitoring apparatus was attached to these subjects to monitor blood pressure (BP) and heart rate (HR) every 30 minutes. Sleeping hours were calculated from the activity levels. The sleeping hours obtained by the Actigraph correlated with those judged from the diary. The correlation was better for the go-to-sleep time than for the awakening time. Activity level, HR and BP showed a similar circadian variation. Activity level differed significantly between the active daytime (4500 counts/hour) and during sleep at night (720 counts/hour). The acrophase of activity level, obtained by the cosinor method, was 235 degrees which did not significantly differ from that of BP and HR. Hourly activity levels correlated with HR and BP at corresponding hours. These results suggest that BP is affected by activity levels even if this rhythm continues to recur in bedrest.

PMID: 8354101 [Indexed for MEDLINE]


The relationship between affective state and the rhythmicity of activity in bipolar disorder.

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OBJECTIVE: The aim of this study was to test the relationships between mood state and rhythm disturbances as measured via actigraphy in bipolar disorder by assessing the correlations between manic and depressive symptoms as
measured via Young Mania Rating Scale (YMRS) and 30-item Inventory for Depressive Symptomatology, Clinician-Rated (IDS-C-30) scores and the actigraphic measurements of rhythm, the 24-hour autocorrelation coefficient and circadian quotient.

METHOD: The research was conducted at the University of Texas Southwestern Medical Center at Dallas from February 2, 2009, to March 30, 2010. 42 patients with a DSM-IV-TR diagnosis of bipolar I disorder were included in the study. YMRS and the IDS-C-30 were used to determine symptom severity. Subjects wore the actigraph continuously for 7 days. The 24-hour autocorrelation coefficient was used as an indicator of overall rhythmicity. The circadian quotient was used to characterize the strength of a circadian rhythm.

RESULTS: A greater severity of manic symptoms correlated with a lower degree of rhythmicity and less robust rhythms of locomotor activity as indicated by lower 24-hour autocorrelation (r = -0.3406, P = .03) and circadian quotient (r = -0.5485, P = .0002) variables, respectively. No relationship was noted between the degree of depression and 24-hour autocorrelation scores (r = -0.1190, P = .45) or circadian quotient (r = 0.0083, P = .96). Correlation was noted between the 24-hour autocorrelation and circadian quotient scores (r = 0.6347, P < .0001).

CONCLUSIONS: These results support the notion that circadian rhythm disturbances are associated with bipolar disorder and that these disturbances may be associated with clinical signatures of the disorder. Further assessment of rhythm disturbances in bipolar disorder is warranted.

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[The relationship between ambulatory blood pressure variation and symptoms of depression and sleep disturbance in community-dwelling elderly persons with independent activities of daily living].

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OBJECTIVE: To clarify the relationship between ambulatory blood pressure variation and symptoms of depression and sleep disturbance in community-dwelling elderly persons with independent activities of daily living.

METHODS: The subjects were 41 volunteers in a health education class for the elderly in a rural community. We carried out: (1) an interview about symptoms of depression using the Geriatric Depression Scale (GDS), competence of daily living, subjective daily sleep complaints and past history of disease, (2) ambulatory blood pressure measurements over 24 hours with a portable device, (3) sleep-awake judgment by wrist actigrams, and (4) instructions for self-records of his/her life activities.

RESULTS: (1) The average value for 24 hour-mean diastolic blood pressure was significantly higher in subjects undergoing hypertension treatment. (2) No significant relationship was observed between subjective sleep disturbance and ambulatory blood pressure variation. (3) No significant relationship was observed between objective sleep disturbance assessed by wrist-actigraphy and ambulatory blood pressure variation. (4) Severe depression was related to a lower degree of night decrease in both systolic and diastolic blood pressure in subjects undergoing hypertension treatment, while it was associated with higher average values for 24 hour- and awaking-mean systolic and diastolic blood pressure in
subjects not receiving such treatment.
CONCLUSIONS: In community-dwelling elderly persons with independent activities of daily living, severer depression was associated with the higher mean blood pressure in subjects not taking medicine for hypertension and with a low degree of night decrease in diastolic blood pressure in those receiving hypertension treatment, while no significant relationship was observed between sleep disturbance and ambulatory blood pressure variation.

PMID: 11974921 [Indexed for MEDLINE]


Relationship between circadian activity rhythms and fatigue in hospitalized children with CNS cancers receiving high-dose chemotherapy.

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PURPOSE: Robust circadian rhythms are increasingly recognized as essential to good health. Adult cancer patients with dysregulated circadian activity rhythms (CAR) experience greater fatigue, lower responsiveness to chemotherapy, and shorter time to relapse. There is scant research describing circadian rhythms and associated outcomes in children with cancer. As part of a larger study
examining whether a cognitive-behavioral intervention could preserve sleep in children and adolescents with central nervous system cancers hospitalized for high-dose chemotherapy (HDCT), this study aimed to compare CAR of these children to published values and to investigate the relationship between CAR and fatigue.

METHODS: Participants aged 4–19 years wore an actigraph throughout their hospitalization (5 days). From activity counts recorded by actigraphy, six CAR variables were calculated: amplitude, 24-h autocorrelation (r24), dichotomy index (I < 0), interdaily stability (IS), intradaily variability (IV), and acrophase. Parent-reported child fatigue and child/adolescent self-reported fatigue measures were collected daily.

RESULTS: Thirty-three participants were included. Three CAR variables (amplitude, r24, and I < 0) showed dysregulation compared to published values. Older age was significantly associated with later acrophase and greater dysregulation of all other CAR variables. Controlling for age, more dysregulated amplitude (p = 0.001), r24 (p = 0.003), IS (p = 0.017), and IV (p = 0.001) were associated with higher parent-reported fatigue; more dysregulated IV (p = 0.003) was associated with higher child-reported fatigue.

CONCLUSIONS: Participants demonstrated dysregulated CAR during hospitalization for HDCT. Greater dysregulation was associated with greater fatigue. Research on circadian dysregulation and its relationship to health-related outcomes in children with cancer, and interventions to support circadian rhythmicity, is urgently needed.

DOI: 10.1007/s00520-019-04960-5
PMID: 31273507  [Indexed for MEDLINE]

Early neuropathological changes characteristic of late-onset Alzheimer's disease (LOAD) involve brain stem and limbic structures that regulate neurovegetative functions, including sleep-wake rhythm. Indeed, sleep pattern is an emerging biomarker and a potential pathophysiological mechanism in LOAD. We hypothesized that cognitively asymptomatic, middle-aged offspring of patients with LOAD (O-LOAD) would display a series of circadian rhythm abnormalities prior to the onset of objective cognitive alterations. We tested 31 children of patients with
LOAD (O-LOAD) and 19 healthy individuals without family history of Alzheimer's disease (control subjects, CS) with basic tests of cognitive function, as well as actigraphy measures of sleep-wake rhythm, cardiac autonomic function, and bodily temperature. Unexpectedly, O-LOAD displayed subtle but significant deficits in verbal episodic memory (Rey Auditory Verbal Learning Test delayed recall 10.6 ± 0.4 vs. 8.6 ± 0.6, t = 4.97, df = 49, p < 0.01) and language (Weschler's vocabulary 51.4 ± 1.3 vs. 44.3 ± 1.5, t = 2.49, df = 49, p < 0.001) compared to CS, even though all participants had results within the clinically normal range.

O-LOAD showed a phase-delayed rhythm of body temperature (2.56 ± 0.47 h vs. 3.8 ± 0.26 h, t = 2.48, df = 40, p = 0.031). Cognitive performance in O-LOAD was associated with a series of cardiac autonomic sleep-wake variables; specifically indicators of greater sympathetic activity at night were related to poorer cognition. The present results suggest sleep pattern deserves further study as a potential neurobiological signature in LOAD, even in middle-aged, at risk individuals.

DOI: 10.3389/fnagi.2017.00093
PMCID: PMC5380732
PMID: 28424614


Relationship between Cortisol Changes during the Night and Subjective and Objective Sleep Quality in Healthy Older People.

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The aim of this study was to investigate whether the nighttime cortisol release was associated with subjective and objective sleep quality and the discrepancy between them. Forty-five healthy older adults (age range from 56 to 75 years) collected salivary samples immediately before sleep and immediately after awakening on two consecutive nights. Actigraphy was used to assess objective sleep quality and quantity. A sleep diary was used to assess subjective sleep quality. Linear mixed models were performed using subjective and objective sleep quality data from 76 nights to investigate between-subject associations. We observed that larger changes in cortisol levels between sleep onset and awakening, reflecting a healthier circadian rhythm of the Hypothalamic-Pituitary-Adrenal (HPA) axis, were associated with better subjective sleep quality, but not with objective sleep quality. Moreover, smaller changes in nighttime cortisol were associated with lower subjective sleep quality relative to objective sleep quality. All these results were observed even after controlling for important confounders such as sleep quantity, age, sex, subjective socioeconomic status, stress perception, depression, physical activity, and adherence to the salivary sampling protocol. This study demonstrates that subjective sleep quality in older people may be explained, to some extent, by the activity of the HPA axis.

DOI: 10.3390/ijerph17041264
PMCID: PMC7068538
PMID: 32079109
The relationship between dementia severity and rest/activity circadian rhythms.

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Patients with dementia have been shown to have disturbed sleep/wake rhythms. There is evidence of impairment in endogenous generation of rhythms and deficient environmental cues in this population. This study sought to examine patterns of rest/activity rhythms as they relate to dementia severity. Three days of actigraphy were collected from 150 nursing-home patients with dementia and used to compute rhythm parameters. Dementia severity was estimated with the Mini-Mental State Examination (MMSE). The relationship between rhythm parameters and dementia severity was examined. Rhythm parameters were not associated with dementia in the sample as a whole, but relationships emerged when the sample was divided on the basis of overall rhythm robustness (F-statistic). Within the group with less robust rhythms, those with stronger rhythms had less severe dementia. In the group with more robust rhythms, milder dementia was associated with having an earlier acrophase (timing of the peak of the rhythm) and narrower peak of the rhythm (shorter duration of peak activity). These results suggested a three-stage model of rest/activity rhythm changes in dementia in which dementia patients have a rapid decline in rhythmicity followed by a slight return to stronger rhythms. In the later stages of dementia, rhythms decline even further.

DOI: 10.2147/nedt.1.2.155.61043
PMCID: PMC2413196
PMID: 18568061
OBJECTIVE: To examine the relationship between early physical and sexual abuse, posttraumatic stress disorder (PTSD), major depression, and activity levels in prepubertal children.

METHOD: Nineteen unmedicated children with documented abuse (9.4 +/- 2.3 years; 6 girls, 13 boys) were compared with 15 healthy controls (8.3 +/- 1.9 years; 6 girls, 9 boys). Diagnoses were derived from structured interviews (Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic Version). Motionlogger actigraphs collected activity data for 72 continuous hours in 1-minute epochs.

RESULTS: Overall, abused children were 10% more active than normal children (p < .05) and displayed a paucity of periods of low-level daytime activity (p < .01). Abused children with PTSD were largely responsible for the increase in activity. Abused children with PTSD had a robust and normal circadian activity rhythm. Abused children in whom PTSD failed to develop had an attenuated circadian amplitude compared with subjects with PTSD (101% versus 93%, p < .01) and were phase-delayed by 61 minutes versus controls (p = .01). Early onset of abuse was significantly associated with greater likelihood of the development of PTSD and hyperactivity. Later age of abuse was associated with circadian dysregulation.

CONCLUSIONS: These preliminary observations indicate that abused children with PTSD have activity profiles similar to those of children with attention-deficit
hyperactivity disorder, while abused children without PTSD have activity profiles more similar to those of depressed children.

DOI: 10.1097/00004583-199610000-00026
PMID: 8885593 [Indexed for MEDLINE]


The relationship between fatigue and light exposure during chemotherapy.

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BACKGROUND: Fatigue is one of the most common and distressing complaints among cancer patients, not only during radiation and chemotherapy, but also for months to years after the completion of treatment. Fatigue interferes with patients' daily lives, reduces their quality of life, and is often a significant reason why patients discontinue treatment. We hypothesized that some of the fatigue may be related to disrupted circadian rhythms and low light exposure. The main objective of this study therefore was to investigate the association between fatigue and light exposure among patients with breast cancer.

METHODS: As part of a larger, ongoing prospective study on fatigue, sleep, and circadian rhythms in patients with breast cancer, an analysis of 63 women newly diagnosed with stage I-IIIA breast cancer and scheduled to receive four cycles of adjuvant or neoadjuvant anthracycline-based chemotherapy was conducted. Data were collected before and during weeks 1, 2, and 3 of cycle 1 and cycle 4. Fatigue was assessed using the Short Form of Multidimensional Fatigue Symptom Inventory. Light exposure was recorded with a wrist actigraph.
RESULTS: There were significant correlations between fatigue levels and light exposure ($r=-0.28 \text{ to } -0.45$) within both cycle 1 and cycle 4, such that higher levels of fatigue were associated with less light exposure. There were also significant correlations between changes in light exposure and changes in fatigue within the first 2 weeks of each cycle ($r=-0.28 \text{ to } -0.52$).

CONCLUSIONS: Increased fatigue was significantly correlated with decreased light exposure among patients with breast cancer. Although the cause and effect of exacerbated fatigue and decreased light exposure cannot be confirmed by the current study, and lower light exposure may just in part be due to the fatigued patients spending less time outdoors in bright light, two hypotheses are proposed about the mechanisms by which light may alleviate the fatigue of patients with breast cancer. These results suggest the need for prospective intervention studies of light therapy for breast-cancer-related fatigue.

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PMCID: PMC1599705
PMID: 15864659 [Indexed for MEDLINE]


Relationship between infant and mother circadian rest-activity rhythm pre- and postpartum, in comparison to an infant with free-running rhythm.

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Some infants show a free-running rhythm in their rest-activity. We do not know why, nor do we know exactly what the entrainment factors are for the development of the normal 24-h rest-activity rhythm. Actigraphic recordings on 10 primiparae
during late pregnancy and these mothers and their infants during the 2nd, 6th, and 12th wks after birth were made over 3-5 continuous days to investigate maternal and infant entrainment. One infant showed a free-running rest-activity circadian rhythm. In late pregnancy, the period in the autocorrelogram of the mother with the free-running infant was longer than the significant period of the mean autocorrelogram of the mothers with non-free-running infants. The finding of this study indicates the free-running rhythm of infant is not reset by maternal entrainment factors.

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Relationship between Intrinsically Photosensitive Ganglion Cell Function and Circadian Regulation in Diabetic Retinopathy.

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BACKGROUND: Intrinsically photosensitive retinal ganglion cells (ipRGCs) control non-visual light responses (e.g. pupillary light reflex and circadian entrainment). Patients with diabetic retinopathy (DR) show reduced ipRGC function, as inferred by abnormalities in the post illumination pupil response (PIPR). We explored whether ipRGC function in DR is associated with circadian outputs and sleep/wake behavior.

METHODS: Forty-five participants (15 without diabetes, 15 with type 2 diabetes (T2D) and no DR, 15 with T2D and DR) participated. ipRGC function was inferred from the PIPR (pupil size following stimulus offset). Circadian outputs were melatonin amplitude (overnight urinary 6-sulfatoxymelatonin (aMT6s)) and timing (dim light melatonin onset (DLMO)), and evening salivary cortisol levels. Sleep/wake patterns were measured with wrist actigraphy and insomnia symptoms were assessed subjectively.

RESULTS: Patients with T2D and DR had smaller PIPR and lower urinary aMT6s than other groups (p < 0.001). In adjusted regression models, smaller PIPR was associated with lower urinary aMT6s (β = 4.552, p = 0.005). Patients with DR were more likely to have no detectable DLMO (p = 0.049), higher evening salivary cortisol, greater insomnia symptoms and greater sleep variability compared to other groups. Sleep duration, efficiency and rest-activity rhythms were similar.

CONCLUSION: Reduced ipRGC function in DR is associated with circadian dysregulation and sleep disturbances, although a causal relationship cannot be established in this cross-sectional study. Prospective mechanistic and intervention studies examining circadian and sleep health in these patients are warranted.

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Relationship between metabolic syndrome, circadian treatment time, and blood pressure non-dipping profile in essential hypertension.


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There is a strong association between metabolic syndrome (MS) and increased cardiovascular risk. Moreover, elevated nighttime blood pressure (BP) and non-dipping (subjects with <10% decline in the asleep relative to the awake BP mean) have been also linked to increased cardiovascular morbidity and mortality.

We investigated the relation between MS, circadian time of hypertension treatment, and impaired nighttime BP decline in a cross-sectional study on 3352 (1576 men/1776 women) non-diabetic hypertensive subjects, 53.7 ± 13.1 (mean ± SD) yrs of age. Among them, 2056 were ingesting all their prescribed hypertension medication upon awakening, and 1296 were ingesting at least one of their BP medications at bedtime. BP was measured by ambulatory monitoring for 48 consecutive hours to substantiate reproducibility of the dipping pattern.

Physical activity was simultaneously monitored every minute by wrist actigraphy to accurately calculate mean BP when awake and asleep for each subject. MS was present in 52.6% of the subjects. The prevalence of an altered non-dipper BP profile was significantly higher among subjects with MS (52.0% vs. 39.5% in subjects without MS, p < .001). Non-dipping was significantly more prevalent among subjects ingesting all BP-lowering medications upon awakening (56.8%) than
among those ingesting at least one of their BP medications at bedtime (29.1%; p < .001). Subjects with MS had significantly higher values of uric acid (6.0 vs. 5.3 g/dL, p < .001), plasma fibrinogen (331 vs. 315 mg/dL, p < .001), and erythrocyte sedimentation rate (14.8 vs. 12.4 mm, p < .001). Non-dipping was significantly associated with the presence of MS and treatment upon awakening in a multiple logistic regression model adjusted by significant confounding factors, including age, creatinine, erythrocyte sedimentation rate, and cigarette smoking. This cross-sectional study documents a significant increase of a blunted sleep-time BP decline in treated hypertensive subjects with MS. Even in the presence of MS, treatment at bedtime is significantly associated with lower prevalence of a high-risk non-dipper BP profile.

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Relationship between napping during night shift work and household obligations of female nursing personnel.

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Night shift employment involves displacing sleep to the daytime. For female workers, the opportunity for daytime sleep is influenced by routine housework demands, which aggravates sleep deprivation. Allowing naps to be taken during the night shift of work is a frequent practice at some hospitals and can help reduce
the effects of sleep deprivation. We hypothesize that an association between domestic work and the length of naps during night work exists for nursing professionals. To test this hypothesis, two cross-sectional studies were conducted in two different hospitals. In Study 1, female workers answered questionnaires regarding sleeping habits, professional work, and housework demands. In Study 2, data regarding napping during shifts was obtained by actigraphy, a noninvasive method of monitoring the human sleep-wake cycle. The demand for the performance of housework was measured by (i) domestic work hours (total time spent performing domestic work per week), and (ii) domestic workload, which considers the degree of sharing domestic tasks and the number of people living at home. The populations from the two studies were subdivided into groups, based on the duration of napping at work. Data on naps were analyzed according to domestic demands, using the Mann-Whitney and Chi-squared tests. Among the two study populations (Studies 1 and 2), those in Study 2 were older, had shorter professional weekly work hours, worked more night shifts, and dedicated more time to housework. Significant associations were only found in Study 2, where greater time napping at work was associated with both greater time spent doing housework and greater domestic workload. The known benefits of napping during night shifts seem to be especially relevant for female workers who are more sleep-deprived from working more night shifts and who have higher demands for housework.

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Relationship between physical activity and blood pressure in dipper and
non-dipper hypertensive patients.

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BACKGROUND: The lack of nocturnal decline in blood pressure has been associated with an increase in end-organ damage and cardiovascular events, although results remain controversial, partly because of the inability to reproduce correctly, over time, the classification of patients into dippers and non-dippers. Moreover, the non-dipping status has been frequently related to an increase in nocturnal activity, differences in quality of sleep, or both.
OBJECTIVE: To assess the relationship between activity and blood pressure in patients with hypertension.
METHODS: We studied 306 mild-to-moderately hypertensive patients (130 men), 53.7 +/- 14.0 years of age (mean +/- SD). Blood pressure and heart rate were measured for 48 consecutive hours, at 20-min intervals during the day and at 30-min intervals at night, using an ambulatory device, and physical activity was simultaneously evaluated at 1-min intervals by wrist actigraphy. Circadian parameters of blood pressure, heart rate and activity established by population multiple-components analysis were compared between dippers and non-dippers, by non-parametric testing. Diurnal and nocturnal means of blood pressure and activity were computed for each patient according to individual resting hours determined by actigraphy, and compared among groups by analysis of variance.
RESULTS: Despite highly statistically significant differences between dippers and non-dippers with respect to nocturnal means and in each hourly nightly mean of blood pressure, there were no differences between them for the same parameters during activity, whether or not the patients were receiving medication
at the
time of monitoring. The average duration of sleep and the 24-h mean
and standard
deviation of activity were also similar between the groups.
CONCLUSIONS: The highly significantly different circadian variation in blood
pressure between dippers and non-dippers with essential hypertension is not
related to a significant increase in nocturnal physical activity. Differences in
blood pressure could, however, be related to the absence of 24-h therapeutic
coverage in most non-dipper patients receiving antihypertensive medication.

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Relationship between sleep disturbance and self-care in adults with type 2 diabetes.

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AIMS: Type 2 diabetes (T2D) is a metabolic disorder requiring intensive self-care
to maintain optimal glycemic control. Sleep disturbance is common in
T2D patients and likely impairs glycemic control. Our aim was to examine the relationship between sleep disturbance and self-care in adults with T2D.

METHODS: This study used a correlational design. Sixty-four adults with T2D were recruited. Validated instruments were used to measure self-care, subjective sleep disturbance, and covariates (e.g., diabetes distress, self-efficacy, fatigue, and daytime sleepiness). Over an 8-day period, the ActiGraph-wGT3X was used to measure objective sleep outcomes (e.g., total sleep time and number of awakenings). Bivariate correlation and multiple linear regression analyses were conducted.

RESULTS: The mean age of the participants was 60.6 (SD 6.8) years (range 50–78), and 51.6% were women. Controlling for covariates, subjective sleep disturbance ($\beta = -0.26$), diabetes distress ($\beta = -0.39$), and daytime sleepiness ($\beta = -0.21$) were strong predictors of diabetes self-care ($R^2 = 0.51$, $p < 0.001$). When objective sleep parameters were used, the number of awakenings ($\beta = -0.23$) also predicted self-care along with diabetes distress, fatigue, and daytime sleepiness ($R^2 = 0.57$, $p < 0.001$).

CONCLUSIONS: Subjective sleep disturbance and frequent nocturnal awakenings are associated with worse diabetes self-care in adults with T2D. Healthcare providers are recommended to include comprehensive sleep assessment at every clinical visit. Diabetes educators may consider including sleep-related education in their diabetes self-management classes and/or counseling sessions.

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The relationship between sleep-wake cycle and cognitive functioning in young
people with affective disorders.

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Although early-stage affective disorders are associated with both cognitive dysfunction and sleep-wake disruptions, relationships between these factors have not been specifically examined in young adults. Sleep and circadian rhythm disturbances in those with affective disorders are considerably heterogeneous, and may not relate to cognitive dysfunction in a simple linear fashion. This study aimed to characterise profiles of sleep and circadian disturbance in young people with affective disorders and examine associations between these profiles and cognitive performance. Actigraphy monitoring was completed in 152 young people (16–30 years; 66% female) with primary diagnoses of affective disorders, and 69 healthy controls (18–30 years; 57% female). Patients also underwent detailed neuropsychological assessment. Actigraphy data were processed to estimate both sleep and circadian parameters. Overall neuropsychological performance in patients was poor on tasks relating to mental flexibility and visual memory. Two hierarchical cluster analyses identified three distinct patient groups based on sleep variables and three based on circadian variables. Sleep clusters included a 'long sleep' cluster, a 'disrupted sleep' cluster, and a 'delayed and disrupted sleep' cluster. Circadian clusters included a 'strong circadian' cluster, a 'weak circadian' cluster, and a 'delayed circadian' cluster. Medication use differed between clusters. The 'long sleep' cluster displayed significantly worse visual memory performance compared to
the 'disrupted sleep' cluster. No other cognitive functions differed between clusters. These results highlight the heterogeneity of sleep and circadian profiles in young people with affective disorders, and provide preliminary evidence in support of a relationship between sleep and visual memory, which may be mediated by use of antipsychotic medication. These findings have implications for the personalisation of treatments and improvement of functioning in young adults early in the course of affective illness.

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Relationship between subjective and actigraphy-measured sleep in 237 patients with metastatic colorectal cancer.


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OBJECTIVE: Patients with cancers frequently experience sleep and circadian dysfunction. To date, only a few studies have used both a questionnaire and actigraphy for concomitant evaluation of sleep and circadian function in patients with cancer. We sought to evaluate objective sleep and circadian parameters in metastatic colon cancer (MCC) patients and their associations with symptoms and quality of life (QOL).

METHODS: Patients reported subjective sleep problems on the EORTC QLQ-C30. Sleep and circadian parameters were calculated using a wrist-actigraph that patients wore for 72 h.

RESULTS: 237 Patients with MCC (mean age: 60.4 years; range: 20.7-77.6; Male/Female ratio: 1.66) participated in this cross-sectional study. Subjective sleep problems were reported by 63.4% of patients (S+). No differences in any sleep parameters (sleep efficiency, sleep latency, total sleep time, total time in bed, wake after sleep onset, activity bathyphase) were observed between S+ and S- patients. However, S+ patients displayed a significantly worse circadian function than S- patients (96.4 vs 98.1%; p = 0.005). The presence of poor subjective sleep and objective circadian dysfunction negatively affected symptoms and QOL domains (p = 0.038).

CONCLUSIONS: Subjective report of sleep problems was not associated with worse objectively measured sleep parameters in patients with MCC although it was associated with disrupted circadian rest-activity rhythm and poorer QOL. These findings coincide with prior research in cancer patients in that an inconsistent relationship exists between subjective and objective sleep measurements on some sleep domains. This study supports the value of coupled evaluation of
self-reported and objective measures of sleep and circadian function in cancer patients.

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The relationship between thermoregulation and REM sleep behaviour disorder in Parkinson's disease.

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BACKGROUND: This study explored the relationship between symptoms of rapid eye movement sleep behaviour disorder, thermoregulation and sleep in Parkinson's Disease.

METHODS: The study group comprised 12 patients with Parkinson's Disease and 11 healthy age-matched controls. We investigated markers of thermoregulation (core-body temperature profile), circadian rhythm (locomotor actigraphy) and sleep (polysomnography).

RESULTS: The mesor (the mean value around which the core temperature rhythm oscillates) of the core-body temperature in patients with Parkinson's Disease was significantly lower than that of controls. In addition, the nocturnal fall in CBT (the difference between the mesor and the nadir temperature) was also significantly reduced in PD patients relative to controls. Furthermore, in patients the reduction in the amplitude of their core-body temperature profile was strongly correlated with the severity of self-reported rapid eye movement sleep behaviour disorder symptom, reduction in the percentage of REM
sleep and prolonged sleep latency. By contrast, these disturbances of thermoregulation and sleep architecture were not found in controls and were not related to other markers of circadian rhythm or times of sleep onset and offset. CONCLUSIONS: These findings suggest that the brainstem pathology associated with disruption of thermoregulation in Parkinson's disease may also contribute to rapid eye movement sleep behavioural disorder. It is possible that detailed analysis of the core-body temperature profile in at risk populations such as those patients with idiopathic rapid eye movement sleep behaviour disorder might help identify those who are at high risk of transitioning to Parkinson's Disease.

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Relationship of chronotype to sleep, light exposure, and work-related fatigue in student workers.

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Students who work during the school year face the potential of sleep deprivation and its effects, since they have to juggle between school and work responsibilities along with social life. This may leave them with less time left for sleep than their nonworking counterparts. Chronotype is a factor that may exert an influence on the sleep of student workers. Also, light and social zeitgebers may have an impact on the sleep-related problems of this population. This study aimed to document sleep, light exposure patterns, social rhythms, and
work-related fatigue of student workers aged 19–21 yrs and explore possible associations with chronotype. A total of 88 student workers (mean ± SD: 20.18 ± .44 yrs of age; 36 males/52 females) wore an actigraph (Actiwatch-L; Mini-Mitter/Respironics, Bend, OR) and filled out the Social Rhythm Metric for two consecutive weeks during the school year. Also, they completed the Morningness–Eveningness Questionnaire (MEQ), Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), and Occupational Fatigue Exhaustion/Recovery Scale (OFER). Repeated and one-way analyses of variance (ANOVAs), Pearson's chi-square tests, and correlation coefficients were used for statistical comparisons. Subjects slept an average of 06:28 h/night. Actigraphic sleep parameters, such as sleep duration, sleep efficiency, wake after sleep onset, and sleep latency, did not differ between chronotypes. Results also show that evening types (n = 17) presented lower subjective sleep quality than intermediate types (n = 58) and morning types (n = 13). Moreover, evening types reported higher levels of chronic work-related fatigue, exhibited less regular social rhythms, and were exposed to lower levels of light during their waking hours (between 2 and 11 h after wake time) as compared to intermediate types and morning types. In addition, exposure to light intensities between 100 and 500 lux was lower in evening types than in intermediate types and morning types. However, bright light exposure (≥ 1000 lux) did not differ between chronotypes. In conclusion, results suggest that student workers may constitute a high-risk population for sleep deprivation. Evening types seemed to cope less well with sleep deprivation, reporting poorer sleep quality and higher levels of work-related fatigue than intermediate types and morning types. The higher chronic work-related fatigue of evening types may be linked to their attenuated level of light exposure and weaker social zeitgebers. These results add credence to the hypothesis that eveningness entails a higher risk of health-impairing
The relationship of electronically monitored physical activity to blood pressure, heart rate, and the circadian blood pressure profile.

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We studied how closely changes in electronically monitored physical activity are reflected in changes in blood pressure and heart rate in a group of untreated hypertensive subjects. Thirty-nine hypertensive patients (office blood pressure > 140/90 mm Hg) of mean age 57 +/- 10 years (mean +/-SD) wore an ambulatory blood pressure monitor and a wrist actigraph simultaneously. Both average and peak activity for 5 min before each valid blood pressure reading were determined, as was average activity for awake and sleep periods, determined by patient kept diaries. For the overall group, awake and 24-h activities were inversely correlated to age (n = 39, r = -0.42; P = 0.01 and n = 39, r = -0.38; P = 0.01, respectively). No correlation was found between group awake activity and group-average blood pressure or heart rate. For individual patients, there was marked variation in the degree of correlation between awake activity measures (both peak and average) and blood pressure and heart rate. The strongest positive correlation was between activity levels and the heart rate-pressure product. Nondipper profile hypertensives had higher sleep activity than dipper hypertensives (44 +/- 28 units/min v 25 +/- 20 units/min, df = 37, t = 2.12; P =
0.04), but awake activity levels were similar. The higher sleep activity remained after adjustment for age. These findings indicate that the relationship between actigraphic activity and hemodynamic parameters is highly variable and that the rate-pressure product is the strongest correlate of short-term activity. Furthermore, hypertensives with the nondipper profile have higher sleep activity than dipper hypertensives. These findings stress the need for further study into the role of day-to-day activity in determining ambulatory blood pressure and heart rate variability.

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The relationship of sleep disturbances and fatigue in multiple sclerosis.

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BACKGROUND: Fatigue is experienced by most patients with multiple sclerosis (MS) and often is profoundly debilitating. No large-scale studies to our knowledge have examined circadian rhythm abnormalities in MS patients or the relationship of fatigue to circadian rhythms.

OBJECTIVE: To determine if patients with MS and fatigue have sleep disturbances or circadian rhythm abnormalities associated with fatigue.

DESIGN: Case-control study.

SETTING: Washington University School of Medicine, St Louis, Mo.

PATIENTS: Fifteen patients with MS and fatigue were compared with 15 patients with MS without fatigue and 15 age- and sex-matched, healthy controls.

MAIN OUTCOME MEASURES: Sleep disturbances and circadian rhythm abnormalities were quantitated by actigraphy, fatigue by the Fatigue Descriptive Scale,
and excessive sleepiness by the Epworth Sleepiness scale (ESS).
RESULTS: Of the 15 fatigued patients with MS, 2 had delayed sleep phase, 10 had disrupted sleep, and 3 had normal sleep. One of the 15 nonfatigued MS patients had irregular sleep cycles, 2 others had disrupted sleep, and 12 had normal sleep. All 15 of the healthy controls had normal sleep. Nine patients with MS and fatigue scored 10 or higher on the ESS, suggesting excessive daytime sleepiness. Only 2 patients with MS without fatigue scored higher than 10 on the ESS. None of the healthy controls were fatigued, and 14 were not excessively sleepy. A relationship was found between fatigue and abnormal sleep cycles or disrupted sleep (Fisher exact test, P = .003). There was also a relationship between subjective excessive daytime sleepiness and fatigue in MS patients (P = .02).
CONCLUSION: There is a significant correlation between fatigue in MS patients and disrupted sleep or abnormal sleep cycles.

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The relationship of trauma exposure to heart rate variability during wake and sleep in midlife women.


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Traumatic experiences are common and linked to cardiovascular disease (CVD) risk, yet the mechanisms underlying these relationships is less well understood. Few studies have examined trauma exposure and its relation to autonomic influence over cardiac function, a potential pathway linking trauma exposure to CVD risk. Investigating autonomic influence over cardiac function during both wake and sleep is critical, given particular links of sleep autonomic function to cardiovascular health. Among midlife women, we tested whether trauma exposure would be related to lower high frequency heart rate variability (HF-HRV), an index of vagal influence over cardiac function, during wake and sleep. Three hundred and one nonsmoking midlife women completed physical measures, a 24-hr electrocardiogram, actigraphy sleep measurement, and questionnaires about trauma (Brief Trauma Questionnaire), childhood abuse (Child Trauma Questionnaire [CTQ]), mood, demographics, and medical/psychiatric history. Relations between trauma and HF-HRV were assessed in linear mixed effects models adjusting for covariates (age, race, education, body mass index, blood pressure, psychiatric history, medication use, sleep, mood, childhood abuse history). Results indicated that most women had experienced trauma. Any trauma exposure as well as a greater number of traumatic experiences were associated with lower HF-HRV during wake and particularly during sleep. Relations were not accounted for by covariates. Among midlife women, trauma exposure was related to lower HF-HRV during wake and sleep.
Trauma may have an important impact on vagal influence over the heart, particularly during sleep. Decreased vagal influence over cardiac function may be a key mechanism by which trauma is associated with CVD risk.

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Relationships of Circadian Rhythms and Physical Activity With Objective Sleep Parameters in Lung Cancer Patients.

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BACKGROUND: Lung cancer patients undergo various treatments leading to sleep problems, rest–activity circadian rhythms disruption, and reduced levels of physical activity. It is important to understand the relationships among these variables. Appropriate interventions can possibly be implemented to improve sleep quality in lung cancer patients.

OBJECTIVE: The objective of this study was to examine the
relationships of circadian rhythms and physical activity with objective sleep parameters in 106 of Taiwanese lung cancer patients.

METHODS: This study used a cross-sectional design. The instruments included an actigraph to measure the objective sleep parameters (total sleep time [TST], sleep efficiency, and sleep-onset latency [SOL]), rest-activity circadian rhythms (r24 [24-hour autocorrelation coefficient] and I < O [in-bed less than out-of-bed dichotomy index]), and physical activity frequency (UP activity mean). The daily physical activity amount in minutes was measured by the Bouchard 3-day physical activity record.

RESULTS: Patients performing light-intensity physical activity of 295 min/d or greater had better values for the TST, sleep efficiency, SOL, r24, and I < O than those performing less than 295 min/d (all P < .05). Significant predictors of the TST included age (β = -.31), I < O (β = .32), and UP activity mean (β = -.42). Predictors of the SOL included current treatment (β = .20), I < O (β = -.28), UP activity mean (β = .51), and 24-hour light-activity minutes (β = -.23).

CONCLUSIONS: Marked circadian rhythms and adequate light-intensity physical activity may improve sleep quality in lung cancer patients.

IMPLICATIONS FOR PRACTICE: Adequate light-intensity physical activity can be an effective intervention to improve sleep quality in lung cancer patients.

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The relative contributions of psychiatric symptoms and psychotropic medications on the sleep-wake profile of young persons with anxiety, depression and bipolar disorders.
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This study investigated the relative contribution of psychiatric symptoms and psychotropic medications on the sleep-wake cycle. Actigraphy and clinical assessments (Brief Psychiatric Rating Scale) were conducted in 146 youths with anxiety, depression or bipolar disorders. Independently of medications, mania symptoms were predictive of lower circadian amplitude and rhythmicity. Independently of diagnosis and symptoms severity: i) antipsychotics were related to longer sleep period and duration, ii) serotonin-norepinephrine reuptake inhibitors to longer sleep period, and iii) agomelatine to earlier sleep onset. Manic symptoms and different subclasses of medications may have independent influences on the sleep-wake cycle of young people with mental disorders.

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Reported light in the sleep environment: enhancement of the sleep diary.

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Background: Light is the primary synchronizing cue for the circadian timing system, capable of exerting robust physiological effects, even with very dim and/or brief photic exposure. Mammals, including humans, are particularly susceptible to light at night. As such, measures of light in the sleeping environment are critical for evaluating sleep health. Sleep diaries provide inexpensive measures of sleep, but do not typically include light information.

Methods: Four questions probing visual perception of light in the bedtime and waking environments were added to the Consensus Sleep Diary for Morning administration. As part of a lighting intervention study, 18 hospital Labor and Delivery Department personnel completed the sleep diary for 1 week in each of two experimental conditions while wearing Actiwatch devices equipped with photosensors. Diary responses were evaluated against photosensor values from the beginning and end of each rest interval (n=194 rest intervals), as well as against sleep measures, utilizing linear mixed models.

Results: Responses to light questions were related to actual light measures at bedtime, controlling for shift type and experimental condition. In
addition, subjective light information at bedtime and waking was related to both objective and subjective sleep parameters, with data generally indicating poorer sleep with light in the sleeping environment. Conclusion: Questions addressing perception of light in the sleeping environment may provide a crude yet affordable metric of relative photic intensity. Further, as responses relate to sleep outcomes, subjective light information may yield valuable insights regarding mechanisms and outcomes of clinical significance in sleep and circadian research.

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Conflict of interest statement: Disclosure SAI consults for Merck, Eisai, Purdue, and Pfizer. GLG reports that through University of California, San Diego, she has received equipment, advice or financial support, and/or served as a consultant to Philips, Litebook, BIOS Lighting, Flux, PennWell Corporation, LightShow West, and Well Building Institute, and that she holds two currently issued patents (USPTO 7,678,140 and 8,366,755) and two continuing patent applications (USPTO 15/085,522 and 14/273,971). The authors report no other conflicts of interest in this work.


Research and commentary: Change in exercise tolerance, activity and sleep patterns, and quality of life in patients with cancer participating in a structured exercise program.

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PURPOSE/OBJECTIVES: To investigate the feasibility of an exercise program patterned after a phase II cardiac rehabilitation program to improve selected physiologic and psychological parameters of health in patients with cancer.

DESIGN: Prospective, repeated measures study.

SETTING: Two major military medical centers in the southwestern United States.

SAMPLE: 62 patients diagnosed with cancer within the previous two years. Ages ranged from 24-83 (meanX = 59). Half of the participants were male and half were female. Minorities made up 29% of the sample. Participants had a wide range of cancer diagnoses and all stages of cancer. Fifteen subjects were undergoing treatment when they enrolled in the study. More than half of the subjects exercised prior to their cancer diagnoses, but fewer than half were able to resume an exercise routine following their cancer diagnoses.

METHODS: Subjects met two days each week for 12 weeks for exercise and education.

MAIN RESEARCH VARIABLES: Exercise tolerance as measured with a graded exercise test, activity and sleep patterns as measured with a wrist actigraph, and quality of life (QOL) as measured with the Cancer Rehabilitation Evaluation System—Short Form.

FINDINGS: Significant improvements were observed over time in exercise tolerance, selected activity and sleep patterns, and QOL among the 46 (74%) subjects who completed the program.

CONCLUSIONS: Patients with various types and stages of cancer can safely exercise using a cardiac rehabilitation model and can realize significant improvements in exercise tolerance, selected activity and sleep patterns, and QOL.

IMPLICATIONS FOR NURSING: Most people are aware that regular exercise is part of a healthy lifestyle. After cancer diagnosis and treatment, patients experience uncertainty regarding how to resume exercise or how to begin an exercise program as part of their rehabilitation. Participation in a structured...
exercise program can provide patients with a safe environment within which to exercise at an intensity appropriate to their individual needs.

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Resetting the late timing of 'night owls' has a positive impact on mental health and performance.

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BACKGROUND: There is conflict between living according to our endogenous biological rhythms and our external environment, with disruptions resulting in negative consequences to health and performance. This is often documented in shift work and jet lag, but 'societal norms' (eg, typical working hours) can create profound issues for 'night owls', people whose internal biological timing predisposes them to follow an unusually late sleep-wake cycle. Night owls have also been associated with health issues, mood disturbances, poorer performance and increased mortality rates.
METHODS: This study used a randomized control trial design aimed to shift the late timing of night owls to an earlier time (phase advance), using non-pharmacological, practical interventions in a real-world setting. These interventions targeted light exposure (through earlier wake up/sleep times), fixed meals times, caffeine intake and exercise.

RESULTS: Overall, participants demonstrated a significant advance of ~2 h in sleep/wake timings as measured by actigraphy and circadian phase markers (dim light melatonin onset and peak time of the cortisol awakening response), whilst having no adverse effect on sleep duration. Notably, the phase advance was accompanied by significant improvements to self-reported depression and stress, as well as improved cognitive (reaction time) and physical (grip strength) performance measures during the typical 'suboptimal' morning hours.

CONCLUSIONS: Our findings propose a novel strategy for shifting clock timing towards a pattern that is more aligned to societal demands that could significantly improve elements of performance, mental health and sleep timing in the real world.

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Rest-activity and behavioral disruption in a patient with frontotemporal dementia.

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The neurological deterioration in dementia is associated with disturbances in circadian rhythms and rest-activity patterns. These disruptions have been documented in Alzheimer's disease (AD) and dementia with Lewy bodies but little is known about rest-activity patterns in patients with frontotemporal dementia (FTD). We report longitudinal (2 year) actigraphy results for a patient who met diagnostic criteria for FTD and his family caregiver. The subject and his family caregiver wore Actiwatches continuously for 2 weeks at 1-year intervals. The findings suggest that with disease progression there is worsening in multiple areas of rest-activity measures for the patient and a negative impact on sleep quality for the family caregiver.

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[Rest-activity and body-temperature rhythm disorders in elderly patients with dementia--senile dementia of Alzheimer's type and multi-infarct dementia].

[Article in Japanese]

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We simultaneously monitored rest-activity and body temperature (BT) rhythm in demented patients with sleep and behavior disorders using ambulatory wrist-worn actigraph and long-term monitoring system for 5-7 consecutive days. Subjects consisted of 19 patients with senile dementia of Alzheimer's type (SDAT) (M/F = 7/12, mean age = 71.7 years), 16 patients with multi-infarct dementia (MID) (M/F = 9/7, mean age = 75.2 years) and 9 normal controls (M/F = 4/5, mean
Both dementia groups showed a significant increase in percentage of nighttime activity. In the SDAT group, a significant positive correlation between the degree of dementia and total activity was observed, but not observed in the MID group. A significant high amplitude of BT rhythm was observed in the SDAT group comparing that in the MID or the control group. These findings indicate that the SDAT patients had a disrupted rest–activity rhythm with the severity of intellectual deterioration and increased night activity, while the circadian BT rhythm was remarkably well preserved, i.e. there was a dissociation between rest–activity and BT rhythms in the SDAT group. On the other hand, the disruption of the rest–activity and BT rhythm in the MID patients was characterized by a concomitant decrease of amplitude, which seems to have no relation with the severity of dementia. Different mechanisms could be involved in characteristic disruption of the circadian rhythms in the 2 dementia groups.

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Rest–activity and light exposure patterns in the home setting: a methodological case study.

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BACKGROUND: This methodological case study describes light exposure and rest–activity patterns in an older adult with dementia and his caregiver spouse.

METHODS: Two devices were used to measure rest–activity and light
exposure data:
a wrist-worn actigraph with a light sensor to record full spectrum
light exposure
data and an eye-level wavelength-sensitive light meter (Daysimeter).
The wife
wore both devices simultaneously; the husband wore only the actigraph.
RESULTS: There were minimal feasibility issues in using the devices in
the home
setting. The wife's light exposure was considerably better than her
husband's,
but she spent little time in bright lighting. Her circadian stimulus
(CS) and
rest-activity values suggest a high level of circadian disruption.
CONCLUSION: This case study provides beginning support for the use of the
Daysimeter in the home setting while also highlighting unrecognized
circadian
disturbances and very low light levels in an older couple's home.

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A rest-activity biomarker to predict response to SSRIs in major
depressive
disorder.

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Comment in
J Psychiatr Res. 2015 Sep;68:45-6.
Most adults with Major Depressive Disorder (MDD) will not experience a
remission
with the first antidepressant trial. No practical biomarkers presently
exist to
predict responsiveness to antidepressants. Herein we report pilot data for a
rest-activity biomarker of antidepressant response. Fifty-eight medication-free adults with MDD underwent a week-long collection of actigraphic data before beginning a 9 week open label trial of fluoxetine, coupled with blinded randomized assignment to eszopiclone/placebo. Depression severity was repeatedly measured with the Hamilton Rating Scale for Depression (HRSD). Baseline actigraphic data was analyzed with functional data analysis to create smoothed 24-h curves of activity. The time of the lowest point of activity (the bathyphase) was calculated for each patient, as well the mean difference between bedtime and the bathyphase (BBD). At the end of treatment, patients were characterized as treatment responders (50% reduction in HRSD) or non-responders, and receiver operating curves were calculated to find the optimal cut point of the BBD for prediction of treatment response. The best cut point for BBD was at 260.2 min, resulting in an effect size of 1.45, and with a positive predictive value of 0.75 and a negative predictive value of 0.88. We conclude that actigraphically-determined measures of rest-activity patterns show promise as potential biomarker predictors of antidepressant response. However, this conclusion is based upon a small number of patients who received only one choice of antidepressant, for a single trial. Replication with a larger sample is needed.

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Rest-activity circadian rhythm and sleep quality in patients with binge eating
Recent findings suggest that altered rest-activity circadian rhythms (RARs) are associated with a compromised health status. RARs abnormalities have been observed also in several pathological conditions, such as cardiovascular, neurological, and cancer diseases. Binge eating disorder (BED) is the most common eating disorder, with a prevalence of 3.5% in women and 2% in men. BED and its associate obesity and motor inactivity could induce RARs disruption and have negative consequences on health-related quality of life. However, the circadian RARs and sleep behavior in patients with BED has been so far assessed only by questionnaires. Therefore, the purpose of this study was to determine RARs and sleep parameters by actigraphy in patients with BED compared to a body mass index-matched control group (Ctrl). Sixteen participants (eight obese women with and eight obese women without BED diagnosis) were recruited to undergo 5-day monitoring period by actigraphy (MotionWatch 8®, CamNtech, Cambridge, UK) to evaluate RARs and sleep parameters. In order to determine the RARs, the actigraphic data were analyzed using the single cosinor method. The rhythmometric parameters of activity levels (MESOR, amplitude and acrophase) were
then processed with the population mean cosinor. The Actiwatch Sleep Analysis Software (Cambridge Neurotecnology, Cambridge, UK) evaluated the sleep patterns. In each participant, we considered seven sleep parameters (sleep onset: S-on; sleep offset: S-off; sleep duration: SD; sleep latency: SL; movement and fragmentation index: MFI; immobility time: IT; sleep efficiency: SE) calculated over a period of five nights. The population mean cosinor applied to BED and Ctrl revealed the presence of a significant circadian rhythm in both groups ($p < 0.001$). The MESOR (170.0 vs 301.6 a.c., in BED and Ctrl, respectively; $p < 0.01$) and amplitude (157.66 vs 238.19 a.c., in BED and Ctrl, respectively $p < 0.05$) differed significantly between the two groups. Acrophase was not different between BED and Ctrl, as well as all sleep parameters. Both groups displayed a low level of sleep quality (SE 80.7% and 75.7% in BED and Ctrl, respectively). These data provided the first actigraphy-based evidence of RARs disruption and sleep behavior disorder in patients with BED. However, while sleep disorders could be reasonably ascribed to overweight/obesity and the related lower daily physical activity, RARs disruption in this pathology should be ascribed to factors other than reduced physical activity. The circadian timing approach can represent a novel potential tool in the treatment of patients with eating disorders. These data provide exploratory evidence of behavioral association in a small population of patients that, if confirmed in a wider number of subjects and across different populations, may lead to a revision and enhancement of interventions in BED patients.

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972. Chronobiol Int. 2019 Aug;36(8):1156-1165. doi:
Rest-activity circadian rhythm in breast cancer survivors at 5 years after the primary diagnosis.


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Rest-activity circadian rhythm (RAR) is a marker of the circadian timing system. Particular attention has been given to RAR characteristics in cancer diseases. Specifically, alterations of RAR parameters have been found, at different stages of clinical pathway, in breast cancer (BC) patients. No studies to date have analyzed RAR alterations in breast cancer survivors several years after the diagnosis. The aim of this study was to determine RAR by actigraphy in a population of BC survivors at 5 years after the primary diagnosis, and to compare their RAR characteristics with healthy controls. The study sample was 28 women: 15 BC survivors at 5 years from the primary diagnosis (BC-group) and 13 healthy controls (Ctrl-group), matched for age and body mass index. All participants have been monitored for 7 days by actigraphy to evaluate RAR. A statistically significant circadian rhythm (T = 24) was found in all 28 subjects (p < .001). The group analysis revealed a significant RAR both in BC- and Ctrl-group (p < .001). The acrophase was not different between the BC- and Ctrl-group (15:09 vs. 15:01 hr:min in BC- and Ctrl-group, respectively). In contrast, the MESOR
(Midline Estimating Statistic of Rhythm) and the amplitude were lower in the BC-group with respect to the Ctrl-group. Indeed, the MESOR was 192.0 vs. 276.4 activity counts in BC- and Ctrl-group, respectively (p < .001), while the amplitude was 167.0 vs. 222.6 activity counts in BC- and Ctrl-group, respectively (p < .001). These results provide the first experimental evidence of alterations in RAR parameters in BC survivors at 5 years after the primary diagnosis. Larger studies with a prospective design are needed to assess the role of RAR in the quality of life and prognosis in BC survivors.

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Rest-activity circadian rhythms and bone mineral density in elderly men.

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Background: Disrupted rest-activity circadian rhythm (RAR) patterns have been associated with poor health outcomes (i.e. diminished cognitive function, increased risk of dementia and falls). Circadian time cues in bone influence the differentiation of osteoblasts and osteoclasts, and bone turnover markers exhibit circadian variation; relationships between bone outcomes and RAR are emerging areas of research. We evaluated associations between RAR and areal bone mineral density (aBMD) at the total hip and femoral neck in older men from the Osteoporotic Fractures in Men (MrOS) cohort. We hypothesized that weaker RAR patterns would be associated with lower aBMD.

Methods: MrOS is an ongoing prospective cohort study following ambulatory men ≥ 65 years (n = 5994) at 6 U.S. clinics (baseline enrollment 3/2000-4/2002); participants for this analysis are from an ancillary study, Outcomes of Sleep Disorders in Older Men (MrOS Sleep). We included data from men who had technically adequate measures of RAR and aBMD at Sleep Visit 1 (12/2003-3/2005), with repeat aBMD at core Visit 3 (3/2007-3/2009) (n = 2412; mean age at Sleep Visit 1: 75.7 ± 5.2 years). aBMD was measured by dual energy x-ray absorptiometry (DXA). Actigraphs worn on the non-dominant wrist were used to collect circadian activity data over 4.8 ± 0.8 consecutive 24-hour periods. An extension of the traditional cosine curve was used to fit RAR to the activity data [Ancoli-Israel et al., 2003; Marler et al., 2006]. Six RAR parameters were evaluated: acrophase (time of peak activity), amplitude (rhythm strength), mesor (mean of activity fitted curve), pseudo F-statistic (overall circadian rhythmicity of rest and activity), alpha statistic (daytime to nighttime activity ratio), and beta statistic (daytime activity). Associations between RAR and aBMD (Sleep Visit 1),
and RAR and ΔaBMD (Sleep Visit 1–Visit 3) were assessed with generalized linear models. Covariates included age, clinic site, physical activity, race, comorbidity, body mass index (BMI), smoking, alcohol, caffeine, beta blocker use, serum 25(OH) vitamin D and urinary melatonin and calcium.

Results: Pseudo F-statistic was significantly associated with total hip aBMD (p-trend = 0.009), femoral neck aBMD (p-trend = 0.007) and total hip ΔaBMD (p-trend = 0.017) in minimally adjusted models but not after multivariate (MV) adjustment. Alpha statistic was significantly associated with femoral neck aBMD (p-trend = 0.029) and femoral neck ΔaBMD (p-trend = 0.019) in minimally adjusted models; significance was retained in the femoral neck ΔaBMD model (p-trend = 0.034) after MV adjustment. There were no consistent, significant associations between the other RAR variables and aBMD or ΔaBMD.

Conclusions: The data demonstrate modest associations between overall circadian rhythmicity of rest and activity (measured by pseudo F-statistic), as well as daytime to nighttime activity ratio (measured by alpha statistic), aBMD and ΔaBMD, but adjustment for covariates related to lifestyle, BMI and comorbidities attenuated most of these associations. These results suggest that RAR patterns are not independently associated with aBMD or four-year ΔaBMD at the total hip or femoral neck in older men, but additional research is needed.

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PMID: 29181439

Rest-Activity Cycle Disturbances in the Acute Phase of Moderate to Severe Traumatic Brain Injury.

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BACKGROUND: Sleep-wake disturbances are among the most persistent sequelae after traumatic brain injury (TBI) and probably arise during the hospital stay following TBI. These disturbances are characterized by difficulties sleeping at night and staying awake during the day.

OBJECTIVE: The aim of the present study was to document rest-activity cycle consolidation in acute moderate/severe TBI using actigraphy and to assess its association with injury severity and outcome.

METHODS: In all, 16 hospitalized patients (27.1 ± 11.3 years) with moderate/severe TBI wore actigraphs for 10 days, starting in the intensive care unit (ICU) when continuous sedation was discontinued and patients had reached medical stability. Activity counts were summed for daytime (7:00–21:59 hours) and nighttime periods (22:00–6:59 hours). The ratio of daytime period activity to total 24-hour activity was used to quantify rest-activity cycle consolidation. An analysis of variance was carried out to characterize the evolution of the daytime activity ratio over the recording period.

RESULTS: Rest-activity cycle was consolidated only 46.6% of all days; however, a significant linear trend of improvement was observed over time. Greater TBI severity and longer ICU and hospital lengths of stay were associated with poorer rest-activity cycle consolidation and evolution. Patients with more rapid return to consolidated rest-activity cycle were more likely to have cleared posttraumatic amnesia and have lower disability at hospital discharge.
CONCLUSIONS: Patients with acute moderate/severe TBI had an altered rest-activity cycle, probably reflecting severe fragmentation of sleep and wake episodes, which globally improved over time. A faster return to rest-activity cycle consolidation may predict enhanced brain recovery.

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Rest-activity cycles in childhood and adolescent depression.

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OBJECTIVE: To quantify circadian rhythms in rest-activity cycles in depressed children and adolescents.
METHOD: Rest-activity cycles were evaluated by actigraphy over five consecutive 24-hour periods in 100 children and adolescents, including 59 outpatients with major depressive disorder (MDD) and 41 healthy normal controls. Total activity, total light exposure, and time spent in light at more than 1,000 lux were averaged over the recording period for each participant. Time series analysis was used to determine the amplitude and period length of circadian rhythms in rest-activity.
RESULTS: Overall, adolescents with MDD had lower activity levels, damped circadian amplitude, and lower light exposure and spent less time in bright light than healthy controls. Among children, those with MDD showed lower light exposure and spent less time in bright light, but only depressed girls showed damped circadian amplitude. The sex differences were substantially greater in
the MDD group than in the normal control group.
CONCLUSIONS: These results confirm damped circadian rhythms in children and adolescents with MDD and highlight the influence of gender and age on these measures.

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Rest-Activity Patterns in Older Adults with Heart Failure and Healthy Older Adults.

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The purpose of this investigation is to examine differences in rest-activity patterns and sleep characteristics in older adults with heart failure (HF) and healthy older adults. The sample included older adults with HF (n = 20) and a reference group of healthy older adults (n = 20). Traditional cosinor analysis was used to assess three parameters of rest-activity from wrist actigraphy data: amplitude (range of activity), mesor (mean activity), and acrophase (time of peak activity). Traditional sleep characteristics were also determined from actigraphy data: total sleep time (TST), sleep latency (SL), sleep efficiency (SE), and wake after sleep onset (WASO). The HF group demonstrated significantly lower mesor and amplitude than the reference group (p < .01). The HF group had significantly greater TST (p < .01), but the groups had similar SE, SL, and WASO. Despite similar sleep characteristics to healthy older adults, overall rest-activity patterns were significantly dampened in those with HF.

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PMCID: PMC6467285
Rest-activity rhythm disruption in progressive supranuclear palsy.

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OBJECTIVE/BACKGROUND: The brainstem is among the first regions affected in progressive supranuclear palsy (PSP) and is part of the sleep/circadian regulation network. In two small studies, blood pressure and core body temperature circadian patterns were disrupted in PSP; however, it is unclear if circadian activity rhythms are also affected. Our objective was to
perform circadian analyses of the rest-activity rhythms in PSP and determine the association with increasing disease severity.

PATIENTS/METHODS: Individuals with a clinical PSP diagnosis (n = 17; nine men) and healthy older adults (n = 17; nine men) were selected for this study. Participants wore actigraphy wristbands and completed sleep diaries for up to 14 consecutive days. Data were analyzed to assess circadian activity strength (amplitude, mesor, f-ratio), phase (acrophase), and circadian stability (intradaily variability, interdaily stability, relative amplitude). Analyses controlled for sleep fragmentation, cognition, and self-reported depression. The association between disease severity using the PSP rating scale and circadian activity rhythm disruption was assessed.

RESULTS: Individuals with PSP had significantly lower circadian activity mesor ($p \leq 0.001$), amplitude ($p \leq 0.001$), robustness (f-ratio, $p < 0.01$), relative amplitude ($p \leq 0.001$), and interdaily stability ($p \leq 0.01$), with increased intradaily variability ($p < 0.05$). CAR remained weaker in PSP after controlling for sleep fragmentation, and again when also controlling for cognitive impairment and depression. Weaker circadian activity (mesor, amplitude, f-ratio, and relative amplitude) was associated with increased disease severity.

CONCLUSIONS: Circadian activity rhythms are disrupted in individuals with PSP as compared to controls, and worsen with disease severity. This is the first study of its kind to describe circadian activity rhythms in PSP.

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Rest-activity rhythm in breast cancer survivors: an update based on non-parametric indices.


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Recently we evaluated by actigraphy the rest-activity circadian rhythm (RAR) in breast cancer (BC) survivors at 5 years from primary diagnosis, as well as in a control group with similar age and body mass index (BMI). RAR, analyzed by Cosinor method, resulted significantly different in BC survivors compared to healthy subjects: BC survivors showed lower values of MESOR and Amplitude (A), while acrophase (φ) was similar in the two groups. Now, using non-parametric methods we have detected Interdaily Stability (IS), Intradian Variability (IV), nocturnal activity (L5), and daily activity (M10) on the same sample of previous study: 15 BC survivors at 5 years from the primary diagnosis (mean age = 56.7 ± 6.6 yrs; mean BMI = 24.5 ± 3.8 Kg/m2) and 13 healthy controls (mean age = 54.4 ± 7.2 yrs; mean BMI = 25.2 ± 2.8 Kg/m2). The non-parametric indices showed that in BC-group IV was significantly higher than in Ctrl-group (0.86 vs. 0.65 a.u. in BC and Ctrl, respectively; p < .01), while L5 (11.27 vs. 34.41 a.c. in BC and Ctrl, respectively; p < .0001) and M10 (326.82 vs. 428.07 a.c. in BC and Ctrl, respectively; p < .01) were significantly lower compared to Ctrl-group. The data suggest that BC patients need constant clinical assessment of RAR characteristics along the years following the primary diagnosis. The analysis of RAR in all its components, parametric and non-parametric, is important
to detect alterations in the sleep-wake cycle and can be useful for developing new strategies for health protection, such as structured and tailored physical activity programs, to improve circadian activity level in order to raise the quality of life in BC survivors.

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Rest/activity rhythm is related to the coexistence of pain and sleep disturbance among advanced cancer patients with pain.

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PURPOSE: This study aimed to explore the relationships among pain, sleep disturbance, and circadian rhythms in advanced cancer patients. METHODS: This cross-sectional study was conducted in 68 cancer patients from the oncology inpatient unit of a teaching hospital. Their demographic and medical characteristics, questionnaire surveys, including Brief Pain Inventory-Chinese version and Pittsburgh Sleep Quality Index Taiwanese version, and sleep logs and actigraphic recordings in consecutive 3 days and nights were collected and analyzed. RESULTS: The mean (SD) scores for autocorrelation coefficient at 24 h (r24) and dichotomy index (I<0) were 0.19 (0.16) and 85.29 % (0.13 %), respectively, indicating dampened circadian rhythms in participants. The mean (SD) worst pain score was 5.47 (2.70). The sleep quality global score ranged 4 ~ 19 with a mean
The worst pain levels, the Pittsburgh Sleep Quality Index (PSQI) global score, and most sleep parameters measured by actigraphy were significantly correlated with r24 and I<0. The worst pain score was significantly correlated with the PSQI global score (r = 0.69, p < 0.01). The Goodman version of the Sobel test further demonstrated that 45.77% of the total effect was mediated by pain intensity (t = 2.76, p = 0.005). Pain was a complete mediator between circadian rhythms and sleep quality.

CONCLUSIONS: The rest/activity rhythm influences the coexisting pain and sleep disturbances. Pain functions as a complete mediator in their relationship. Interventions that improve rest/activity rhythms may improve the management of pain and sleep disturbances in cancer patients.

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Rest/activity rhythms and cardiovascular disease in older men.


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Prior studies have suggested an increased risk of cardiovascular disease (CVD)-related mortality in older adults with disturbed circadian rest/activity rhythms (RARs). The objective goal of this study was to examine the association between disrupted RARs and risk of CVD events in older men. A total of 2968 men aged 67 yrs and older wore wrist actigraphs for 115 ± 18 consecutive hours. RAR parameters were computed from wrist actigraphy data and expressed as
quartiles (Q). CVD events consisted of a composite outcome of coronary heart disease (CHD), stroke, and peripheral vascular disease (PVD) events. Secondary analyses examined associations between RARs and individual components of the composite outcome (CHD, stroke, and PVD). There were 490 CVD events over an average of 4.0 ± 1.2 yrs. Overall, reduced amplitude (HR = 1.31, 95% confidence interval [CI] 1.01–1.71 for Q2 vs. Q4) and greater minimum (HR = 1.33, 95% CI 1.01–1.73 for Q4 vs. Q1) were associated with an increased risk of CVD events in multivariable-adjusted models. In secondary analyses, there was an independent association between reduced amplitude (HR = 1.36, 95% CI 1.00–1.86) and greater minimum activity counts (HR = 1.39, 95% CI 1.02–1.91) with increased risk of CHD events. Reduced F value (HR = 2.88, 95% CI 1.41–5.87 for Q1 vs. Q4 and HR = 2.71, 95% CI 1.34–5.48 for Q2 vs. Q4) and later occurring acrophase of the RAR (HR = 1.65, 95% CI 1.04–2.63 for Q4 vs. Q2–3) were associated with an increased risk of PVD events. Results were similar in men without a history of CVD events. The findings revealed that among older men, measures of decreased circadian activity rhythm robustness (reduced amplitude and greater minimum activity) were associated with an increased risk of CVD events, primarily through increased risk of CHD or stroke events, whereas measures of reduced circadian activity rhythmicity were not associated with risk of CVD events overall, but were associated with an increased risk of PVD events. These results should be confirmed in other populations.

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Rest-Activity Rhythms and Cognitive Decline in Older Men: The Osteoporotic Fractures in Men Sleep Study.

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OBJECTIVE: To examine rest-activity circadian rhythm (RAR) and cognitive decline in older men.

DESIGN: Longitudinal.

SETTING: Osteoporotic Fractures in Men (MrOS) and ancillary Outcomes of Sleep Disorders in Men (MrOS Sleep) studies.

PARTICIPANTS: MrOS and MrOS Sleep participants (N=2,754; mean age 76.0 ± 5.3).

MEASUREMENTS: The Modified Mini-Mental State examination (3MS) was used to assess cognition at baseline (2003-05) and follow-up examinations (2005-06 and 2007-09).

Wrist actigraphy was used to measure 24-hour activity counts at baseline. RAR variables included amplitude (strength of activity rhythm), mesor (mean activity level), pseudo F-statistic (overall circadian rhythm robustness), and acrophase (time of daily peak activity).

RESULTS: After an average of 3.4 ± 0.5 years, men with lower amplitudes, mesors, and pseudo F-statistics had greater decline in 3MS performance (amplitude: -0.7 points Q1 vs -0.5 points Q4, p<.001; mesor: -0.5 points Q1 vs -0.2 points Q4, p=.01; pseudo F-statistic: -0.5 points Q1 vs -0.3 points Q4, p<.001). Lower amplitudes and pseudo-F statistics were associated with greater odds of clinically significant cognitive decline (≥5-point decrease) (amplitude Q1 vs. Q4: odds ratio (OR)=1.4, 95% confidence interval (CI)=1.0-1.9; pseudo-F statistic Q1 vs Q4: OR=1.4, 95% CI=1.0-1.9). Men with phase-advanced acrophase had greater odds of clinically significant cognitive decline (OR=1.8, 95% CI=1.2-2.8).

Results were adjusted for multiple confounders.

CONCLUSION: Several parameters of disrupted RAR (lower amplitude, pseudo F-statistic, mesor, phase-advanced acrophase) were associated with greater cognitive decline in older community-dwelling men. These findings contribute to a growing body of evidence suggesting that altered RARs are associated with cognitive decline in older adults. J Am Geriatr Soc 66:2136-2143, 2018.
An association between increased risk of mortality and disruptions in rest/activity circadian rhythms (RAR) has been shown among adults with dementia and with metastatic colorectal cancer. However, the association among a more general population of older adults has not been studied. Our study population consisted of 2964 men aged ≥ 67 yrs of age enrolled in the Outcomes of Sleep Disorders in Older Men (MrOS Sleep) Study. Rest/activity patterns were measured with wrist actigraphy. RAR parameters were computed and expressed as quintiles, and included acrophase (time of peak activity level), amplitude (peak-to-nadir difference), mesor (middle of the peak), pseudo F-value (overall circadian rhythmicity), beta (steepness), and alpha (peak-to-trough width). After adjustment for multiple potential confounders, men in the lowest quintile of pseudo F-value had a 57% higher mortality rate (hazard ratio [HR] = 1.57, 95% CI, 1.03-2.39) than men in the highest quintile. This association was even stronger
with increased risk of cardiovascular disease-related mortality (CVD) (HR = 2.32, 95% CI, 1.04-5.22). Additionally, men in the lowest quintile of acrophase had a 2.8-fold higher rate of CVD-related mortality (HR = 2.84, 95% CI, 1.29-6.24).

There was no evidence of independent associations with amplitude, mesor, alpha, beta, and mortality risk. Older men with less robust RAR and earlier acrophase timing have modestly higher all-cause and CVD-related mortality rates. Further research should examine potential biological mechanisms underlying this association.

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Rest-activity rhythms in small scale homelike care and traditional care for residents with dementia.

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BACKGROUND: An enriched environment for residents with dementia may have a positive effect on the rest-activity rhythm. A small scaled homelike special care unit might be such an enriched environment. The present study shows whether the rest-activity rhythm of residents with moderate to severe dementia responds positively to a transfer from a regular Special Care Unit (SCU) to a
METHODS: Initially, a group of 145 residents living in a regular SCU participated. Out of this group, 77 residents moved to a small scaled homelike SCU. This group was compared to the group of 68 residents that remained at the regular SCU. Rest-activity rhythm was assessed by means of actigraphy and observation scales before and after relocation.

RESULTS: No significant main effects nor significant interaction effects in intradaily and interdaily activity were found for the data of 38 residents in the small scaled homelike SCU and 20 residents of the regular SCU. The effect sizes, however, ranged from small to large.

CONCLUSIONS: Considering the effect sizes, a new study with a larger number of participants is necessary before firm conclusions can be drawn.

TRIAL REGISTRATION: Current Controlled Trials ISRCTN11151241.

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Restless leg syndrome is a treatable cause of sleep disturbance and fatigue in primary biliary cirrhosis.

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BACKGROUND: Primary biliary cirrhosis (PBC) patients frequently describe sleep problems. The cause remains unclear and treatment is challenging. Restless leg syndrome (RLS) is a common sleep disorder. In this study, we systematically screened PBC patients for the presence of RLS.

METHODS: Participants were recruited from our specialist PBC clinical service.
Subjects completed the International Restless Leg Syndrome Study Group rating scale (IRLSS) a validated measure of the presence of RLS and its severity. Those fulfilling diagnostic criteria for RLS underwent foot actigraphy (CamNtech Actiwatch) to objectively assess periodic limb movement index (PLMI) (normal <5/h).

RESULTS: Restless leg syndrome was assessed in 42 consecutive early stage PBC patients. Twelve (29%) fulfilled the IRLSS criteria for RLS. Scores were significantly higher in PBC compared to controls (P = 0.005). Twenty-four patients were further assessed with foot actigraphy for 3 nights (12 with subjective RLS symptoms and 12 with no RLS symptoms). Thirteen of twenty-four subjects had PLMI >5/h and four had moderate or severe PLMI >15/h. All moderate or severe PLMI subjects had subjective symptoms of moderate or severe RLS. No patients had PLMI >10 in the absence of RLS symptoms. Eleven PBC patients with symptomatic RLS went on to have treatment. Sixty-three per cent had clear benefit in restless leg symptoms and associated symptoms of fatigue.

CONCLUSION: Restless leg syndrome symptoms are common and underdiagnosed in PBC patients. RLS represents a potential therapy for PBC patients with daytime sleepiness, fatigue and unpleasant lower limb symptoms and this is worthy of further studies in larger cohorts.

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Restless legs syndrome and central nervous system gamma-aminobutyric acid: preliminary associations with periodic limb movements in sleep and restless leg
syndrome symptom severity.

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BACKGROUND: Previous research has demonstrated abnormalities in glutamate and N-acetyl aspartate (NAA) in the thalamus in individuals with restless legs syndrome (RLS) compared with healthy matched controls. However, levels of these transmitters in other RLS-related brain areas and levels of the most common inhibitory neurotransmitter, gamma-aminobutyric acid (GABA), have not been assessed.

METHODS: This study examined GABA, glutamate, and NAA levels in the dorsal anterior cingulate cortex (ACC), thalamus and cerebellum with the use of proton magnetic resonance spectroscopy ((1)H–MRS) at 4 tesla (4 T) and Megapress difference-editing in 18 subjects with RLS and a matched control group without RLS. Actigraphy was performed on the nights before scans to assess periodic limb movements of sleep (PLMS).

RESULTS: Levels of GABA, glutamate, and NAA were no different between RLS and control subjects in any of the three voxels of interest. However, GABA levels were positively correlated with both PLM indices and RLS severity in the thalamus and negatively with both of these measures in the cerebellum in RLS
subjects. In addition, NAA levels were higher in the ACC in RLS than in controls. CONCLUSION: Our preliminary data suggest that known cerebellar-thalamic interactions may modulate the intensity of RLS sensory and motor symptoms. In addition, anterior cingulate cortex may be associated with the affective components of the painful symptoms in this disorder.

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Restless Legs Syndrome and Depression: Effect Mediation by Disturbed Sleep and Periodic Limb Movements.

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OBJECTIVE: To investigate an association between restless legs syndrome (RLS) and
depression and to what extent sleep disturbance, periodic limb movements during sleep (PLMS), and antidepressant medication mediate this relationship. METHODS: A cross-sectional analysis was conducted of the Osteoporotic Fractures in Older Men Study data in 982 men assessed for RLS (International RLS Study Group scale [IRLSS]) and depression (Geriatric Depression Scale [GDS]), who underwent actigraphy (for sleep latency/efficiency) and polysomnography (for PLMS). Men were split into three groups: no RLS (N = 815), mild RLS (IRLSS ≤ 12, N = 85), moderate-to-severe RLS (IRLSS > 12, N = 82). Depression was defined as GDS score ≥ 6. Logistic and linear regression assessed associations of RLS and depression or number depressive symptoms, respectively. Models were adjusted for age, site, race, education, body mass index, personal habits, benzodiazepine/dopaminergic medication, physical activity, cardiovascular risk factors, and apnea-hypopnea index. RESULTS: Of 982 men, 167 (17.0%) had RLS. Depression was significantly associated with moderate-to-severe RLS after adjustment (versus no RLS: OR [95% CI] 2.85 [1.23, 6.64]). Further adjustment for potential mediators attenuated effect size modestly, most for sleep efficiency (OR: 2.85–2.55). Compared with no RLS, moderate-to-severe RLS was associated with the number of depressive symptoms after adjustment (adjusted means [95% CI]; no RLS: 1.14 [1.05, 1.24] versus IRLSS > 12: 1.69 [1.32, 2.11]). Further adjustment for potential mediators did not alter effect size. For men with PLMS index at least median, number of depressive symptoms significantly increased as RLS category became more severe. CONCLUSION: Depression is more common as RLS severity worsens. The RLS-depression relationship is modestly explained by sleep disturbance and PLMS. Published by Elsevier Inc.

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Restoration of resident sleep and wellness with block scheduling.

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CONTEXT: Block scheduling during residency is an innovative model in which in-patient and ambulatory rotations are separated. We hypothesised that this format may have a positive impact on resident sleep and wellness in comparison with a traditional format.

METHODS: We performed a single-centre, cross-sectional, observational study of residents rotating in the medical intensive care unit (MICU). Residents were observed for 4 weeks at a time: internal medicine (IM) residents were observed
for 3 weeks in the MICU followed by 1 week in an ambulatory context, and non-IM residents were observed for 4 weeks in the MICU. We monitored daily total sleep time (TST) utilising actigraphy, and wellness measures with weekly Epworth Sleepiness Scale (ESS) and Perceived Stress Scale (PSS) questionnaires.

RESULTS: A total of 64 of 110 (58%) eligible residents participated; data for 49 of 110 (45%) were included in the final analysis. Mean ± standard deviation (SD) daily TST in the entire cohort was 6.53 ± 0.78 hours. Residents slept significantly longer during the ambulatory block than during the MICU block (mean ± SD TST 6.97 ± 1.00 hours and 6.43 ± 0.78 hours, respectively; p < 0.0005). Sleep duration during night call was significantly shorter than during day shift (mean ± SD TST 6.07 ± 1.16 hours and 6.50 ± 0.73 hours, respectively; p < 0.0005). A total of 390 of 490 (80%) ESS and PSS questionnaires were completed; scores significantly declined during rotations in the MICU.

Internal medicine residents showed significant improvements in TST, and in ESS and PSS scores (p < 0.05) at the end of the ambulatory week. Non-IM residents, who remained in the MICU for a fourth week, continued a trend that showed a decline in perceived wellness.

CONCLUSIONS: Despite duty hour restrictions, residents obtain inadequate sleep. As MICU days accumulate, measures of resident wellness decline. Residents in a block schedule experienced improvements in all measured parameters during the ambulatory week, whereas residents in a traditional schedule continued a downward trend. Block scheduling may have the previously unrecognised benefits of repaying sleep debt, correcting circadian misalignment and improving wellness.

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Rhythmic changes in Fabry disease: Inversion and non-oscillatory pattern in 6-sulfatoxymelatonin daily profile.

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Fabry disease is a progressive disease characterized by an enzymatic deficiency of acid alpha-galactosidase and glycosphingolipids storage within the lysosomes. The disease has two phenotypes: classic and nonclassic. Excessive daytime sleepiness is a common sign reported by patients and can be caused by a circadian rhythm sleep disorder. Activity and rest cycle, variation of body temperature and melatonin biosynthesis are known rhythmicity markers. In the face of these evidences, our goal was to evaluate the rhythmic profile in Fabry's disease patients using rhythmicity markers. For this purpose, we recruited 17 patients diagnosed with Fabry disease (11 classic and 6 nonclassic variant) that answered the Epworth Sleepiness Scale and the Morningness-Eveningness questionnaire adapted from Horne and Ostberg; recorded activity and body temperature rhythms by an actigraphy during at least 10 days and collected urine to assess 6-sulfatoxymelatonin excretion load during the day (from the second urine in the morning until 7 p.m.) and night (starting from 7 p.m. until the first urine in
the morning of the following day). We observed that control subjects presented higher excretion load of 6-sulfatoxymelatonin during the night (p < 0.05, d = 7.8), as expected. Patients with the nonclassic variant presented an inversion on 6-sulfatoxymelatonin daily profile (p < 0.05, d = 3.8) and there was no difference between the day and night profile of classic variant patients when compared to the other two groups. Patients with the classic variant also presented temperature period greater than 24 hours (p < 0.05, d = 2.0).

Therefore, we came to the conclusion that there is an alteration in the circadian rhythms in Fabry disease patients, evidenced by modifications in the 6-sulfatoxymelatonin daily profile and in the body temperature rhythm period.

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Right- and left-brain hemisphere. Rhythm in reaction time to light signals is task-load-dependent: age, gender, and handgrip strength rhythm comparisons.

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In healthy mature subjects simple reaction time (SRT) to a single light signal (an easy task) is associated with a prominent rhythm with tau = 24 h of dominant (DH) as well as nondominant (NDH) hand performance, while three-choice reaction time (CRT), a complex task, is associated with tau = 24 h of the DH but tau < 24 h of the NDH. The aims of the study were to assess the influence of age and gender on the difference in tau of the NDH and DH, as it relates to the
corresponding cortical hemisphere of the brain, in comparison to the rhythm in handgrip strength. Healthy subjects, 9 (5 M and 4 F) adolescents 10-16 yr of age and 15 (8 M and 7 F) adults 18-67 yr of age, active between 08:00 +/- 1 h and 23:00 +/- 1:30 h and free of alcohol, tobacco, and drug consumption volunteered. Data were gathered longitudinally at home and work 4-7 times daily for 11-20 d. At each test time the following variables were assessed: grip strength of both hands (Dynamometer: Colin–Gentile, Paris, France); single reaction time to a yellow signal (SRT); and CRT to randomized yellow, red, or green signal series with varying instruction from test to test (Psycholog–24: Biophyderm, France). Rhythms in the performance in SRT, CRT, and handgrip strength of both DH and NDH were explored. The sleep–wake rhythm was assessed by sleep-logs, and in a subset of 14 subjects it was also assessed by wrist actigraphy (Mini-MotionLogger: AMI, Ardsley NY). Exploration of the prominent period tau of time series was achieved by a special power spectra analysis for unequally spaced data. Cosinor analysis was used to quantify the rhythm amplitude A and rhythm–adjusted mean M of the power spectral analysis determined trial tau. A 24h sleep–wake rhythm was detected in almost all cases. In adults, a prominent tau of 24 h characterized the performance of the easy task by both the DH and NDH. In adults a prominent tau of 24 h was also detected in the complex CRT task performed by the DH, but for the NDH the tau was < 24 h. This phenomenon was not gender–related but was age–related since it was seldom observed in adolescent subjects. Hand–side differences in the grip strength rhythms in the same individuals were detected, the tau being ultradian rather than circadian in adolescent subjects while in mature subjects the tau frequently differed from that of the rhythm in CRT. These findings further support the hypothesis that functional biological clocks exist.
in both the left and right hemispheres of the human cortex.

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Ring the bell for Matins: circadian adaptation to split sleep by cloistered monks and nuns.

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Cloistered monks and nuns adhere to a 10-century-old strict schedule with a common zeitgeber of a night split by a 2- to 3-h-long Office (Matins). The authors evaluated how the circadian core body temperature rhythm and sleep adapt in cloistered monks and nuns in two monasteries. Five monks and five nuns following the split-sleep night schedule for 5 to 46 yrs without interruption and 10 controls underwent interviews, sleep scales, and physical examination and produced a week-long sleep diary and actigraphy, plus 48-h recordings of core body temperature. The circadian rhythm of temperature was described by partial Fourier time-series analysis (with 12- and 24-h harmonics). The temperature peak and trough values and clock times did not differ between groups. However, the temperature rhythm was biphasic in monks and nuns, with an early decrease at 19:39 ± 4:30 h (median ± 95% interval), plateau or rise of temperature at 22:35 ± 00:23 h (while asleep) lasting 296 ± 39 min, followed by a second decrease after the Matins Office, and a classical morning rise. Although they required alarm clocks to wake-up for Matins at midnight, the body temperature rise anticipated
the nocturnal awakening by 85 ± 15 min. Compared to the controls, the monks and nuns had an earlier sleep onset (20:05 ± 00:59 h vs. 00:00 ± 00:54 h, median ± 95% confidence interval, \( p = .0001 \)) and offset (06:27 ± 0:22 h, vs. 07:37 ± 0:33 h, \( p = .0001 \)), as well as a shorter sleep time (6.5 ± 0.6 vs. 7.6 ± 0.7 h, \( p = .05 \)). They reported difficulties with sleep latency, sleep duration, and daytime function, and more frequent hypnagogic hallucinations. In contrast to their daytime silence, they experienced conversations (and occasionally prayers) in dreams. The biphasic temperature profile in monks and nuns suggests the human clock adapts to and even anticipates nocturnal awakenings. It resembles the biphasic sleep and rhythm of healthy volunteers transferred to a short (10-h) photoperiod and provides a living glance into the sleep pattern of medieval time.

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The role of actigraphy in the assessment of primary insomnia: a retrospective study.

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OBJECTIVE: The aim of our study was to evaluate quantitative
actigraphic criteria obtained using the Actiwatch device (AW64; Cambridge Neurotechnology Ltd., Cambridge, UK) to differentiate participants with insomnia from normal sleepers.

METHODS: In our retrospective study, we recovered 493 actigraphic records from two sleep measure databases of patients with insomnia (n=151) and one of normal sleepers (n=342). We considered the following actigraphic sleep parameters: time in bed (TIB), sleep-onset latency (SOL), total sleep time (TST), wake after sleep onset (WASO), sleep efficiency (SE), number of awakenings (NWAK), terminal wakefulness (TWAK), fragmentation index (FI), and mean motor activity (MA). We also considered two actigraphic circadian indexes: interdaily stability and intradaily variability. Using the Youden index, we calculated the quantitative actigraphic criteria that performed best for each actigraphic sleep parameter. Finally, we created receiver operating characteristic curves to test the accuracy of each criterion identified.

RESULTS: All sleep parameters except TST and TWAK differentiated the two groups of participants, allowing calculation of quantitative actigraphic criteria. There were no differences in the circadian indices.

CONCLUSIONS: The quantitative actigraphic criteria obtained in our study were not the same as those obtained previously with a different device, suggesting the need to adopt shared technical solutions for actigraphy.

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The role of pre-sleep cognitions in adolescent sleep-onset problems.

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STUDY OBJECTIVES: To examine the relationship between pre-sleep cognitions and sleep-onset difficulties in an adolescent sample.

METHODS: Participants comprised 385 students (59% male) from grades 9 to 11, aged between 13 and 18 years (M = 15.6, SD = 1.0), from eight co-educational high schools of varied socio-economic status in metropolitan Adelaide, South Australia. The cross-sectional study used a questionnaire battery including the Sleep Anticipatory Anxiety Questionnaire –Adolescent Version (SAAQ–A), completed during school time, followed by eight days of sleep diary completion and wearing wrist actigraphy to obtain subjective and objective sleep onset latency (SOL).

RESULTS: Significant relationships were found between somatic arousal (SAAQ–A subscale) and objective SOL and also between sleep-related cognitions (SAAQ–A subscale) and subjective SOL and SOL overestimation (sleep misperception). No relationships were found between subjective SOL and somatic or rehearsal and planning cognitions. Objective SOL was not related to rehearsal and planning and to sleep-related cognition scores, and sleep misperception had no relationship with somatic as well as rehearsal and planning cognition scores.

CONCLUSIONS: These findings are not only similar to those in clinical adult populations but also notably different, for example, the lack of association between negative sleep-related pre-sleep cognitions and objective sleep difficulty. The results of this study provide a basis for a more detailed causal study on the existing relationships between negative pre-sleep cognitions and subjective and objective sleep difficulties in this population.
Role of the IL-6-Receptor expression in CD14+ monocytes in modulating sleep in patients with bipolar disorder.


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OBJECTIVE: Bipolar disorder is a severe mental disorder associated with persistent sleep disturbances and elevated levels of mRNA coding for pro-inflammatory cytokines within peripheral monocytes. The mechanisms causing and sustaining a reduced sleep quality remain elusive. The pro-
inflammatory cytokine receptor IL-6R is known to negatively affect sleep quality and architecture. Since elevations in IL-6R have repeatedly been demonstrated in bipolar disorder the association of sleep quality and architecture with levels of mRNA coding for IL-6R in monocytes was to be tested.

METHODS: Euthymic patients with bipolar disorder (n = 24) and healthy control subjects (n = 25) were assessed using all night polysomnography (PSG) and six day actigraphy. CD14+ monocytes were isolated on the evening of PSG assessment and levels of mRNA coding for IL-6R and other cytokines were determined using hybridization based assays. Interactions between IL-6R and sleep measures were calculated using linear regression models, adjusting for potential confounders.

RESULTS: Patients with bipolar disorder were found to have a reduced subjective sleep quality as assessed by the Pittsburgh Sleep Quality Index (PSQI) and more frequent arousals and short changes to wake during sleep. Both PSQI and the frequency of arousals were significantly predicted by levels of IL-6R. Contrary to previous publications, elevated levels of mRNA coding for pro-inflammatory cytokines in peripheral CD14+ monocytes of patients with bipolar disorder could not be replicated.

LIMITATIONS: Participants were only investigated with one night of PSG which may have given rise to first night effects.

CONCLUSIONS: Reduced sleep quality in euthymic patients with bipolar disorder may be related to an increased expression of IL-6R by peripheral monocytes.

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Sao Paulo Epidemiologic Sleep Study: rationale, design, sampling, and procedures.

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OBJECTIVES: To present the rational design, sampling, and procedures utilized in an Epidemiologic Sleep Study carried out in 2007 to establish the epidemiologic profile of sleep disorders in the adult population of a large metropolitan city, Sao Paulo, Brazil.

METHODS: A population-based survey adopting a probabilistic three-stage cluster sample of Sao Paulo was used to represent the population according to gender, age (20–80 years), and socioeconomic class. Questionnaires, actigraphy, polysomnography (PSG), and blood samples were collected to investigate associations between sleep patterns and disturbances according to social-demographic status, activity/rest cycle, physical activity habits, mood disturbances, memory complaints, sexual dysfunction in males, drug addiction, genetic markers, and anthropometric, clinical, biochemical, hematological, endocrine, immunologic, and inflammatory indicators.

RESULTS: A total of 1101 questionnaires were administered at home. A total of 156 volunteers were substituted, who were equivalent to the remaining sample in terms of age, gender, and socioeconomic class. A total of 1042 volunteers underwent PSG recordings at a Sleep Institute, and the refusal rate was 5.4%.

CONCLUSION: The Sao Paulo Sleep Study is a pioneering investigation, incorporating and integrating up-to-date methodologies for understanding sleep profiles and sleep disorders in large populations. This study will provide reliable information for the planning of health policies and programs aimed to control such disorders and their consequences in the city of Sao Paulo and
similar urban environments.

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Scheduled bright light for treatment of insomnia in older adults.

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OBJECTIVES: To determine whether bright light can improve sleep in older individuals with insomnia.
DESIGN: Single-blind, placebo-controlled, 12-week, parallel-group randomized design comparing four treatment groups representing a factorial combination of two lighting conditions and two times of light administration.
SETTING: At-home light treatment; eight office therapy sessions.
PARTICIPANTS: Thirty-six women and fifteen men (aged 63.6+/−7.1) meeting primary insomnia criteria recruited from the community.
INTERVENTION: A 12-week program of sleep hygiene and exposure to bright (approximately 4,000 lux) or dim light (approximately 65 lux) scheduled daily in the morning or evening for 45 minutes.
MEASUREMENTS: Within-group changes were observed for subjective (sleep logs, questionnaires) and objective (actigraphy, polysomnography) sleep measures after morning or evening bright light.
RESULTS: Within-group changes for subjective sleep measures after morning or evening bright light were not significantly different from those observed after exposure to scheduled dim light. Objective sleep changes (actigraphy, polysomnography) after treatment were not significantly different between the
bright and dim light groups. Scheduled light exposure was able to shift the circadian phase predictably but was unrelated to changes in objective or subjective sleep measures. A polymorphism in CLOCK predicted morningness but did not moderate the effects of light on sleep. The phase angle between the circadian system (melatonin midpoint) and sleep (darkness) predicted the magnitude of phase delays, but not phase advances, engendered by bright light.

CONCLUSION: Except for one subjective measure, scheduled morning or evening bright light effects were not different from those of scheduled dim light. Thus, support was not found for bright light treatment of older individuals with primary insomnia.

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Scheduled evening sleep and enhanced lighting improve adaptation to night shift work in older adults.


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OBJECTIVES: We tested whether a sleep and circadian-based treatment shown to improve circadian adaptation to night shifts and attenuate negative
effects on alertness, performance and sleep in young adults would also be effective in older adults.

METHODS: We assessed subjective alertness, sustained attention (psychomotor vigilance task, PVT), sleep duration (actigraphy) and circadian timing (salivary dim-light melatonin onset, DLMO) in 18 older adults (57.2±3.8 years; mean±SD) in a simulated shift work protocol. 4 day shifts were followed by 3 night shifts in the laboratory. Participants slept at home and were randomised to either the treatment group (scheduled evening sleep and enhanced lighting during the latter half of night shifts) or control group (ad-lib sleep and typical lighting during night shifts).

RESULTS: Compared with day shifts, alertness and sustained attention declined on the first night shift in both groups, and was worse in the latter half of the night shifts. Alertness and attention improved on nights 2 and 3 for the treatment group but remained lower for the control group. Sleep duration in the treatment group remained similar to baseline (6-7 hours) following night shifts, but was shorter (3-5 hours) following night shifts in the control group. Treatment group circadian timing advanced by 169.3±16.1 min (mean±SEM) but did not shift (-9.7±9.9 min) in the control group.

CONCLUSIONS: The combined treatment of scheduled evening sleep and enhanced lighting increased sleep duration and partially aligned circadian phase with sleep and work timing, resulting in improved night shift alertness and performance.

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Schizophrenia patients with predominantly positive symptoms have more disturbed sleep-wake cycles measured by actigraphy.

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Sleep disturbances are widespread in schizophrenia, and one important concern is to determine the impact of this disruption on self-reported sleep quality and quality of life (QoL). Our aim was to evaluate the sleep-wake cycle in a sample of patients with schizophrenia (SZ), and whether sleep patterns differ between patients with predominantly negative versus predominantly positive symptoms, as well as its impact on sleep quality and QoL. Twenty-three SZ outpatients were studied with 24 h continuous wrist-actigraphy during 7 days. The quality of sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI), and the self-reported QoL was evaluated with the World Health Organization Quality of Life – Abbreviated version (WHOQOL-Bref). About half of the studied population presented an irregular sleep-wake cycle. We found a trend for more disrupted sleep-wake patterns in patients with predominantly positive symptoms, who also had a trend self-reported worse quality of sleep and worse QoL in all domains. Overall, patients with worse self-reported QoL demonstrated worse sleep quality. Our findings suggest that SZ patients are frequently affected with sleep and circadian rhythm disruptions; these may have a negative impact on rehabilitation strategies. Moreover, poor sleep may play a role in sustaining poor quality of life in SZ patients.
School-based sleep education program improves sleep and academic performance of school-age children.

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STUDY OBJECTIVE: The objective of this study was to develop and evaluate the effectiveness of a school-based sleep education program aimed at improving the sleep and academic performance of school-age children.

METHODS: Using a community-based participatory research approach, we created a school-based sleep education program, "Sleep for Success"™ (SFS), composed of four distinct modules that addressed the children, their family and community, the school staff, and decision makers within the school setting. Implementation was carried out in three elementary schools. Seventy-one students participated in the evaluation of the program. The effectiveness of the SFS program was evaluated using non-randomized controlled before-and-after study groups (intervention and control) assessed over two time points (pre- and post-program implementation). Before (baseline) and after implementation, sleep and academic
performance were measured using actigraphy and report card marks, respectively.

RESULTS: In the intervention group, true sleep was extended by 18.2 min per night, sleep efficiency improved by 2.3%, and sleep latency was shortened by 2.3 min, and report card grades in mathematics and English improved significantly. No changes were noted in the control group.

CONCLUSION: Participation in the sleep education program was associated with significant improvements in children's sleep and academic performance.

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Screening and evaluation tools for sleep disorders in older adults.

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The negative effects of impaired sleep on physical and mental well-being in older adults have recently been recognized by health care professionals. However, researchers and clinicians may be unaware of reliable and valid screening and evaluation tools for evaluating sleep disorders in older adults. The purpose of this article is to present subjective and objective instruments that measure sleep quality, excessive daytime sleepiness, obstructive sleep apnea, insomnia and restless leg syndrome that are appropriate for use in adult and older adult patients.

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Seasonal effect on infants' sleep regulation: a preliminary study in a Mediterranean climate.

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Infants' sleep-wake rhythms are influenced by multiple factors, including developmental and contextual aspects, as well as circadian cycles. Empirical studies that address the seasonal impact on infants' sleep are scarce. The present study examined aspects of sleep schedule and quality, comparing summer and winter months in a Mediterranean climate. This report is based on a convenience sample of 34 healthy 7-mo-olds, an age in which sleep is well consolidated and regulated compared with the first few months of life. Sleep was measured with actigraphy, in the home context. It was found that compared with winter, in the summer months, sleep onset occurred at a later hour, and more motor activity during sleep was detected. Although the overall sleep quality, as defined by sleep efficiency score, was similar in the two seasons, in the summer, more active sleep was observed. The authors discuss the finding in terms of circadian rhythms, developmental characteristics, as well as possible environmental factors and family routines, and call for more studies, in different climates and geographical zones, and in different developmental periods.
Seasonal variation in nocturnal home blood pressure fall: the Nagahama study.

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Abnormalities in circadian blood pressure (BP) variation have been suggested to be associated with cardiovascular diseases and mortality. Factors affecting this variability need to be clarified to precisely evaluate the risk of circadian BP abnormalities. Given the seasonal differences in casual BP, it was hypothesized that nocturnal BP may also differ by season. Here, we aimed to clarify
the seasonality of circadian BP variation, as well as the factors associated with this seasonality, in a large-scale general population (n = 4780). This is a cross-sectional study based on multiday BP values measured in the evening, during sleep, and in the morning. Measurements were taken at home using an automatic cuff-oscillometric device. The sleeping period was objectively defined by actigraphy. The nocturnal systolic BP fall was significantly less in individuals whose BP was measured during the summer season (summer, -5.8 ± 7.8%; middle (spring or autumn), -8.2 ± 7.5%; winter, -11.0 ± 7.7%; p < 0.001), resulting in higher frequencies of riser (summer, 19.9; middle, 12.8; winter, 7.8%) and non-dipper (summer, 51.4; middle, 46.3; winter, 37.0%) patterns in the summer season (p < 0.001). The results of linear regression analysis identified the middle (β = 0.154, p < 0.001) and summer season (β = 0.261, p < 0.001) as strong positive determinants for decreasing the nocturnal SBP fall. No seasonality was observed in day-to-day variability of the dipping pattern (Kendall's coefficient: winter, 0.527; middle, 0.539; summer, 0.515). The nocturnal BP fall was largely different by season, with a higher frequency of riser and non-dipper patterns in the summer. The seasonality might not be due to the seasonal difference in day-to-day variability of nocturnal BP changes.

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Seasonal variations in daily rhythms of activity in athletic horses.
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Circadian rhythms reflect extensive programming of biological activity that meets and exploits the challenges and opportunities offered by the periodic nature of the environment. In the present investigation, we recorded the total activity of athletic horses kept at four different times of the year (vernal equinox, summer solstice, autumn equinox and winter solstice), to evaluate the presence of seasonal variations of daily activity rhythms. Athletic Thoroughbred horses were kept in individual boxes with paddock. Digitally integrated measure of total activity of each mare was continuously recorded by actigraphy-based data loggers. Horse total activities were not evenly distributed over the day, but they were mainly diurnal during the year. Daily activity rhythms showed clear seasonal variations, with the highest daily amount of activity during the vernal equinox and the lowest during the winter solstice. Interestingly, the amount of activity during either photophase or scotophase changed significantly throughout the year. Circadian analysis of horse activities showed that the acrophase, the estimated time at which the peak of the rhythm occurs, did not change during the year, it always occurred in the middle of the photoperiod. Analysing the time structure of long-term and continuously measured activity and feeding could be a useful method to critically evaluate athletic horse management systems in which spontaneous locomotor activity and feeding are severely limited. Circadian rhythms are present in several elements of sensory motor and psychomotor functions and these would be taken into consideration to plan the training schedules and competitions in athletic horses.

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Segmented sleep in a nonelectric, small-scale agricultural society in Madagascar.

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OBJECTIVES: We studied sleep in a rural population in Madagascar to (i) characterize sleep in an equatorial small-scale agricultural population without electricity, (ii) assess whether sleep is linked to noise levels in a dense population, and (iii) examine the effects of experimentally introduced artificial light on sleep timing.

METHODS: Using actigraphy, sleep-wake patterns were analyzed for both daytime napping and nighttime wakefulness in 21 participants for a sum total of 292 days. Functional linear modeling was used to characterize 24-h time-averaged circadian patterns and to investigate the effect of experimentally introduced mobile field lights on sleep timing. We also obtained the first polysomnography (PSG) recordings of sleep in a traditional population.

RESULTS: In every measure of sleep duration and quality, the Malagasy population experienced shorter and lower quality sleep when compared to similarly measured postindustrial values. The population slept for a total of 6.5 h per night and napped during 89% of recorded days. We observed a peak in activity after midnight for both sexes on 49% of nights, consistent with segmented sleep. Access to
mobile field lights had no statistical effect on nighttime sleep timing. From PSG, we documented relatively short rapid eye movement (14%), poor sleep efficiency (66%), and high wake after sleep onset (162 min).

CONCLUSIONS: Sleep in this population is segmented, similar to the "first" sleep and "second" sleep reported in the historical record. Moreover, although average sleep duration and quality were lower than documented in Western populations, circadian rhythms were more stable across days.

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Self-reported sleep latency in postmenopausal women.


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The aim of this study was to access how self-reported sleep latency (SRSL) was affected by sleep habits, mood, and circadian rhythm in postmenopausal women. Subjects (n=384, 67.9+/−7.7 yr) completed sleep and mood questionnaires, sleep log and actigraphic data. The major urinary melatonin metabolite (6-sulphatoxymelatonin, aMT6s) was assayed in fractional urine specimens for two 24-hr intervals. Although SRSL (26.5+/−24.4 min) and actigraphic sleep latency (ASL; 27.8+/−20.0 min) were correlated (r(s)=0.361, p<0.001), the short SRSLs tended to be underestimated whereas the long SRSLs tended to be overestimated as compared to ASL. SRSL was positively correlated with the scales of insomnia, mood and hot flash, hypertension, use of anti-hypertensive drugs and the
acrophase and the offset of aMT6s. SRSL was negatively correlated with the global assessment of functioning scale in DSM-IV (GAF scale), and light exposure and wrist activity. Multiple linear regression analysis showed that the best-fit model to predict SRSL was light exposure, GAF scale, and use of anti-hypertensive drugs. SRSL may be determined by psychophysiological factors as well as circadian rhythm function. Therapeutic approaches suggested for trouble falling asleep might include increased daylight exposure, improvements in general health, and modification of anti-hypertensive pharmacotherapy.

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PMID: 18162715 [Indexed for MEDLINE]


The SENSE Study (Sleep and Education: learning New Skills Early): a community cognitive-behavioural therapy and mindfulness-based sleep intervention to prevent depression and improve cardiac health in adolescence.

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BACKGROUND: Sleep problems are a major risk factor for the emergence of depression in adolescence. The aim of this study was to test whether an intervention for improving sleep habits could prevent the emergence of depression, and improve well-being and cardiovascular indices amongst at-risk adolescents.

METHODS/DESIGN: A longitudinal randomised controlled trial (RCT) is being conducted across Victorian Secondary Schools in Melbourne, Australia. Adolescents (aged 12–17 years) were defined as at-risk for depression if they reported high levels of anxiety and sleep problems on in-school screening questionnaires and had no prior history of depression (assessed by clinical diagnostic interview). Eligible participants were randomised into either a sleep improvement intervention (based on cognitive behavioral and mindfulness principles) or an active control condition teaching study skills. Both programs consisted of seven
90 minute-long sessions over seven weeks. All participants were required to complete a battery of mood and sleep questionnaires, seven-days of actigraphy, and sleep diary entry at pre- and post-intervention. Participants also completed a cardiovascular assessment and two days of saliva collection at pre-intervention. Participants will repeat all assessments at two-year follow up (ongoing).

DISCUSSION: This will be the first efficacy trial of a selective group-based sleep intervention for the prevention of depression in an adolescent community sample. If effective, the program could be disseminated in schools and greatly improve health outcomes for anxious adolescents.

TRIAL REGISTRATION: Australian New Zealand Clinical Trials Registry ACTRN12612001177842. Date of Registration: 06-Nov-2012.

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Sensor-based assessment of mobility-related behavior in dementia: feasibility and relevance in a hospital context.

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BACKGROUND: The assessment of patients' motor behavior is a key challenge in dementia care. Common geriatric assessment questionnaires or actigraphy measurements often lack methodological quality and are unsuitable to individually
tailor interventions. Hence, there is a need for developing objective tools to assess patterns of motor behavior. Therefore, the feasibility of a sensor-based assessment of mobility-related behavior in patients with dementia is investigated.

METHODS: A cross-sectional investigation on three dementia care wards in a psychiatric hospital was conducted. Forty-five patients with stages of dementia were included. Hybrid motion sensors, recording the sequence of body-postures, were attached on the patients' lower back for 72 consecutive hours.

RESULTS: Eighty-nine percent of the assessment periods were completed. On average patients spent 10.9 h/day lying (45%), 9.7 h/day sedentary while sitting or standing (41%), 1.7 h/day active while sitting or standing (7%), 1.7 h/day walking (7%), and reached on average 8,829 steps per day (SD = 7,428). Though overall activity levels were low, the results indicate a wide spectrum of activity patterns – ranging from almost inactive to highly active with general restlessness and wandering behavior.

CONCLUSION: The excellent adherence to the assessment protocol compared to wrist-worn actigraphy and the consistency of the sensor-derived analyses with clinical observations are pivotal findings of this study. These results show that it is possible to acquire objective data on individual motor behavior of patients suffering from dementia. This information is essential for tailoring the therapeutic management of these patients in a hospital context.

DOI: 10.1017/S1041610216001034
PMID: 27585706  [Indexed for MEDLINE]
Sensorimotor abilities are crucial for performance in athletic, military, and other occupational activities, and there is great interest in understanding learning in these skills. Here, behavioral performance was measured over three days as twenty-seven participants practiced multiple sessions on the Nike SPARQ Sensory Station (Nike, Inc., Beaverton, Oregon), a computerized visual and motor assessment battery. Wrist-worn actigraphy was recorded to monitor sleep-wake cycles. Significant learning was observed in tasks with high visuomotor control demands but not in tasks of visual sensitivity. Learning was primarily linear, with up to 60% improvement, but did not relate to sleep quality in this normal-sleeping population. These results demonstrate differences in the rate and capacity for learning across perceptual and motor domains, indicating potential targets for sensorimotor training interventions.

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Serum Macro TSH Level is Associated with Sleep Quality in Patients with Cardiovascular Risks – HSCAA Study.

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Macro thyroid-stimulating hormone (TSH) has been reported to be associated with seasonality and regulated by changes in day length in rodents, different from free TSH. In the present study, we investigated structural differences between macro TSH and free TSH levels in human serum, as well as the association of macro TSH with sleep quality. We enrolled 314 patients registered in the Hyogo Sleep Cardio-Autonomic Atherosclerosis (HSCAA) study. Sleep quality shown by actigraphy, sleep physical activity, and percent sleep in all and TSH closely matched subjects were significantly associated with high macro TSH levels. Macro and free TSH were similarly increased following thyrotropin-releasing hormone (TRH) stimulation, while circadian changes associated with those were distinct. To further analyze the structure of macro TSH, serum samples were separated by gel filtration chromatography. Although treatment with glycosidase did not affect morbidity, the macro TSH fraction had a markedly low affinity to the Con A column as compared with free TSH, indicating a distinct glycosylation structure. In conclusion, an increase in serum macro TSH is associated with low sleep quality and regulated in a manner distinct from free TSH, potentially due to an altered glycosylation structure.

DOI: 10.1038/srep44387
OBJECTIVES: Trait ruminators exhibit significantly higher levels of sleep disturbance than those without this cognitive vulnerability. However, support for the sleep disruptive effects of state rumination, especially in the pre-sleep period, is rare, and hindered by methodological drawbacks such as self-report and single night assays of sleep. Finally, despite the pervasiveness of the ruminative response style among individuals with depression, the association between rumination and sleep disturbance has not been explored in this population. The present study employed a week-long daily sampling approach to examine the effects of naturally occurring pre-sleep rumination on self-reported and actigraphy-based sleep among individuals with high depressive symptomatology.

METHODS: Forty-two university students (19.6±3.2 yo; 73.8% female), all of whom reported at least moderate levels of depressive symptoms, completed a short
questionnaire after waking each morning for seven days. On this questionnaire, they self-reported sleep indices from the previous night and levels of engagement in pre-sleep rumination. Sleep was also monitored throughout this period via wrist actigraphy. Hierarchical-linear-modeling was used to examine the association between nightly rumination and sleep.

RESULTS: Nightly variations in pre-sleep rumination were predictive of significantly longer actigraphy- and diary-based sleep onset latency (SOL). Notably, a 1 SD increase on the pre-sleep rumination scale was associated with an approximately 7 minute increase in actigraphy-based SOL, even after controlling for baseline sleep disturbance and depressive symptoms.

CONCLUSIONS: These data offer compelling evidence for the impact of pre-sleep rumination on sleep onset, providing insight into one potential mechanism that triggers sleep disturbance among individuals with depressive symptoms.

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Sex Differences in the Relationship Between Depressive Symptoms and Actigraphic Assessments of Sleep and Rest-Activity Rhythms in a Population-Based Sample.

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OBJECTIVE: Depression is often associated with disruptions in sleep and circadian rhythms. We aimed to confirm these relationships via actigraphic assessment in a large, population-based sample and test whether sex moderates these relationships.
METHODS: A total of 418 participants (age = 35–85 years, mean [standard deviation] = 57.04 [11.47]) completed questionnaires and 1 week of actigraphy, used to calculate sleep and rest–activity statistics including mesor (mean activity level), amplitude (height of rhythm), and acrophase (time of day that rhythm peaks).

RESULTS: Depressive symptoms, assessed via Center for Epidemiologic Studies Depression Scale, were associated with disrupted sleep and rest–activity rhythms. Furthermore, men demonstrated longer sleep onset latency (SOL, B = -13.28, p < .001), longer wake time after sleep onset (B = -6.26, p < .01), lower sleep efficiency (B = 5.91, p < .001), and lower total sleep time (TST, B = 33.16, p < .001) than women. Sex moderated the relationship between depression and SOL, TST, mesor, and amplitude; sex-stratified models revealed that higher depression scores were associated with greater SOL (B = 1.05, p < .001) and less TST (B = -0.87, p < .10) for women with higher depressive symptoms, but lower mesor (B = -1.75, p < .01) and amplitude (B = -1.94, p < .01) for men with higher depressive symptoms.

CONCLUSIONS: Depressive symptoms were related to disrupted sleep continuity and rest–activity rhythms in this population-based sample; however, these relationships differed by sex. Women with greater depressive symptoms exhibited difficulty with sleep continuity, whereas men with greater depressive symptoms demonstrated disruption throughout the 24-hour rhythm.

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Shift rotation, circadian misalignment and excessive body weight influence psychomotor performance: a prospective and observational study under
We aimed to evaluate the influence of shift work rotation, circadian misalignment and being overweight/obese on psychomotor performance throughout a complete shift rotation schedule. The study was conducted with 30 males working rotating shifts from a mining company under real life conditions. Individuals were evaluated over seven days in a shift schedule carried out as follow: two shifts in the morning (D1 and D2), two shifts in the afternoon (D3 and D4), 24 hour free day (D5) and two shifts at night (D6 and D7). Work performance was evaluated by psychomotor vigilance task tests (PVT), and actigraphy was used to characterise the rest-activity rhythm based on intradaily variability (IV) and interdaily stability (IS) of nonparametric functions. We found a significant effect of the shift, body mass index (BMI), IS and IV on lapses in attention. More lapses occurred on D7 than D1, D2, D3 and D4 of the schedule shift. The obese group presented a higher number of lapses in attention than eutrophic. The interaction
between day and IS showed that less synchronised individuals presented a higher number of lapses in attention on D7 than D1 and, for the interaction between day and IV, more fragmentated individuals presented a higher number of lapses in attention on D7 than D6. We conclude that higher BMI, lower synchronisation and higher fragmentation of the rest–activity pattern influenced lapses in attention throughout the shift rotation.

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Shift work, sleep disturbances and social jetlag in healthcare workers.

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The aim of this study was to compare chronotype- and age-dependent sleep disturbances and social jetlag between rotating shift workers and non-shift workers, and between different types of shifts. In the Klokwerk+ cohort study, we included 120 rotating shift workers and 74 non-shift workers who were recruited
from six Dutch hospitals. Participants wore Actigraph GT3X accelerometers for 24 hr for 7 days. From the Actigraph data, we predicted the sleep duration and social jetlag (measure of circadian misalignment). Mixed models and generalized estimation equations were used to compare the sleep parameters between shift and non-shift workers. Within shift workers, sleep on different shifts was compared with sleep on work-free days. Differences by chronotype and age were investigated using interaction terms. On workdays, shift workers had 3.5 times (95% confidence interval: 2.2-5.4) more often a short (< 7 hr per day) and 4.1 times (95% confidence interval: 2.5-6.8) more often a long (≥ 9 hr per day) sleep duration compared with non-shift workers. This increased odds ratio was present in morning chronotypes, but not in evening chronotypes (interaction p-value < .05). Older shift workers (≥ 50 years) had 7.3 times (95% confidence interval: 2.5-21.8) more often shorter sleep duration between night shifts compared with work-free days, while this was not the case in younger shift workers (< 50 years). Social jetlag due to night shifts increased with increasing age (interaction p-value < .05), but did not differ by chronotype (interaction p-value ≥ .05). In conclusion, shift workers, in particular older workers and morning chronotypes, experienced more sleep disturbances than non-shift workers. Future research should elucidate whether these sleep disturbances contribute to shift work-related health problems.

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Short Blue Light Pulses (30 Min) in the Morning Support a Sleep-Advancing Protocol in a Home Setting.

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Many people in our modern civilized society sleep later on free days compared to work days. This discrepancy in sleep timing will lead to so-called 'social jetlag' on work days with negative consequences for performance and health. Light therapy in the morning is often proposed as the most effective method to advance the circadian rhythm and sleep phase. However, most studies focus on direct effects on the circadian system and not on posttreatment effects on sleep phase and sleep integrity. In this placebo-controlled home study we investigated if blue light, rather than amber light therapy, can phase shift the sleep phase along with the circadian rhythm with preservation of sleep integrity and performance. We selected 42 participants who suffered from 'social jetlag' on workdays. Participants were randomly assigned to either high-intensity blue light exposure or amber light exposure (placebo) with similar photopic illuminance. The protocol consisted of 14 baseline days without sleep restrictions, 9 treatment days with either 30-min blue light pulses or 30-min amber light pulses in the morning along with a sleep advancing scheme and 7 posttreatment days.
without sleep restrictions. Melatonin samples were taken at days 1, 7, 14 (baseline), day 23 (effect treatment), and day 30 (posttreatment). Light exposure was recorded continuously. Sleep was monitored through actigraphy. Performance was measured with a reaction time task. As expected, the phase advance of the melatonin rhythm from day 14 to day 23 was significantly larger in the blue light exposure group, compared to the amber light group (84 min ± 51 (SD) and 48 min ± 47 (SD) respectively; t36 = 2.23, p < 0.05). Wake-up time during the posttreatment days was slightly earlier compared to baseline in the blue light group compared to slightly later in the amber light group (-21 min ± 33 (SD) and +12 min ± 33 (SD) respectively; F1,35 = 9.20, p < 0.01). The number of sleep bouts was significantly higher in the amber light group compared to the blue light group during sleep in the treatment period (F1,32 = 4.40, p < 0.05). Performance was significantly worse compared to baseline at all times during (F1,13 = 10.1, p < 0.01) and after amber light treatment (F1,13 = 17.1, p < 0.01), while only in the morning during posttreatment in the blue light condition (F1,10 = 9.8, p < 0.05). The data support the conclusion that blue light was able to compensate for the sleep integrity reduction and to a large extent for the performance decrement that was observed in the amber light condition, both probably as a consequence of the advancing sleep schedule. This study shows that blue light therapy in the morning, applied in a home setting, supports a sleep advancing protocol by phase advancing the circadian rhythm as well as sleep timing.

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Short sleep and late bedtimes are detrimental to educational learning and knowledge transfer: An investigation of individual differences in susceptibility.

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Good sleep hygiene practices, including consistent bedtimes and 7–9 h of sleep/night, are theorized to benefit educational learning. However, individuals differ in how much sleep they need, as well as in their chronotype preference. Therefore, some students may be more vulnerable to the cognitive effects of sleep loss, later bedtimes and nonpreferred times of learning than others. One prominent example is the debate regarding whether sleep loss and later bedtimes affect classroom learning more in female or male students. To inform this gender-and-sleep-loss debate, we developed a virtual college-level lecture to use in a controlled, laboratory setting. During Session 1, 78 undergraduate students were randomly assigned to take the lecture at 12:00 (noon condition) or 19:30 (evening condition). Then participants wore wristband actigraphy for 1 week to monitor average and intraindividual variability in sleep duration, bedtime and midpoint of sleep. During Session 2, participants completed a test at the same time of day as Session 1. The test included basic questions that were similar to trained concepts during the lecture (trained items) as well as integration questions that required application of learned concepts (knowledge-transfer items). Bayesian analyses supported the null hypothesis that time of learning did not affect test performance. Collapsed across time of testing, regression
analyses showed that shorter sleep durations and later bedtimes explained 13% of the variance in test performance. Longer sleep durations and earlier bedtimes predicted better test performance primarily in females, younger students and morning-types. Interestingly, students with above-median fluid intelligence scores were resilient to short sleep and late bedtimes. Our findings indicate that both sleep and circadian factors should be addressed to optimize educational learning, particularly in the students who are most susceptible to sleep loss.

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Short sleep duration and incident coronary artery calcification.

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Comment in JAMA. 2009 May 13;301(18):1879; author reply 1880.

CONTEXT: Coronary artery calcification is a subclinical predictor of coronary heart disease. Recent studies have found that sleep duration is correlated with established risk factors for calcification including glucose regulation, blood pressure, sex, age, education, and body mass index.

OBJECTIVE: To determine whether objective and subjective measures of sleep duration and quality are associated with incidence of calcification over 5 years and whether calcification risk factors mediate the association.

DESIGN, SETTING, AND PARTICIPANTS: Observational cohort of home monitoring in a healthy middle-aged population of 495 participants from the Coronary Artery Risk
Development in Young Adults (CARDIA) cohort Chicago site (black and white men and women aged 35-47 years at year 15 of the study in 2000-2001 with follow-up data at year 20 in 2005-2006). Potential confounders (age, sex, race, education, apnea risk, smoking status) and mediators (lipids, blood pressure, body mass index, diabetes, inflammatory markers, alcohol consumption, depression, hostility, self-reported medical conditions) were measured at both baseline and follow-up. Sleep metrics (wrist actigraphy measured duration and fragmentation, daytime sleepiness, overall quality, self-reported duration) were examined for association with incident calcification. Participants had no detectable calcification at baseline.

MAIN OUTCOME MEASURE: Coronary artery calcification was measured by computed tomography in 2000-2001 and 2005-2006 and incidence of new calcification over that time was the primary outcome.

RESULTS: Five-year calcification incidence was 12.3% (n = 61). Longer measured sleep duration was significantly associated with reduced calcification incidence (adjusted odds ratio, 0.67 per hour [95% confidence interval, 0.49-0.91 per hour]; P = .01). No potential mediators appreciably altered the magnitude or significance of sleep (adjusted odds ratio estimates ranged from 0.64 to 0.68 per sleep hour; maximum P = .02). Alternative sleep metrics were not significantly associated with calcification.

CONCLUSION: Longer measured sleep is associated with lower calcification incidence independent of examined potential mediators and confounders.

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Short sleep duration and large variability in sleep duration are
independently associated with dietary risk factors for obesity in Danish school children.

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BACKGROUND: Lack of sleep and increased consumption of energy-dense foods and sugar-sweetened beverages (SSBs) have all been suggested as factors contributing to the increased prevalence of overweight and obesity. OBJECTIVE: To evaluate whether objectively measured sleep duration (average and day-to-day variability) as well as parent-reported sleep problems are independently associated with proposed dietary risk factors for overweight and obesity in 8-11-year-old children. DESIGN: In this cross-sectional study, data on sleep duration and day-to-day variability in sleep duration were measured in 676 Danish, apparently healthy children by an objective measure (actigraphy) for 8 nights, and the Children's Sleep Habits Questionnaire (CSHQ) was filled out by the parents. Diet was recorded using a web-based food record for 7 consecutive days. Fasting blood samples were obtained for measurements of plasma leptin and ghrelin levels. RESULTS: Sleep duration (h per night) was negatively associated with
energy density (ED) of the diet ($\beta = -0.32$ kJ g$^{-1}$), added sugar ($\beta = -1.50$ E%) and SSBs ($\beta = -1.07$ E%) (all $P \leq 0.003$). Furthermore, variability in sleep duration (10-min per night) was positively associated with SSBs ($\beta = 0.20$ E%, $P = 0.03$), independent of sleep duration, and CSHQ score was positively associated with ED ($\beta = 0.16$ kJ g$^{-1}$, $P = 0.04$). All of these associations were independent of potential confounders (age, sex, pubertal status, height, weight, screen time, moderate-to-vigorous physical activity and parental education and ethnicity).

CONCLUSION: Our study suggests that short sleep duration, high sleep duration variability and experiencing sleep problems are all associated with a poor, obesity-promoting diet in children.

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Short-term influence of cataract surgery on circadian biological rhythm and related health outcomes (CLOCK-IOL trial): study protocol for a randomized controlled trial.

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BACKGROUND: Light information is the most important cue of circadian rhythm which synchronizes biological rhythm with external environment. Circadian misalignment of biological rhythm and external environment is associated with increased risk of depression, insomnia, obesity, diabetes, cardiovascular disease,
and cancer. Increased light transmission by cataract surgery may improve circadian misalignment and related health outcomes. Although some observational studies have shown improvement of depression and insomnia after cataract surgery, randomized controlled trials are lacking. We will conduct a parallel-group, assessor-blinded, simple randomized controlled study comparing a cataract surgery group at three months after surgery with a control group to determine whether cataract surgery improves depressive symptoms, sleep quality, body mass regulation, and glucose and lipid metabolism.

METHODS/DESIGN: We will recruit patients who are aged 60 years and over, scheduled to receive their first cataract surgery, and have grade 2 or higher nuclear opacification as defined by the lens opacities classification system III. Exclusion criteria will be patients with major depression, severe corneal opacity, severe glaucoma, vitreous haemorrhage, proliferative diabetic retinopathy, macular oedema, age-related macular degeneration, and patients needing immediate or combined cataract surgery. After baseline participants will be randomized to two groups. Outcomes will be measured at three months after surgery among the intervention group, and three months after baseline among the control group. We will assess depressive symptoms as a primary outcome, using the short version geriatric depression scale (GDS-15). Secondary outcomes will be subjective and actigraph-measured sleep quality, sleepiness, glycated haemoglobin, fasting plasma glucose and triglyceride, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, body mass index, abdominal circumference, circadian rhythms of physical activity and wrist skin temperature, and urinary melatonin metabolite. Chronotype and visual function will be assessed using the 'morningness-eveningness' questionnaire, the Munich chronotype questionnaire, and the National Eye Institute Visual Function Questionnaire.

DISCUSSION: Although there are potential limitations due to the
difference in duration from baseline survey to outcome measurements between two groups, any seasonal effect on the outcome measurement will be balanced as a result of continuous inclusion of participants through the year, and outcomes will be adjusted for day length at outcome measurements at analysis. TRIAL REGISTRATION: UMIN000014559, UMIN Clinical Trials Registry, registered on 15 July 2014.

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Shortening day length: a potential risk factor for perinatal depression.

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The aim of this secondary analysis was to determine whether seasonal light exposure, categorized by type of day length, is associated with or predictive of depressive symptoms in late pregnancy and the first 3 months postpartum. Women (n = 279) expecting their first child were recruited from prenatal clinics and childbirth education classes. Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale. Day lengths were categorized into short, lengthening, long and shortening. Data analysis included linear mixed
models and multiple linear regression. When days were shortening (August to first 4 days of November) in late third trimester, depressive symptom scores were highest (35%) and continued to be higher at each postpartum assessment compared to other day length categories. Implications for clinical practice include increased vigilance for depressive symptoms, particularly if late pregnancy and birth occurs during the 3 months around the Autumn equinox when day length is shortening. Strategies that increase light exposure in late pregnancy and postpartum should also be considered.

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Significance of time awake for predicting pilots' fatigue on short-haul flights: implications for flight duty time regulations.


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European regulations restrict the duration of the maximum daily flight duty period for pilots as a function of the duty start time and the number of scheduled flights. However, late duty end times that may include long times awake are not specifically regulated. In this study, fatigue levels in pilots finishing their duty late at night (00:00-01:59 hour) were analysed and compared with pilots starting their duty early (05:00-06:59 hour). Fatigue levels of 40 commercial short-haul pilots were studied during a total of 188 flight duty
periods, of which 87 started early and 22 finished late. Pilots used a small handheld computer to maintain a duty and sleep log, and to indicate fatigue levels immediately after each flight. Sleep logs were checked with actigraphy. Pilots on late-finishing flight duty periods were more fatigued at the end of their duty than pilots on early-starting flight duty periods, despite the fact that preceding sleep duration was longer by 1.1 h. Linear mixed-model regression identified time awake as a preeminent factor predicting fatigue. Workload had a minor effect. Pilots on late-finishing flight duty periods were awake longer by an average of 5.5 h (6.6 versus 1.1 h) before commencing their duty than pilots who started early in the morning. Late-finishing flights were associated with long times awake at a time when the circadian system stops promoting alertness, and an increased, previously underestimated fatigue risk. Based on these findings, flight duty limitations should consider not only duty start time, but also the time of the final landing.

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Single-parent family structure and sleep problems in black and white adolescents.

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OBJECTIVES: Sleep is critical for adolescent health and is influenced by the family environment. In our study, we examined if family structure defined as single- vs. two-parent households affected adolescent sleep. METHODS: Participants were 242 (57% black; 47% boys) healthy adolescents (mean age, 15.7 years). Sleep was measured using self-report and wrist actigraphy over seven consecutive nights. Outcomes were actigraphy-assessed sleep duration and sleep efficiency (SE) for the full week and weekends and weekdays separately, as well as self-reported sleep-wake problems and variability in bedtimes. Linear regression examined the relationship between family structure and sleep, after adjusting for age, sex, race, body mass index, and depressive symptoms, parental education, family conflict, and financial strain. Race and sex were examined as potential moderators. RESULTS: After adjusting for covariates, adolescents from single-parent households had poorer SE across the week and shorter sleep duration on weekends. White adolescents from two-parent households had fewer sleep-wake problems and lower bedtime variability, whereas black adolescents from single-parent households had the lowest weekend SE. There were no significant differences in family structure-sex interactions. CONCLUSION: Our findings are the first to demonstrate that single-parent family structure is an independent correlate of sleep problems in adolescents and they highlight the moderating role of race.
Sleep abnormalities in type 2 diabetes may be associated with glycemic control.


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Sleep disturbances may be associated with impaired glucose metabolism. The aim of this study was to evaluate sleep duration and quality in relation to glycemic control in patients with type 2 diabetes. In a cross-sectional study, sleep duration and quality were assessed in 47 middle-aged patients with type 2 diabetes treated with oral agents and without sleep disturbing complications and 23 healthy control subjects similar by age, sex, body mass index, occupation and schooling. Sleep was recorded by wrist-actigraphy for three consecutive days under free-living conditions. Univariate analysis showed lower sleep maintenance (P = 0.002) and sleep efficiency (P = 0.005), and higher fragmentation index (P < 0.0001), total activity score (P = 0.05) and moving time (P < 0.0001) in patients with type 2 diabetes. After adjusting for age, gender and schooling, fragmentation index and moving time remained significantly higher in the patients with diabetes (P < 0.05, both). HbA1c correlated inversely with sleep efficiency (r = -0.29; P = 0.047) and positively with moving time (r = 0.31; P = 0.031). These findings suggest that type 2 diabetes is associated with sleep disruptions even in the absence of complications or obesity. The relevance of sleep
Abnormalities to metabolic control and possible strategies to improve sleep quality in type 2 diabetes deserve further investigation.

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Sleep & Circadian Health are Associated with Mood & Behavior in Adolescents with Overweight/Obesity.


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Objective/Background Rates of overweight/obesity and insufficient/delayed sleep are high among adolescents and are also unique risk factors for mood/behavior difficulties. This study aimed to evaluate relationships between sleep/circadian health and mood/behavior in a cohort of adolescents with overweight/obesity.

Participants Twenty-two adolescents (16.4 ± 1.1 years) with overweight/obesity attending high school completed in the study. Methods Participants completed one week of home sleep monitoring (actigraphy), questionnaires assessing
chronotype (diurnal preference; Morningness/Eveningness Scale for Children) and mood/behavior (Strengths & Difficulties Questionnaire), and had in-laboratory salivary melatonin sampling on a Thursday or Friday during the academic year.

Results Linear regressions revealed later weekday bedtime and shorter weekday time in bed and sleep duration were associated with worse mood/behavior scores. Shorter duration of melatonin secretion and greater "eveningness" were also associated with worse mood/behavior scores. Conclusions Short and late sleep, shorter melatonin secretion, and eveningness chronotype are associated with worse mood/behavior symptoms in a cohort of adolescents with overweight/obesity. Clinicians should assess for both sleep and mood/behavior symptoms and further research is needed to evaluate the impact of improved sleep on mood/behavior in adolescents with overweight/obesity.

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Sleep and 24-h activity rhythms in relation to cortisol change after a very low-dose of dexamethasone.

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The hypothalamic-pituitary-adrenal (HPA) axis plays an important role in sleep. Nevertheless, the association of sleep and its 24-h organization with negative feedback control of the HPA axis has received limited attention in population-based studies. We explored this association in 493 middle-aged persons of the Rotterdam Study, a large population-based study (mean age 56 years, standard deviation: 5.3 years; 57% female). The negative feedback of the HPA axis was measured as the change in morning saliva cortisol after the intake of 0.25mg dexamethasone the night before. Actigraphy allowed us to measure the stability and fragmentation of the activity rhythm and to estimate total sleep time, sleep onset latency and wake after sleep onset. A sleep diary kept during the week of actigraphy was used to assess self-reported total sleep time, sleep onset latency, number of awakenings and perceived sleep quality. In our study, enhanced negative feedback of the HPA axis was found in association with unstable activity rhythms (B=0.106, 95% confidence interval (CI): 0.002; 0.210), total sleep time (B=0.108, 95%CI: 0.001; 0.215) and poor subjective sleep quality (B=0.107, 95%CI: 0.009; 0.206) after multivariate adjustment. These results indicated that the 24-h organization, duration and experience of sleep are all associated with the negative feedback control of the HPA axis.

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OBJECTIVES: We investigated physical activity as a moderator of relations between sleep duration and quality and adolescents' internalizing and externalizing problems.

DESIGN: The study used a cross-sectional design.

SETTING: Participants were recruited from small towns and semi-urban communities in Alabama.

PARTICIPANTS: The sample was comprised of 235 adolescents (Mage = 15.78 years, SD = 9.60 months) who were diverse in sex (53% female), race/ethnicity (34% Black/African American, 66% White), and socioeconomic status.

MEASUREMENTS: Sleep duration (actual sleep minutes), efficiency (minutes/total sleep period), and latency (minutes from sleep attempt to onset) were examined with actigraphs for 1 week. Youth reported on their physical activity levels and internalizing and externalizing problems.

RESULTS: Interactions between sleep and physical activity emerged in the prediction of adolescents' internalizing and externalizing problems. Supportive of moderation effects, adolescents with shorter or poorer-quality sleep in conjunction with less physical activity showed the highest levels of internalizing and externalizing problems. Demonstrative of protective effects, adolescents with more physical activity had lower levels of internalizing and
externalizing problems regardless of their sleep duration or quality. CONCLUSIONS: Findings illustrate that not all youth are at equal risk for adjustment problems when they experience short or poor-quality sleep, suggesting the importance of examining both bioregulatory and environmental factors in understanding adolescent adjustment.

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Sleep and Alertness in a Duty-Hour Flexibility Trial in Internal Medicine.

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BACKGROUND: A purpose of duty-hour regulations is to reduce sleep
deprivation in
medical trainees, but their effects on sleep, sleepiness, and
alertness are
largely unknown.
METHODS: We randomly assigned 63 internal-medicine residency programs
in the
United States to follow either standard 2011 duty-hour policies or
flexible
policies that maintained an 80-hour workweek without limits on shift
length or
mandatory time off between shifts. Sleep duration and morning
sleepiness and
alertness were compared between the two groups by means of a
noninferiority
design, with outcome measures including sleep duration measured with
actigraphy,
the Karolinska Sleepiness Scale (with scores ranging from 1 [extremely
alert] to
9 [extremely sleepy, fighting sleep]), and a brief computerized
Psychomotor
Vigilance Test (PVT-B), with long response times (lapses) indicating
reduced
alertness.
RESULTS: Data were obtained over a period of 14 days for 205 interns
at six
flexible programs and 193 interns at six standard programs. The
average sleep
time per 24 hours was 6.85 hours (95% confidence interval [CI], 6.61
to 7.10)
among those in flexible programs and 7.03 hours (95% CI, 6.78 to 7.27)
among
those in standard programs. Sleep duration in flexible programs was
noninferior
to that in standard programs (between-group difference, -0.17 hours
per 24 hours; one-sided lower limit of the 95% confidence interval, -0.45 hours; noninferiority margin, -0.5 hours; P = 0.02 for noninferiority), as was the score on the Karolinska Sleepiness Scale (between-group difference, 0.12 points; one-sided upper limit of the 95% confidence interval, 0.31 points; noninferiority margin, 1 point; P < 0.001). Noninferiority was not established for alertness according to the PVT-B (between-group difference, -0.3 lapses; one-sided upper limit of the 95% confidence interval, 1.6 lapses; noninferiority margin, 1 lapse; P = 0.10).

CONCLUSIONS: This noninferiority trial showed no more chronic sleep loss or sleepiness across trial days among interns in flexible programs than among those in standard programs. Noninferiority of the flexible group for alertness was not established. (Funded by the National Heart, Lung, and Blood Institute and American Council for Graduate Medical Education; ClinicalTrials.gov number, NCT02274818.).

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Sleep and Alertness in Medical Interns and Residents: An Observational Study on the Role of Extended Shifts.


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Study Objectives: Fatigue from sleep loss is a risk to physician and patient safety, but objective data on physician sleep and alertness on different duty hour schedules is scarce. This study objectively quantified differences in sleep duration and alertness between medical interns working extended overnight shifts and residents not or rarely working extended overnight shifts.

Methods: Sleep-wake activity of 137 interns and 87 PGY-2/3 residents on 2-week Internal Medicine and Oncology rotations was assessed with wrist-actigraphy. Alertness was assessed daily with a brief Psychomotor Vigilance Test (PVT) and the Karolinska Sleepiness Scale.

Results: Interns averaged 6.93 hours (95% confidence interval [CI] 6.84–7.03 hours) sleep per 24 hours across shifts, significantly less than residents not working overnight shifts (7.18 hours, 95% CI 7.06–7.30 hours, p = .007). Interns obtained on average 2.19 hours (95% CI 2.02–2.36 hours) sleep during on-call nights (17.5% obtained no sleep). Alertness was significantly lower on mornings after on-call nights compared to regular shifts (p < .001). Naps between 9 am and 6 pm on the first day post-call were frequent (90.8%) and averaged 2.84 hours (95% CI 2.69–3.00 hours), but interns still slept 1.66 hours less per 24 hours.
(95% CI 1.56–1.76 hours) compared to regular shift days (p < .001). Sleep inertia significantly affected alertness in the 60 minutes after waking on-call.

Conclusions: Extended overnight shifts increase the likelihood of chronic sleep restriction in interns. Reduced levels of alertness after on-call nights need to be mitigated. A systematic comparison of sleep, alertness, and safety outcomes under current and past duty hour rules is encouraged.

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Sleep and alertness in shift work disorder: findings of a field study.

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PURPOSE: Although shift work disorder (SWD) affects a major part of the shift working population, little is known about its manifestation in real life. This
observational field study aimed to provide a detailed picture of sleep and alertness among shift workers with a questionnaire-based SWD, by comparing them to shift workers without SWD during work shifts and free time.

METHODS: SWD was determined by a questionnaire. Questionnaires and 3-week field monitoring, including sleep diaries, actigraphy, the Karolinska Sleepiness Scale (KSS), EEG-based sleep recordings, and Psychomotor Vigilance Tasks (PVT), were used to study 22 SWD cases and 9 non-SWD workers.

RESULTS: The SWD group had a shorter subjective total sleep time and greater sleep debt before morning shifts than the non-SWD group. Unlike the non-SWD group, the SWD group showed little compensatory sleep on days off. The SWD group had lower objective sleep efficiency and longer sleep latency on most days, and reported poorer relaxation at bedtime and sleep quality across all days than the non-SWD group. The SWD group's average KSS-sleepiness was higher than the non-SWD group's sleepiness at the beginning and end of morning shifts and at the end of night shifts. The SWD group also had more lapses in PVT at the beginning of night shifts than the non-SWD group.

CONCLUSIONS: The results indicate that SWD is related to disturbed sleep and alertness in association with both morning and night shifts, and to less compensatory sleep on days off. SWD seems to particularly associate with the quality of sleep.

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PMID: 30511341 [Indexed for MEDLINE]
BACKGROUND: Children transition out of naps in early childhood. However, there is disagreement about when this transition should occur.

AIMS: We compared measures of sleep and behavior in children divided into Frequent, Sometimes, and Rarely nappers to determine what factors predict when napping should cease. We then examined the effect of an experimenter-promoted nap on measures of sleep and behavior.

METHODS: We studied 133 children (50.4% female; mean=52.77 months) over 16 days. Parents completed questionnaires, whereas children wore actigraphs. On 1 study day, children were nap-promoted.

RESULTS: Overnight sleep duration was significantly less for children who napped frequently than those who rarely napped, yet total 24-hour sleep and other sleep parameters did not differ across napping groups. Effortful control was marginally greater in those who rarely napped. Nap promotion was 91% successful across nap groups. When typical sleep was compared with sleep following a promoted nap, frequent nappers slept more on the nap-promoted night. Total 24-hour
sleep increased in all children following the promoted nap, and other sleep parameters did not differ between groups.

CONCLUSIONS: The emergence of self-regulatory behaviors may predict when children should cease napping, consistent with the hypothesis that transitioning out of naps may be related to brain maturation. Given previously reported benefits of sleep on cognition and the observed increase in 24-hour sleep following nap promotion, nap promotion may benefit early education. Further research should explore maturational cues that illuminate when children are ready to transition out of napping.

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Sleep and circadian abnormalities in patients with cirrhosis: features of delayed sleep phase syndrome?
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Sleep disturbances are common in patients with cirrhosis but their origins are unknown. The aim of this study was to investigate possible involvement of the circadian system. Sleep was monitored for two weeks, in the home environment, using sleep diaries and actigraphy, in 35 patients with cirrhosis (21 men; mean age [+- 1SD] 58 +/- 10 yr) and 12 matched healthy controls (eight
urinary 6-sulphatoxymelatonin (aMT6s), the major metabolite of melatonin, was measured over 56 h, to assess circadian rhythmicity. The patients woke up and got up significantly later than the healthy volunteers and their sleep was significantly more fragmented. Mean 24-hour urinary aMT6s outputs were comparable in the patients and controls (15.5 +/- 13.1 vs. 20.3 +/- 13.8 microg/24 h) but were significantly lower in the decompensated patients (9.8 +/- 11.3 vs. 17.0 +/- 13.3 microg/24 h; p = 0.03). Significant 24-hour urinary aMT6s rhythms were observed in 26 (79%) of the 33 patients with complete urine collections; 20 patients had a normally timed (midnight-06:00) urinary aMT6s peak, while it was delayed (> or = 06:00) in the remainder. Significant correlations were observed between abnormalities in the urinary aMT6s profile (delays and/or lack of a 24-hour rhythm) and indices of sleep timing; parallel delays were observed in sleep habits and urinary aMT6s peaks. The association between delayed circadian rhythms and delayed sleep habits observed in approximately one-third of the patients with cirrhosis is reminiscent of 'delayed sleep phase syndrome'; this condition is managed by attempting to resynchronise the circadian clock by exposure to bright light shortly after morning awakening.

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Sleep and circadian phase in a ship's crew.


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Numerous factors influence the increased health risks of seamen. This study investigated sleep (by actigraphy) and the adaptation of the internal clock in watch-keeping crew compared to day workers, as possible contributory factors. Fourteen watch keepers, 4 h on, 8 h off (0800-1200/2000-2400 h, 1200-1600/2400-0400 h, 1600-2000/0400-0800 h) (fixed schedule, n = 6; rotating by delay weekly, n = 8), and 12 day workers participated during a voyage from the United Kingdom to Antarctica. They kept daily sleep diaries and wore wrist monitors for continuous recording of activity. Sleep parameters were derived from activity using the manufacturer's software and analyzed by repeated-measures ANOVA using SAS 8.2. Sequential urine samples were collected for 48 h weekly for 6-sulphatoxymelatonin measurement as an index of circadian rhythm timing. Individuals working watches of 1200-1600/2400-0400 h and 1600-2000/0400-0800 h had 2 sleeps daily, analyzed separately as main sleep (longest) and 2nd sleep. Main sleep duration was shorter in watch keepers than in day workers (p < 0.0001). Objective sleep quality was significantly compromised in rotaters compared to both day workers and fixed watch keepers, the most striking comparisons being sleep efficiency (percentage desired sleep time spent sleeping) main sleep (p < 0.0001) and sleep fragmentation (an index of restlessness) main sleep (p < 0.0001). The 2nd sleep was substantially less efficient than was the main sleep (p < 0.0001) for all watch keepers. There were few significant differences in sleep between the different watches in rotating watch keepers. Circadian timing remained constant in day workers. Timing of the 6-sulphatoxymelatonin rhythm was later for the watch of 1200-1600/2400-0400 h than for all others (1200-1600/2400-0400 h, 5.90 +/- 0.85 h; 1600-2000/0400-0800 h, 1.5 +/- 0.64 h; 0800-1200/2000-2400 h, 2.72 +/- 0.76 h; days, 2.09 +/- 0.68 h [decimal hours, mean +/- SEM]: ANOVA, p < 0.01). This study identifies weekly
changes in watch time as a cause of poor sleep in watch keepers. The most likely mechanism is the inability of the internal clock to adapt rapidly to abrupt changes in schedule.

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Sleep and circadian rhythm disruption in schizophrenia.

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BACKGROUND: Sleep disturbances comparable with insomnia occur in up to 80% of people with schizophrenia, but very little is known about the contribution of circadian coordination to these prevalent disruptions. AIMS: A systematic exploration of circadian time patterns in individuals with schizophrenia with recurrent sleep disruption. METHOD: We examined the relationship between sleep-wake activity, recorded actigraphically over 6 weeks, along with ambient light exposure and simultaneous circadian clock timing, by collecting weekly 48 h profiles of a urinary metabolite of melatonin in 20 out-patients with schizophrenia and 21 healthy control individuals matched for age, gender and being unemployed. RESULTS: Significant sleep/circadian disruption occurred in all the participants with schizophrenia. Half these individuals showed severe circadian misalignment ranging from phase-advance/delay to non-24 h periods in sleep-wake and melatonin cycles, and the other half showed patterns from excessive sleep to
highly irregular and fragmented sleep epochs but with normally timed melatonin production.

CONCLUSIONS: Severe circadian sleep/wake disruptions exist despite stability in mood, mental state and newer antipsychotic treatment. They cannot be explained by the individuals' level of everyday function.

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Sleep and Circadian Rhythm Disturbance in Remitted Schizophrenia and Bipolar Disorder: A Systematic Review and Meta-analysis.


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BACKGROUND: Sleep and circadian rhythm disturbances in schizophrenia are common, but incompletely characterized. We aimed to describe and compare the magnitude and heterogeneity of sleep-circadian alterations in remitted schizophrenia and compare them with those in interepisode bipolar disorder.

METHODS: EMBASE, Medline, and PsycINFO were searched for case-control studies reporting actigraphic parameters in remitted schizophrenia or bipolar disorder. Standardized and absolute mean differences between patients and
controls were quantified using Hedges' $g$, and patient-control differences in variability were quantified using the mean-scaled coefficient of variation ratio (CVR). A wald-type test compared effect sizes between disorders.

RESULTS: Thirty studies reporting on 967 patients and 803 controls were included. Compared with controls, both schizophrenia and bipolar groups had significantly longer total sleep time (mean difference [minutes] [95% confidence interval {CI}] = 99.9 [66.8, 133.1] and 31.1 [19.3, 42.9], respectively), time in bed (mean difference = 77.8 [13.7, 142.0] and 50.3 [20.3, 80.3]), but also greater sleep latency (16.5 [6.1, 27.0] and 2.6 [0.5, 4.6]) and reduced motor activity (standardized mean difference [95% CI] = –0.86 [–1.22, –0.51] and –0.75 [–1.20, –0.29]). Effect sizes were significantly greater in schizophrenia compared with the bipolar disorder group for total sleep time, sleep latency, and wake after sleep onset. CVR was significantly elevated in both diagnoses for total sleep time, time in bed, and relative amplitude.

CONCLUSIONS: In both disorders, longer overall sleep duration, but also disturbed initiation, continuity, and reduced motor activity were found. Common, modifiable factors may be associated with these sleep–circadian phenotypes and advocate for further development of transdiagnostic interventions that target them.

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[Sleep and circadian rhythm disturbances in schizophrenia].

[Article in Polish]

Skowerska A(1), Wichniak A, Skalski M.
AIM: In this study we investigated sleep and circadian rhythm, functioning and psychopathological symptoms in patients with schizophrenia. We looked for answers to the following questions: What percentage of patients with schizophrenia after a therapeutic process in the daily psychiatric ward suffers from insomnia and excessive daytime sleepiness? What factors influence the functioning of patients with schizophrenia.

METHODS: 23 patients and 23 healthy controls matched for age and sex (14 women, 9 men; mean age 40.5 +/- 13.66) were examined. All subjects filled out sleep diaries, underwent actigraphy for 7 days, and ratings with scales for the assessment of sleep quality, daytime sleepiness, general clinical state and the degree of improvement, presence and severity of psychopathological symptoms and depression, drug side effects.

RESULTS: Moderate insomnia was found in 6 (26%), severe insomnia in 2 (8%) patients. Four patients (17%) suffered from severe daytime sleepiness. Actigraphy showed a low activity level that had influence on the functioning of patients. The functioning of the patients was most negatively influenced by negative symptoms of schizophrenia and drug side effects. Older patients and those who were ill for a longer time presented more drug side effects and they were more depressive. The patients spent more time in bed and had longer sleep time than healthy controls. The patients presented highest activity at the time of therapeutic activities.

CONCLUSIONS: Despite improvement of psychopathological symptoms, many patients with schizophrenia still present low daytime activity and clinically significant insomnia and/or daytime sleepiness, which deteriorates their functioning.
Sleep and circadian rhythm function and trait impulsivity: An actigraphy study.

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We report the relationship between daily rest–activity patterns and trait impulsivity in healthy young adults. The Barratt Impulsiveness Scale was used to identify high and low impulsive individuals among a group of 51 volunteers. Participants' sleep behaviour and circadian rhythm function was assessed using week-long actigraphy. High impulsive individuals displayed phase-delayed patterns of sleep, a decreased total sleep time and sleep efficiency, and disrupted circadian function. Such outcomes were also associated with greater self-reported attention deficit hyperactivity disorder symptoms. The results highlight that sleep and circadian rhythm disturbances may be associated with impulsive traits replicating relationships described in psychiatric illnesses in which impulsivity is a core feature.

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Sleep and circadian rhythm regulation in early Parkinson disease.

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Comment in

IMPORTANCE: Sleep disturbances are recognized as a common nonmotor
complaint in
Parkinson disease but their etiology is poorly understood.
OBJECTIVE: To define the sleep and circadian phenotype of patients
with
early-stage Parkinson disease.
DESIGN, SETTING, AND PARTICIPANTS: Initial assessment of sleep
characteristics in
a large population–representative incident Parkinson disease cohort
(N=239) at
the University of Cambridge, England, followed by further
comprehensive
case–control sleep assessments in a subgroup of these patients (n=30)
and matched
controls (n=15).
MAIN OUTCOMES AND MEASURES: Sleep diagnoses and sleep architecture
based on
polysomnography studies, actigraphy assessment, and 24-hour analyses
of serum
cortisol, melatonin, and peripheral clock gene expression (Bmal1,
Per2, and
Rev-Erbα).
RESULTS: Subjective sleep complaints were present in almost half of
newly
diagnosed patients and correlated significantly with poorer quality of
life.
Patients with Parkinson disease exhibited increased sleep latency (P
= .04),
reduced sleep efficiency (P = .008), and reduced rapid eye movement
sleep (P = .02). In addition, there was a sustained elevation of serum cortisol levels, reduced circulating melatonin levels, and altered Bmal1 expression in patients with Parkinson disease compared with controls.

CONCLUSIONS AND RELEVANCE: Sleep dysfunction seen in early Parkinson disease may reflect a more fundamental pathology in the molecular clock underlying circadian rhythms.

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Sleep and circadian rhythms as possible trait markers of suicide attempt in bipolar disorders: An actigraphy study.


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BACKGROUND: The poor prognostic of Bipolar disorders (BD) is closely linked to deaths by suicide. Sleep and circadian abnormalities are observed during all phases of BD and are also associated with suicide attempt (SA). In this context, this study sought to identify specific sleep and circadian rhythms markers associated with suicidal attempt in euthymic patients with BD.

METHODS: The sample (N = 236) comprised 3 groups: 147 patients with BD including 57 with a history of SA and 90 without (NoSA), and 89 healthy controls (HC). All participants were recorded during 21 days with actigraphy.

RESULTS: SA was associated with women gender (p = 0.03), familial history of SA (p = 0.03), mixed episodes (p = 0.001), and benzodiazepines (p = 0.019). SA, compared to noSA, had a morning phase preference (p = 0.04), and were more vigorous on the circadian type inventory (p = 0.04), and tended to suffer more from insomnia (45% versus 25% respectively, p = 0.10). SA was also associated with an earlier onset of daily activity assessed with actigraphy (M10 onset: p = 0.01). Backward stepwise linear regression indicated that a combination of four variables (Gender, vigour, insomnia, M10onset) significantly differentiated patients with SA from NoSA (p = 0.03).

LIMITATIONS: Cross-sectional design, and no examination of suicidal behaviors' subgroups such as first attempters or repeaters, or violent suicide attempt.

CONCLUSIONS: Woman gender, vigorous circadian type, insomnia and an earlier daily activity appeared independently associated with SA in BD. If these biomarkers are confirmed in prospective studies, they should be screened and used to
prevent suicide, with the development of personal and targeted chronobiological treatments.

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Sleep and circadian rhythms in hospitalized patients with decompensated cirrhosis: effect of light therapy.

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Patients with liver cirrhosis often exhibit sleep-wake abnormalities, which are, at least to some extent, circadian in origin. A relatively novel non-pharmacological approach to circadian disruption is appropriately timed bright light therapy. The aims of this pilot study were to investigate sleep-wake characteristics of a well-characterized population of inpatients with cirrhosis, and to evaluate the efficacy of bright light therapy in the hospital setting. Twelve consecutive inpatients with cirrhosis underwent complete sleep-wake assessment, to include qualitative and semi-quantitative (actigraphic) indices of night-time sleep quality, daytime sleepiness, diurnal preference, habitual sleep timing, quality of life, mood and circadian rhythmicity [i.e. urine collections for measurement of the melatonin metabolite 6-sulphatoxymelatonin (aMT6s)]. Patients showed extremely impaired night sleep quality (Pittsburg Sleep Quality
Index global score: 16.3 ± 2.1) and daytime sleepiness was common (Epworth Sleepiness Scale: 8.3 ± 3.2). Five patients were randomly assigned to a single room in which lighting was controlled in relation to timing, spectral composition and intensity (lights on at 06:30 and off at 22:30, blue-enriched, more intense light in the morning, red-enriched, less intense light in the afternoon/evening); the others stayed in identical rooms with standard lighting. Sleep diaries revealed poor sleep quality, prolonged sleep latency (67 ± 138 min) and a reduced sleep efficiency (69 ± 21%). These features were confirmed by actigraphy (sleep efficiency: 71 ± 13%; fragmentation index: 55 ± 15%). Quality of life was globally impaired, and mood moderately depressed (Beck Depression Inventory: 19.4 ± 7.9). Seven patients underwent serial urine collections: no circadian aMT6s rhythm was detected in any of them, neither at baseline, nor during the course of hospitalization in either room (n = 4). In conclusion, sleep and circadian rhythms in hospitalized, decompensated patients with cirrhosis are extremely compromised. Treatment with bright light therapy did not show obvious, beneficial effects, most likely in relation to the severity of disturbance at baseline.

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Sleep and Circadian Rhythms in Survivors of Acute Respiratory Failure.


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Background: Little is known about sleep and circadian rhythms in survivors of acute respiratory failure (ARF) after hospital discharge. Objectives: To examine sleep and rest-activity circadian rhythms in ARF survivors 3 months after hospital discharge, and to compare them with a community-dwelling population.

Methods: Sleep diary, actigraphy data, and insomnia symptoms were collected in a pilot study of 14 ARF survivors. Rest-activity circadian rhythms were assessed with wrist actigraphy and sleep diary for 9 days, and were analyzed by cosinor and non-parametric circadian rhythm analysis. Results: All participants had remarkable actigraphic sleep fragmentation, 71.5% had subclinical or clinical insomnia symptoms. Compared to community-dwelling adults, this cohort had less stable rest-activity circadian rhythms (p < 0.001), and weaker circadian strength (p < 0.001). Conclusion: Insomnia and circadian disruption were common in ARF survivors. Sleep improvement and circadian rhythm regularity may be a promising approach to improve quality of life and daytime function after ARF.

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Sleep and circadian variability in people with delayed sleep-wake phase disorder versus healthy controls.
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OBJECTIVE/BACKGROUND: To compare sleep and circadian variability in adults with delayed sleep–wake phase disorder (DSWPD) to healthy controls.

PATIENTS/METHODS: Forty participants (22 DSWPD, 18 healthy controls) completed a ten-day protocol, consisting of DLMO assessments on two consecutive nights, a five-day study break, followed by two more DLMO assessments. All participants were instructed to sleep within one hour of their self-reported average sleep schedule for the last four days of the study break. We analyzed the participants' wrist actigraphy data during these four days to examine intraindividual variability in sleep timing, duration and efficiency. We also examined shifts in the DLMO from before and after the study break.

RESULTS AND CONCLUSIONS: Under the same conditions, people with DSWPD had significantly more variable wake times and total sleep time than healthy controls (p ≤ 0.015). Intraindividual variability in sleep onset time and sleep efficiency was similar between the two groups (p ≥ 0.30). The DLMO was relatively stable across the study break, with only 11% of controls but 27% of DSWPDs showed more than a one hour shift in the DLMO. Only in the DSWPD sample was greater sleep variability associated with a larger shift in the DLMO (r = 0.46, p = 0.03).

These results suggest that intraindividual variability in sleep can be higher in
DSWPD versus healthy controls, and this may impact variability in the DLMO. DSWPD patients with higher intraindividual variability in sleep are more likely to have a shifting DLMO, which could impact sleep symptoms and the optimal timing of light and/or melatonin treatment for DSWPD.


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Sleep and cognitive functioning in childhood: Ethnicity, socioeconomic status, and sex as moderators.

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We examined children's sleep at age 9 as a predictor of developmental trajectories of cognitive performance from ages 9 to 11 years. The effects of sleep on cognition are not uniform and thus we tested race/ethnicity, socioeconomic status (SES), and sex as moderators of these associations. At the first assessment, 282 children aged 9.44 years (52% boys, 65% European American [EA], 35% African American [AA]) participated. Two more waves of data collection spaced 1 year apart followed. The majority of children (63%) were living at or below the poverty line. Children's sleep was measured objectively with actigraphy and 2 well-established sleep parameters were derived: duration,
indexed by sleep minutes between sleep onset and wake time, and quality, indexed by efficiency. Multiple cognitive functioning domains were examined with the Woodcock Johnson Tests of Cognitive Abilities (WJ III). Across the sample, higher sleep efficiency, but not duration, was associated with better cognitive performance. Significant moderation effects emerged. Controlling for SES, AA children scored lower on general intellectual ability and working memory (WM) at age 11 only if they experienced lower sleep efficiency at age 9. Further, boys scored lower on general abilities and processing speed (PS) at age 11 only if their sleep efficiency was lower at age 9. Findings indicate that lower sleep efficiency may contribute to lower cognitive functioning especially for AA children and boys. These vulnerabilities appear to emerge early in development and are maintained over time. Results underscore the importance of individual differences in explicating relations between sleep and children's cognitive performance.

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Sleep and cognitive performance of African-Americans and European-Americans before and during circadian misalignment produced by an abrupt 9-h delay in the sleep/wake schedule.

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We conducted two studies of circadian misalignment in non-Hispanic African and European-Americans. In the first, the sleep/wake (light/dark) schedule was advanced 9 h, similar to flying east, and in the second these schedules were delayed 9 h, similar to flying west or sleeping during the day after night work. We confirmed that the free-running circadian period is shorter in African-Americans compared to European-Americans, and found differences in the magnitude and direction of circadian rhythm phase shifts which were related to the circadian period. The sleep and cognitive performance data from the first study (published in this journal) documented the impairment in both ancestry groups due to this extreme circadian misalignment. African-Americans slept less and performed slightly worse during advanced/misaligned days than European-Americans. The current analysis is of sleep and cognitive performance from the second study. Participants were 23 African-Americans and 22 European-Americans (aged 18–44 years). Following four baseline days (8 h time in bed, based on habitual sleep), the sleep/wake schedule was delayed by 9 h for three days. Sleep was monitored using actigraphy. During the last two baseline/aligned days and the first two delayed/misaligned days, beginning 2 h after waking, cognitive performance was assessed every 3 h using the Automated Neuropsychological Assessment Metrics (ANAM) battery. Mixed model ANOVAs assessed the effects of ancestry (African-American or European-American) and condition (baseline/aligned or delayed/misaligned) on sleep and performance. There was decreased sleep and impaired cognitive performance in both ancestry groups during the two delayed/misaligned days relative to baseline/aligned days. Sleep and cognitive performance did not differ between African-Americans and European-Americans during either baseline/aligned or delayed/misaligned days. While our previous work showed that an advance in the sleep/wake schedule
impaired the sleep of African-Americans more than European-Americans, delaying
the sleep/wake schedule impaired the sleep and cognitive performance of
African-Americans and European-Americans equally.

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Sleep and cognitive performance: the role of income and respiratory
sinus arrhythmia reactivity.

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A health disparities view suggests that low family income status acts
as a risk factor for poor cognitive functioning. A biosystems view suggests that
poor sleep and poor stress response system functioning are also risk factors.
These views are rarely integrated to test multiplicative risk or protective
effects from social-cultural and biological variables. We investigated interactions
among familial income, children's sleep and respiratory sinus arrhythmia
reactivity (RSA reactivity, indexing parasympathetic nervous system reactivity)
in the prediction of cognitive performance of school-aged children.
Participants were 282 children (146 boys; 35% African American and 65% European
American; M age = 9.42 years, SD = .71). Mothers reported on family income.
Children's sleep quality (efficiency) and duration (minutes) were assessed via a week
of actigraphy. Children's RSA reactivity to an attention demanding and frustrating
star tracing challenge was assessed in the lab. Children completed
standardized cognitive assessments examining attention, processing speed, and crystallized cognitive functioning. Findings show that more optimal sleep efficiency and RSA reactivity interact to confer protection against poor cognitive performance, particularly for children from lower income homes. Results build on the literature and suggest that interactions between biological systems and socioeconomic variables are key for understanding children's cognitive performance.

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Sleep and eating behavior in adults at risk for type 2 diabetes.
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Insufficient quantity and quality of sleep may modulate eating behavior, everyday physical activity, overall energy balance, and individual risk of obesity and type 2 diabetes. We examined the association of habitual sleep quantity and quality with the self-reported pattern of eating behavior in 53 healthy urban adults with parental history of type 2 diabetes (30 F/23 M; mean (s.d.) age: 27 (4) years; BMI: 23.9 (2.3) kg/m(2)) while taking into consideration the amount of their everyday physical activity. Participants completed 13 (3) days of sleep and physical activity monitoring by wrist actigraphy and waist accelerometry while
following their usual lifestyle at home. Overnight laboratory polysomnography was used to screen for sleep disorders. Subjective sleep quality was measured with the Pittsburgh Sleep Quality Index. Eating behavior was assessed using the original 51-item and the revised 18-item version of the Three-Factor Eating Questionnaire including measures of cognitive restraint, disinhibition, hunger, and uncontrolled and emotional eating. In multivariable regression analyses adjusted for age, BMI, gender, race/ethnicity, level of education, habitual sleep time measured by wrist actigraphy and physical activity measured by waist accelerometry, lower subjective sleep quality was associated with increased hunger, more disinhibited, uncontrolled and emotional eating, and higher cognitive restraint. There was no significant association between the amount of sleep measured by wrist actigraphy and any of these eating behavior factors. Our findings indicate that small decrements in self-reported sleep quality can be a sensitive indicator for the presence of potentially problematic eating patterns in healthy urban adults with familial risk for type 2 diabetes.

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Sleep and fatigue symptoms in women before and 6 weeks after hysterectomy.

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OBJECTIVE: To compare sleep and fatigue experiences of women before
hysterectomy
and at 3 and 6 weeks after surgery, to compare symptoms by type of surgical procedure, and to examine the biopsychosocial contextual factors related to symptoms.

DESIGN: A descriptive repeated measures study assessed sleep and fatigue using questionnaires and objective wrist actigraphy monitoring for sleep.

SETTING: Data were collected in women's homes at least 2 days before surgery, and at 3 and 6 weeks postoperatively.

PARTICIPANTS: A convenience sample of 25 women scheduled for hysterectomy.

RESULTS: There was significantly higher self-reported sleep disturbance 3 weeks after surgery compared with baseline. Women who had vaginal hysterectomy continued to experience sleep disturbance and fatigue 6 weeks after surgery, while those who had abdominal hysterectomy reported better sleep and less fatigue at 6 weeks compared with baseline. The number of awakenings recorded with actigraphy increased postoperatively for both groups, and younger women experienced more wake time during the night than older women. Level of education was positively related to preoperative fatigue severity.

CONCLUSIONS: Findings suggested poor sleep and fatigue during the postoperative period should be evaluated in light of women's ages, level of education, and type of surgical procedure.

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Sleep and female reproduction.

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PURPOSE OF REVIEW: Sleep disturbances are increasing in prevalence in North America. There is growing evidence that poor sleep quality and short sleep duration may adversely affect circadian rhythms, which in turn may affect female reproduction. The objective of this review is to evaluate recent literature on the association between sleep disturbances and female reproduction.

RECENT FINDINGS: There is accumulating evidence that sleep quality and duration are important for female reproduction, but epidemiologic research is limited. Recent studies provide suggestive evidence that sleep disorders are associated with increased menstrual irregularity, subfertility/infertility, and poor pregnancy and birth outcomes. Mechanisms underlying these associations are likely to be multifactorial and complex. In addition to genetics, circadian disruption may impact reproductive outcomes through dysregulation of the hypothalamic-pituitary-adrenal axis, insulin resistance, oxidative stress, and systemic inflammation. Recommendations for future studies include: use of prospective study designs; assessment of populations not already experiencing reproductive disorders; more detailed and accurate assessments of sleep such as validated self-reported measures or objective sleep measures (e.g. actigraphy); comprehensive assessment of potential confounders and mediators; and elucidation of biologic mechanisms.

SUMMARY: There is a growing body of literature showing evidence that sleep disturbances influence female reproduction, although further epidemiologic research is needed.

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Sleep and frailty syndrome in elderly residents of long-stay institutions: a cross-sectional study.

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AIM: Aging changes sleep patterns in most elderly people. Frailty shares a number of characteristics with sleep disorders and leads to similar results. However, their relationship in residents of long-stay institutions remains unclear. Thus, the present study aimed to evaluate the relationship between sleep and frailty syndrome in residents of long-stay institutions.

METHODS: This was a cross-sectional study of 69 institutionalized elderly in the city of João Pessoa, Brazil. The Pittsburg Sleep Quality Index, actimetry and specific tests for frailty phenotype variables were used. Pearson's $\chi^2$-test, one-way anova and multiple linear regression were applied in statistical analysis.

RESULTS: The sample was characterized as predominantly frail (49.3%), mainly women (62.3%), with a mean age of 77.52 years ($\pm$ 7.82). Frail elderly exhibited poor sleep quality, when compared with non-frail individuals ($P = 0.02$). In the multiple linear regression analysis, sleep latency ($R^2 = 0.11$, $P = 0.003$) and sleep quality ($R^2 = 0.08$, $P = 0.013$) had an influence on frailty, especially sleep quality. No differences were found between rest-activity pattern and frailty phenotype.

CONCLUSION: Sleep alterations, including poor sleep quality and prolonged latency, were related to frailty in institutionalized elderly.

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Sleep and Lipid Profile During Transition from Childhood to Adolescence.

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OBJECTIVES: To assess the longitudinal effects of sleep duration and quality on lipid profiles during the transition from childhood to early adolescence, over a 4-year-period.

STUDY DESIGN: A cohort study of children born in 1998 examined at 8 years of age (SD, 0.3; n = 105) and 12 years of age (SD, 0.5; n = 190). Sleep duration, wake after sleep onset, sleep efficiency, and weekend catch-up sleep were measured with actigraphs for 7 (8 years of age) and 8 (12 years of age) nights.
Fasting serum samples were collected at 12 years of age. Covariates included age, pubertal development, socioeconomic status, body mass index, and physical activity.

RESULTS: In girls, shorter sleep duration at 8 and 12 years of age was associated with lower high-density lipoprotein-cholesterol and higher triglycerides at 12 years of age. Poorer sleep quality at 8 years of age and longer weekend catch-up sleep at 12 years of age was associated with higher triglycerides at 12 years of age. From 8 to 12 years of age, improvement in sleep quality associated with higher total cholesterol, and a decrease in sleep duration with lower lipid levels. In boys, longer sleep duration at 8 years of age, and a larger decrease in sleep duration from 8 to 12 years of age was associated with higher levels of triglycerides at 12 years of age.

CONCLUSIONS: Poorer sleep during transition to early adolescence is associated with an atherogenic lipid profile in early adolescent girls, and such effects are less prominent in boys. Poor sleep may have long-term associations with health, which are not mitigated by the amount of physical activity.

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Sleep and neurobehavioral performance vary by work start time during non-traditional day shifts.

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INTRODUCTION: It is established that shiftwork causes sleep loss and circadian misalignment. Individuals who work non-traditional day shifts that encroach into typical sleep times, such as those in the service and transportation sectors, may also experience sleep and circadian disruption. We aimed to determine how neurobehavioral performance and sleep would be affected by work start time among individuals working a non-traditional daytime shift pattern.

METHODS: We collected sleep diaries, wrist-worn actigraphy (CamNtech, Cambridge UK), and the psychomotor vigilance task (PVT) from 44 pilots (4F) who worked a shift rotation consisting of a five-day baseline block starting in the mid-morning (baseline), five early shifts (early), five high workload midday shifts (midday), and five days of late shifts (late), each separated by 3-4 days off.

RESULTS: Mixed-model analysis revealed that individuals obtained less sleep when working the early shifts (5.70 ± 0.73 h) relative to baseline (6.78 ± 0.86 h; P < .01). Sleep duration declined significantly from the beginning to the end of late shifts (P = .003). All shifts were associated with decreased reaction time on the PVT relative to baseline (236 ± 48 ms; early, 257 ± 70 ms; midday 261 ± 62 ms; late 266 ± 64 ms; P < .01 for all).

CONCLUSIONS: We found that non-traditional day shifts encroach on an individual's sleep opportunity and such shifts could be a contributing factor to the high prevalence of sleep deficiency observed in modern society. Our findings suggest that it would be prudent for industries requiring such shifts to expand fatigue risk management training to individuals classified as day shift workers.
Sleep and Night-time Caregiving in Parents of Children and Adolescents with Type 1 Diabetes Mellitus – A Qualitative Study.

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Background: Type 1 diabetes mellitus (T1DM) is a common chronic illness of childhood, with parents assuming considerable responsibility for night-time diabetes caregiving. This qualitative study explored diabetes-related factors affecting, and solutions proposed to improve, parental sleep.

Participants: 10 mothers and 10 fathers of children ≤18 years of age with T1DM in Otago, New Zealand. Methods: Semi-structured individual interviews were audio-recorded, transcribed, and systematically coded for themes. Parents completed the Pittsburgh Sleep Quality Index (PSQI) and habitual sleep of parents and children were assessed via 7-day actigraphy. Results: Parents (n = 20) and their children with T1DM (n = 16) were aged between 32 and 54 years, and 1 and 17 years, respectively. PSQI revealed poor quality sleep in 13/20 parents. A range of diabetes-related factors, including glucose monitoring and fear of hypoglycemia, contributed to parental sleep disturbance, including awakenings and
the perception of "sleeping lightly". Two distinct time periods resulted in greater sleep disturbance, notably, following T1DM diagnosis and when transitioning to using a new diabetes technology. Factors influencing maternal and paternal sleep were similar, but, generally, mothers described greater night-time care burden and sleep disturbance. While the use of diabetes technologies was generally advocated to improve parental sleep and the provision of nocturnal T1DM care, they were also perceived to potentially contribute to parental sleep disturbance.

Conclusions: Pediatric diabetes care teams should be aware of diabetes-related factors potentially affecting parental sleep, the mixed impacts of diabetes technologies, and consider tailored parental support and education to reduce the burden of nocturnal care.

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Sleep and performance in simulated Navy watch schedules.

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To operate Navy ships 24h per day, watchstanding is needed around the clock, with watch periods reflecting a variety of rotating or fixed shift schedules. The 5/15 watch schedule cycles through watch periods with 5h on, 15h off watch, such that watches occur 4h earlier on the clock each day – that is, the watches rotate backward. The timing of sleep varies over 4-day cycles, and sleep is split on some days to accommodate nighttime watchstanding. The 3/9 watch schedule cycles through watch periods with 3h on, 9h off watch, allowing for consistent sleep timing over days. In some sections of the 3/9 watch schedule, sleep may need to be split to accommodate nighttime watchstanding. In both the 5/15 and 3/9 watch schedules, four watch sections alternate to cover the 24h of the day. Here we compared sleep duration, psychomotor vigilance and subjective sleepiness in simulated sections of the 5/15 and 3/9 watch schedules. Fifteen healthy male subjects spent 6 consecutive days (5 nights) in the laboratory. Sleep
opportunities were restricted to an average of 6.5h daily. Actigraphically
estimated sleep duration was 5.6h per watch day on average, with no
significant
difference between watch sections. Sleep duration was not reduced when
sleep
opportunities were split. Psychomotor vigilance degraded over watch
days, and
tended to be more variable in the 5/15 than in the 3/9 watch sections. These
laboratory-based findings suggest that Navy watch schedules are
associated with
cumulative sleep loss and a build-up of fatigue across days. The fixed
watch
periods of the 3/9 watch schedule appear to yield more stable
performance than
the backward rotating watch periods of the 5/15 watch schedule. Optimal
performance may require longer and more consistent daily opportunities
for sleep
than are typically obtained in Navy operations.

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Sleep and recovery in physicians on night call: a longitudinal field
study.


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BACKGROUND: It is well known that physicians' night-call duty may
cause impaired
performance and adverse effects on subjective health, but there is
limited
knowledge about effects on sleep duration and recovery time. In recent
years
occupational stress and impaired well-being among anaesthesiologists
have been
frequently reported for in the scientific literature. Given their main
focus on handling patients with life-threatening conditions, when on call, one might
expect sleep and recovery to be negatively affected by work, especially in this
specialist group. The aim of the present study was to examine whether a 16-hour
night-call schedule allowed for sufficient recovery in anaesthesiologists
compared with other physician specialists handling less life-threatening
conditions, when on call.

METHODS: Sleep, monitored by actigraphy and Karolinska Sleep Diary/Sleepiness
Scale on one night after daytime work, one night call, the following first and
second nights post-call, and a Saturday night, was compared between 15
anaesthesiologists and 17 paediatricians and ear, nose, and throat surgeons.

RESULTS: Recovery patterns over the days after night call did not differ between
groups, but between days. Mean night sleep for all physicians was 3
hours when on call, 7 h both nights post-call and Saturday, and 6 h after daytime
work (p < 0.001). Scores for mental fatigue and feeling well rested were poorer
post-call, but returned to Sunday morning levels after two nights' sleep.

CONCLUSIONS: Despite considerable sleep loss during work on night
call, and unexpectedly short sleep after ordinary day work, the physicians' self-reports
indicate full recovery after two nights' sleep. We conclude that these
16-hour night duties were compatible with a short-term recovery in both
physician groups, but the limited sleep duration in general still implies a long-term
health concern. These results may contribute to the establishment of safe
working hours for night-call duty in physicians and other health-care workers.

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PMID: 20712854 [Indexed for MEDLINE]

Sleep and rhythm consequences of a genetically induced loss of
BACKGROUND: A genetic deficiency in sepiapterin reductase leads to a combined deficit of serotonin and dopamine. The motor phenotype is characterized by a dopa-responsive fluctuating generalized dystonia-parkinsonism. The non-motor symptoms are poorly recognized. In particular, the effects of brain serotonin deficiency on sleep have not been thoroughly studied.

OBJECTIVE: We examine the sleep, sleep-wake rhythms, CSF neurotransmitters, and melatonin profile in a patient with sepiapterin reductase deficiency. 

PATIENT: The patient was a 28-year-old man with fluctuating generalized dystonia-parkinsonism caused by sepiapterin reductase deficiency.

METHODS: A sleep interview, wrist actigraphy, sleep log over 14 days, 48-h continuous sleep and core temperature monitoring, and measurement of CSF neurotransmitters and circadian serum melatonin and cortisol levels before and after treatment with 5-hydroxytryptophan (the precursor of serotonin) and levodopa were performed.

RESULTS: Before treatment, the patient had mild hypersomnia with long sleep time (704 min), ultradian sleep–wake rhythm (sleep occurred every 11.8 +/- 5.3 h), organic hyperphagia, attention executive dysfunction, and no depression. The serotonin metabolism in the CSF was reduced, and the serum melatonin profile was flat, while cortisol and core temperature profiles were normal. Supplementation with 5-hydroxytryptophan, but not with levodopa, normalized serotonin metabolism in the CSF, reduced sleep time to 540 min, normalized the eating disorder and the melatonin profile, restored a circadian sleep–wake rhythm (sleep occurred every
24 +/- 1.7 h, P < 0.0001), and improved cognition.

CONCLUSION: In this unique genetic paradigm, the melatonin deficiency (caused by a lack of its substrate, serotonin) may cause the ultradian sleep-wake rhythm.

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Sleep and sadness: exploring the relation among sleep, cognitive control, and depressive symptoms in young adults.

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BACKGROUND: Sleep disturbance is a common feature of depression. However, recent
work has found that individuals who are vulnerable to depression report poorer sleep quality compared to their low-risk counterparts, suggesting that sleep disturbance may precede depression. In addition, both sleep disturbance and depression are related to deficits in cognitive control processes. Thus we examined if poor sleep quality predicts subsequent increases in depressive symptoms and if levels of cognitive control mediated this relation.

METHODS: Thirty-five undergraduate students participated in two experimental sessions separated by 3 weeks. Participants wore an actigraph watch between sessions, which provided an objective measure of sleep patterns. We assessed self-reported sleep quality and depressive symptoms at both sessions. Last, individuals completed an exogenous cuing task, which measured ability to disengage attention from neutral and negative stimuli during the second session.

RESULTS: Using path analyses, we found that both greater self-reported sleep difficulty and more objective sleep stability measures significantly predicted greater difficulty disengaging attention (i.e., less cognitive control) from negative stimuli. Less cognitive control over negative stimuli in turn predicted increased depression symptoms at the second session. Exploratory associations among the circadian locomotor output cycles kaput gene, CLOCK, single nucleotide polymorphism (SNP), rs11932595, as well as sleep assessments and depressive symptoms also are presented.

CONCLUSIONS: These preliminary results suggest that sleep disruptions may contribute to increases in depressive symptoms via their impact on cognitive control. Further, variation in the CLOCK gene may be associated with sleep quality.

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BACKGROUND: Fetal alcohol spectrum disorder (FASD) is a syndrome that results from prenatal alcohol exposure and is defined by significant neurobehavioral impairments. Sleep disruption has been recognized as a clinically important symptom of FASD that has multiple negative effects on the child's health, ability to function adaptively, as well as on family and caregivers. However, few studies have addressed and characterized the sleep problems in this population.

OBJECTIVE: The objective of this study was to characterize sleep in FASD and describe the impact of sensory processing difficulties on sleep patterns in children with FASD.

METHODS: Children with FASD were compared with age-matched typically developing children between 3 and 6 years of age. Sleep was assessed using actigraphy, a sleep log, and the Children's Sleep Habits Questionnaire. The Sensory Profile™, completed by caregivers, was used to evaluate the child's sensory processing abilities. Overall differences in sensory processing were correlated with actigraphic parameters measured in alcohol exposed and control groups.

RESULTS: Data show that children with FASD have significantly more sleep disturbances than typically developing children, including increased bedtime resistance, shortened sleep duration, increased sleep anxiety, and increased night awakenings and parasomnias. Actigraphy reveals a significant
difference between groups for sleep onset latency.

CONCLUSIONS: This study demonstrates that sensory processing deficits are widespread in children with FASD and that these deficits are associated with multiple sleep problems. Children with FASD should be screened for sleep-related disorders and would benefit from occupational therapy for sensory-based treatment aimed at sleep regulation and consolidation.

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Sleep and sleepiness of fishermen on rotating schedules.

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Seafaring is a hazardous occupation with high death and injury rates, but the role of seafarer fatigue in these events is generally not well documented. The International Maritime Organization has identified seafarer fatigue as an important health and safety issue. Most research to date has focused on more regularly scheduled types of operations (e.g., merchant vessels, ferries), but there is relatively little information on commercial fishing, which often involves high day-to-day and seasonal variability in work patterns and workload. The present study was designed to monitor the sleep and sleepiness of commercial fishermen at home and during extended periods at sea during the peak of the hoki fishing season, with a view to developing better fatigue management strategies for this workforce. Sleep (wrist actigraphy and sleep diaries) and sleepiness (Karolinska Sleepiness Scale [KSS] before and after each sleep period)
of 20 deckhands were monitored for 4-13 days at home and for 5-9 days at sea while working a nominal 12 h on/6 h off schedule. On the 12 h on/6 h off schedule, there was still a clear preference for sleep at night. Comparing the last three days at home and the first three days at sea showed that fishermen were more likely to have split sleep at sea (Wilcoxon signed ranks \( p < 0.001 \)), but the median sleep/24 h did not differ significantly by location (5.9 h at sea vs. 6.7 h at home). However, on 23% of days at sea, fishermen obtained < 4 h total sleep/24 h, compared to 3% of days at home (\( p(\chi^2) < 0.01 \)). Sleep efficiency, mean activity counts/min sleep, and subjective ratings of sleep quality did not differ significantly between the last three days at home and the first three days at sea. However, sleepiness ratings remained higher after sleep at sea (Wilcoxon signed ranks \( p < 0.05 \)), with fishermen having post-sleep KSS ratings \( \geq 7 \) on 24% of days at sea vs. 9% of days at home (Wilcoxon signed ranks \( p < 0.01 \)). This work adds to the limited number of studies that objectively monitored the sleep of seafarers. It has the strength of operational fidelity but the weakness that large inter- and intra-individual variability in sleep, combined with the small sample size, limited the power of the study to detect statistically significant differences between sleep at home and at sea. The clear preference for sleep at night during the 12 h on/6 h off schedule at sea is consistent with the expectation that this 18 h duty/rest cycle is outside the range of entrainment of the circadian pacemaker. High levels of acute sleep loss, and residual sleepiness after sleep, were much more common at sea than at home. The longer duration of trips during the peak of the fishing season increases the risk of performance impairment due to greater cumulative sleep loss than would be expected on typical three-day trips. Key fatigue management strategies in this environment
include

that fishermen report to work as well rested as possible. Once at sea, the
day-to-day variability in activities due to uncontrollable factors, such as
fishing success, repairing gear, and weather conditions, mean that
contingency planning is required for managing situations where the entire crew have
experienced long periods of intensive work with minimum recovery opportunities.

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Sleep and stress before and after duty across residency years under 2017 ACGME hours.

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INTRODUCTION: Residents may differentially experience high stress and poor sleep across multiple post-graduate years (PGYs), negatively affecting safety. This study characterized sleep and stress among medical and surgical residents across multiple PGYs and at specific times surrounding duty.

METHOD: Thirty-two medical and surgical residents (Mage = 28.6 years; 56% male) across PGYs 1-5 participated in 3 appointments (immediately before duty, after duty, and on an off day) providing 96 data points. Sleep, stress, and occupational fatigue were measured by both self-report and objectively (actigraphy, salivary cortisol).

RESULTS: Residents averaged 7 h of actigraphy-estimated sleep per night but varied ±3 h day-to-day. Residents reported clinically poor sleep quality. Life stress decreased by PGY-2. All residents averaged elevated life stress values. Poor sleep quality did not differ among PGY cohorts.

DISCUSSION: Poor sleep quality is similar between early residency cohorts (PGY-1) and later residency cohorts (PGY-3+). Persistent fatigue is highest in later residency cohorts. Even the most experienced residents may struggle with persisting fatigue. Current hour policies may have shortcomings in addressing this risk.

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Sleep and the endogenous melatonin rhythm of high arctic residents during the summer and winter.

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The seasonal extremes of photoperiod in high latitudes place particular strain on the human circadian system. Arctic residence has been associated with poor sleep in both summer and winter. The goal of the work reported here was to study the circadian rhythms of individuals living in the high Arctic by measuring sleep variables and the timing of melatonin production. Two research trials were conducted in the built environment of CFS Alert (82° 29' 58" N). Participants wore motion logging devices (actigraphs), which measure ambient light as well as motion, for 1 week to provide data on sleep quantity, quality and light exposure. On the penultimate day of each trial, the participants were maintained together in a gymnasium with lounge chairs and saliva was collected at regular intervals to measure melatonin and assess the dim light melatonin onset (DLMO), offset (MelOFF), 50% rise and fall times of the whole profile and total production. In general, sleep duration was found to be significantly different between the January and June data collections at CFS Alert, with participants in June sleeping 50 min on average less each day compared to their January counterparts. In June sleep was mistimed in many subjects relative to circadian phase as evidenced by the melatonin rhythm. Exposure to bright evening light was the most likely causal factor and should be avoided in the Arctic summer. The Arctic summer represents a particularly challenging environment for obtaining sufficient sleep. This has implications for the cognitive performance of staff during work hours.
Sleep/awake status throughout the night and circadian motor activity patterns in older nursing-home residents with or without dementia, and older community-dwelling people without dementia.

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BACKGROUND: Sleep disturbances are commonly observed in older nursing home residents, mainly in combination with dementia. However, sleep-associated circadian motor activity patterns have not been thoroughly investigated in Japanese nursing homes. The present study aimed to respectively clarify the effect of community living and the presence of dementia on sleep disturbances and interrupted activity rhythm of older nursing-home residents with or without dementia and older community-dwelling people without dementia.

METHODS: Actigraph devices worn on the participants' non-dominant wrists for seven days were used to collect objective measurements of the sleep/awake status throughout the night and the circadian motor activity patterns. The presence of dementia was assessed by a trained medical doctor using the residents' records and the Clinical Dementia Rating (CDR). The functional capacity of the participants was determined using the Barthel Index (BI).

RESULTS: Fifty-one older people in Akita prefecture were included in...
the current study, consisting of 17 residents with dementia (mean age: 82.2 years), 17 residents without dementia (84.5 years), and 17 community-dwelling people (83.6 years). The results showed that older nursing-home residents with dementia had significantly a lower rate of sleep efficiency and a longer awake time throughout the night than the other groups. Older nursing-home residents with and without dementia had more fragmented rhythm than community-dwelling people without dementia.

CONCLUSION: These results provide evidence of poor sleep/awake status throughout the night and interrupted circadian activity rhythms in nursing-home residents with and without dementia. However, further studies performed according to dementia classifications are needed.

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Sleep Characteristics and Carotid Atherosclerosis Among Midlife Women.


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Introduction: Midlife, which encompasses the menopause transition in women, can be a time of disrupted sleep and accelerated atherosclerosis accumulation. Short or poor sleep quality has been associated with cardiovascular disease (CVD) risk; few studies have investigated relations among midlife women. We tested whether shorter actigraphy sleep time or poorer subjective sleep quality was associated with carotid atherosclerosis among midlife women.

Aims and Methods: Two hundred fifty-six peri- and postmenopausal women aged 40-60 years completed 3 days of wrist actigraphy, hot flash monitoring, questionnaires (Pittsburgh Sleep Quality Index [PSQI], Berlin), a blood draw, and carotid ultrasound [intima media thickness (IMT), plaque]. Associations of objective (actigraphy) and subjective (PSQI) sleep with IMT/plaque were tested in regression models (covariates: age, race, education, body mass index, blood pressure, lipids, insulin resistance, medications, snoring, depressive symptoms, sleep hot flashes, and estradiol).

Results: Shorter objective sleep time was associated with higher odds of carotid plaque (for each hour shorter sleep, plaque score ≥ 2, odds ratio (OR) [95% confidence interval, CI] = 1.58 (1.11-2.27), p = .01; plaque score = 1, OR [95% CI] = 0.95 (0.68-1.32), p = .75, vs. no plaque, multivariable). Poorer subjective sleep quality was associated with higher mean IMT [β, b (standard error, SE) = 0.004 (0.002), p = .03], maximal IMT [b (SE) = 0.009 (0.003), p = .005], and plaque [plaque score ≥ 2, OR (95% CI) = 1.23 (1.09-1.40), p = .001; score = 1, OR (95% CI) = 1.06 (0.93-1.21), p = .37, vs. no plaque] in multivariable models. Findings persisted additionally adjusting for sleep hot flashes and estradiol.

Conclusions: Shorter actigraphy-assessed sleep time and poorer subjective sleep...
quality were associated with increased carotid atherosclerosis among midlife women. Associations persisted adjusting for CVD risk factors, hot flashes, and estradiol.

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Sleep characteristics and health-related quality of life in 9- to 11-year-old children from 12 countries.

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INTRODUCTION: Previous studies have linked short sleep duration, poor sleep quality, and late sleep timing with lower health-related quality of life (HRQoL) in children. However, almost all studies relied solely on self-reported sleep information, and most studies were conducted in high-income countries. To address these gaps, we studied both device-measured and self-reported sleep characteristics in relation to HRQoL in a sample of children from 12 countries that vary widely in terms of economic and human development.

METHODS: The study sample included 6,626 children aged 9–11 years from Australia, Brazil, Canada, China, Colombia, Finland, India, Kenya, Portugal, South Africa,
the United Kingdom, and the United States. Waist-worn actigraphy was used to measure total sleep time, bedtime, wake-up time, and sleep efficiency on both weekdays and weekends. Children also reported ratings of sleep quantity and quality. HRQoL was measured by the KIDSCREEN-10 survey. Multilevel regression models were used to determine the relationships between sleep characteristics and HRQoL.

RESULTS: Results showed considerable variation in sleep characteristics, particularly duration and timing, across study sites. Overall, we found no association between device-measured total sleep time, sleep timing or sleep efficiency, and HRQoL. In contrast, self-reported ratings of poor sleep quantity and quality were associated with HRQoL.

CONCLUSIONS: Self-reported, rather than device-based, measures of sleep are related to HRQoL in children. The discrepancy related to sleep assessment methods highlights the importance of considering both device-measured and self-reported measures of sleep in understanding its health effects.

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Sleep characteristics and inflammatory biomarkers among midlife women.


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Study Objectives: Research suggests that sleep disturbances are associated with elevated levels of inflammation. Some evidence indicates that women may be particularly vulnerable; increased levels of inflammatory biomarkers with sleep disturbances are primarily observed among women. Midlife, which encompasses the menopause transition, is typically reported as a time of poor sleep. We tested whether poorer objectively measured sleep characteristics were related to a poorer inflammatory profile in midlife women.

Methods: Two hundred ninety-five peri- and postmenopausal women aged 40–60 completed 3 days of wrist actigraphy, physiologic hot flash monitoring, questionnaires (e.g. Berlin sleep apnea risk questionnaire), and a blood draw for the assessment of inflammatory markers, including C-reactive protein (CRP), interleukin-6 (IL-6), and von Willebrand factor (VWF) antigen. Associations of objective (actigraphy) sleep with inflammatory markers were tested in regression models. Sleep efficiency was inverse log transformed. Covariates included age, race/ethnicity, education, body mass index, sleep apnea risk, homeostatic model assessment (a measure of insulin resistance), systolic blood pressure, low-density lipoprotein cholesterol, and physical activity.

Results: In separate models controlling for age, race/ethnicity, and education, lower sleep efficiency was associated with higher IL-6 \( b(\text{SE}) = .02 (.10), p = .003 \) and VWF \( b(\text{SE}) = .02 (.08), p = .002 \). More minutes awake after sleep onset was associated with higher VWF \( b(\text{SE}) = .12 (.06), p = .01 \). Findings
persisted in multivariable models. Conclusions: Lower sleep efficiency and more minutes awake after sleep onset were independently associated with higher circulating levels of VWF. Lower sleep efficiency was associated with higher circulating levels of IL-6. These findings suggest that sleep disturbances are associated with greater circulating inflammation in midlife women.

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Sleep Characteristics and Rest-Activity Rhythms Are Associated with Gastrointestinal Symptoms Among Adults with Inflammatory Bowel Disease.

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BACKGROUND: Sleep disturbance is common in inflammatory bowel disease (IBD) and is associated with poorer quality of life and increased disease activity; however, sleep is a multidimensional process, and little is known about specific sleep characteristics and rest-activity rhythms (RARs) in this population.

AIMS: The purposes were to (1) describe sleep characteristics and RARs; (2) compare sleep characteristics and RARs and GI symptoms by disease activity; and (3) describe associations between sleep characteristics, RARs, and GI symptoms among adults with IBD.

METHODS: We conducted a cross-sectional study of adults with IBD. We measured
sleep characteristics and RARs (continuous wrist actigraphy); GI symptoms (PROMIS-GI); and disease activity (physicians' global assessment). We conducted cosinor and nonparametric analyses to compute RAR variables and bivariate analyses to address the aims.

RESULTS: The sample included 37 participants [age M = 38 years (SD = 13.8) and 21 (56.8%) female], of whom 23 (60.6%) were in remission. Sleep efficiency [M = 82.91% (SD 5.35)] and wake after sleep onset (WASO) [M = 42.26 min (SD 18.57)] were not associated with disease activity. Inter-daily stability of the RAR was associated with heartburn/reflux (r = - .491, p = .005) and gas/bloating (r = - .469, p = .008). Intra-daily variability of the RAR was associated with heartburn/reflux (r = .421, p = .018).

CONCLUSIONS: People with IBD may have disrupted RARs, which are associated with GI symptoms. Research is needed to improve understanding of these associations and to develop interventions to improve these characteristics in adults with IBD.

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Sleep characteristics in child and adolescent offspring of parents with bipolar disorder: a case control study.


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BACKGROUND: Impairment of sleep and circadian rhythm is a typical feature of bipolar disorder (BD). We carried out an exploratory cross-sectional case-control study to extend the knowledge of sleep characteristics in offspring at risk for BD.

METHODS: We investigated 42 offspring of bipolar parents (OB) (mean age 12.5 ± 3.2) and 42 sex and age matched comparison offspring of healthy parents. We administered the Pediatric Sleep Questionnaire, the Morningness/Eveningness Questionnaire and The General Behavior Inventory Sleep Subscale (GBISS) to assess circadian preference, and to identify sleep impairment symptoms. In addition, the participants completed 14 days of actigraphy to characterise sleep and wake patterns. The current psychopathology profile was assessed using Kiddie Schedule for Affective Disorders and Schizophrenia.

RESULTS: Prevalence of sleep disturbance symptoms was higher among OB than controls (headache after waking up, 17.9% vs. 2.4%, p = 0.03; excessive daytime sleepiness, 38.5% vs. 10.0%, p = 0.004; apparent tiredness at wake-up times, 43.6% vs. 15.0%, p = 0.007 and nightmares, 21.6% vs. 2.4%, p = 0.01), but the differences between groups were not significant after adjusting for current psychopathology. OB had higher GBISS total score (parental version, p < 0.001; self-assessment, p = 0.07) than the controls. OB had higher preference
for eveningness than the controls (p = 0.047). According to the actigraphy, OB had longer sleep onset latency (p = 0.048) than the controls.

CONCLUSION: Evidence suggests that the offspring of bipolar parents experience sleep disturbance symptoms, which was associated with psychopathology in this study. Prospective longitudinal sleep studies would clarify whether sleep disturbance could be a predictor of mood disorder onset in this high-risk population.

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Sleep, circadian rhythm, and physical activity patterns in depressive and anxiety disorders: A 2-week ambulatory assessment study.

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BACKGROUND: Actigraphy may provide a more valid assessment of sleep, circadian rhythm (CR), and physical activity (PA) than self-reported
questionnaires, but has not been used widely to study the association with depression/ anxiety and their clinical characteristics.

METHODS: Fourteen-day actigraphy data of 359 participants with current (n = 93), remitted (n = 176), or no (n = 90) composite international diagnostic interview depression/anxiety diagnoses were obtained from the Netherlands Study of Depression and Anxiety. Objective estimates included sleep duration (SD), sleep efficiency, relative amplitude (RA) between day-time and night-time activity, mid sleep on free days (MSF), gross motor activity (GMA), and moderate-to-vigorous PA (MVPA). Self-reported measures included insomnia rating scale, SD, MSF, metabolic equivalent total, and MVPA.

RESULTS: Compared to controls, individuals with current depression/anxiety had a significantly different objective, but not self-reported, PA and CR: lower GMA (23.83 vs. 27.4 milli-gravity/day, p = .022), lower MVPA (35.32 vs. 47.64 min/day, p = .023), lower RA (0.82 vs. 0.83, p = .033). In contrast, self-reported, but not objective, sleep differed between people with current depression/anxiety compared to those without current disorders; people with current depression/anxiety reported both shorter and longer SD and more insomnia. More depressive/anxiety symptoms and number of depressive/anxiety diagnoses were associated with larger disturbances of the actigraphy measures.

CONCLUSION: Actigraphy provides ecologically valid information on sleep, CR, and PA that enhances data from self-reported questionnaires. As those with more severe or comorbid forms showed the lowest PA and most CR disruptions, the potential for adjunctive behavioral and chronotherapy interventions should be explored, as well as the potential of actigraphy to monitor treatment response to such interventions.

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Sleep coach intervention for teens with type 1 diabetes: Randomized pilot study.

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BACKGROUND: Teens with type 1 diabetes (T1D) experience increased sleep disturbances, which have been linked to problems with adherence and glycemic control. As such, sleep represents a novel target to improve outcomes in teens.

OBJECTIVE: To evaluate the feasibility, acceptability, and preliminary efficacy of a sleep-promoting intervention in teens with T1D.

RESEARCH DESIGN AND METHODS: Teens aged 13 to 17 with T1D (n = 39) completed measures of sleep quality and diabetes management and wore actigraphs to obtain an objective measure of sleep. Hemoglobin A1C (HbA1c) was collected from medical records. Teens were randomized to Usual Care (n = 19) or the Sleep Coach intervention (n = 20). Teens in the Sleep Coach group received educational materials on healthy sleep habits and completed three individual telephone sessions. Follow-up data were collected at 3 months, including exit interviews with teens and parents.

RESULTS: Feasibility of the study was excellent; 80% of teens in the Sleep Coach group completed all three sessions, and retention was high (90%). Based on actigraphy data, a significant improvement in sleep efficiency and
Sleep duration was observed (48-minute increase) among teens randomized to the Sleep Coach intervention, and teens in the control group were 7.5 times more likely to report poor sleep quality after 3 months than intervention participants. No change in HbA1c was observed.

CONCLUSIONS: The Sleep Coach intervention for teens with T1D is a feasible and acceptable program that increased sleep duration and improved sleep quality for this high-risk population.

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Sleep-Cognition Hypothesis In maritime Pilots, what is the effect of long-term work-related poor sleep on cognition and amyloid accumulation in healthy middle-aged maritime pilots: methodology of a case-control study.


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INTRODUCTION: Evidence indicates a bidirectional relationship between poor sleep and Alzheimer's disease (AD). While AD may lead to disruption of normal sleep, poor sleep in itself may play a causal role in the development of AD by influencing the production and/or clearance of the amyloid-beta (Aβ) protein. This led to the hypothesis that extended periods (>10 years) of sleep loss could lead to Aβ accumulation with subsequent cognitive AD-related decline. This manuscript describes the methodology of the SCHIP study, a cohort study in maritime pilots that aims at investigating the relationship between prolonged work-related sleep loss, cognitive function and amyloid accumulation among healthy middle-aged maritime pilots, to test the hypothesis that prolonged sleep loss increases the risk of AD-related cognitive decline.

METHODS: Our study sample consists of a group of healthy middle-aged maritime pilots (n=20), who have been exposed to highly irregular work schedules for more than 15 years. The maritime pilots will be compared to a group of healthy, age and education-matched controls (n=20) with normal sleep. Participants will complete 10 days of actigraphy (Actiwatch 2, Philips Respironics) combined with a sleep-wake diary. They will undergo one night of polysomnography, followed by comprehensive assessment of cognitive function. Additionally, participants will undergo amyloid positron emission tomography-CT to measure brain amyloid accumulation and MRI to investigate atrophy and vascular changes.

ANALYSIS: All analyses will be performed using IBM SPSS V.20.0 (SPSS). We will perform independent samples t-tests to compare all outcome parameters.

ETHICS AND DISSEMINATION: The study protocol was approved by our institutional ethical review board (NL55712.091.16, file number 2016-2337) and will be performed according to Good Clinical Practice rules. Data and results will be published in 2020.
STUDY OBJECTIVES: Coregulation of biological systems is a defining feature of normative attachment in close adult relationships. Sleep is a shared, intimate biological process between couples; however, sleep is usually examined at the individual level. We examined minute-by-minute concordance in couples' actigraphy-defined sleep-wake patterns, and how attachment style and marital satisfaction relate to concordance.

DESIGN: Couples completed measures of avoidant and anxious attachment styles and relationship functioning and wore wrist actigraphs for 10 days. Minute-by-minute concordance of sleep and wake (i.e., the percentage of epochs in which both partners were asleep, or both were awake) was calculated for each sleep period. Mixed modeling was used to account for measurement occasions across time.

RESULTS: Percent concordance ranged from 53–88% and was not associated with couples' sleep quality or circadian preference. For wives, neither anxious nor avoidant attachment was associated with sleep-wake concordance. For
husbands, anxious attachment style was associated with higher concordance, but was moderated by wives' marital satisfaction. High marital satisfaction in wives was associated with higher concordance, regardless of husbands' attachment style. In couples in which wives reported low satisfaction, concordance was higher when husbands had an anxious attachment style. Avoidant attachment style in husbands was not related to concordance.

CONCLUSIONS: Sleep concordance provides a unique measure of couples' cosleep and varies depending on attachment style and relationship satisfaction.

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Sleep deficits in the High Arctic summer in relation to light exposure and behaviour: use of melatonin as a countermeasure.

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BACKGROUND: There are conflicting reports regarding seasonal sleep difficulties in polar regions. Herein we report differences in actigraphic sleep measures between two summer trials (collected at Canadian Forces Station Alert,
82.5°N, in 2012 and 2014) and evaluate exogenous melatonin for preventing/treating circadian phase delay due to nocturnal light exposure.

METHODS: Subjects wore actigraphs continuously to obtain sleep data. Following seven days of actigraphic recording the subjects filled out questionnaires regarding sleep difficulty and psychosocial parameters and subsequently remained in dim light conditions for 24 hours, during which saliva was collected bihourly to measure melatonin. During Trial 2, individuals who reported difficulty sleeping were prescribed melatonin, and a second saliva collection was conducted to evaluate the effect of melatonin on the circadian system.

RESULTS: Trial 1 subjects collectively had late dim light melatonin onsets and difficulty sleeping; however, the Trial 2 subjects had normally timed melatonin rhythms, and obtained a good quantity of high-quality sleep. Nocturnal light exposure was significantly different between the trials, with Trial 1 subjects exposed to significantly more light between 2200 and 0200h. Melatonin treatment during Trial 2 led to an improvement in the subjective sleep difficulty between the pre- and post-treatment surveys; however there were no significant differences in the objective measures of sleep.

CONCLUSIONS: The difference in sleep and melatonin rhythms between research participants in June 2012 and June 2014 is attributed to the higher levels of nocturnal light exposure in 2012. The avoidance of nocturnal light is likely to improve sleep during the Arctic summer.

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Sleep deprivation and a non-24-h working schedule lead to extensive
alterations
in physiology and behavior.


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Most organisms on Earth possess circadian rhythms in their physiology and behaviors that allow them to resonate with the cycling environment over a 24-h period. However, in human society, a substantial quantity of jobs requires non-24-h working and rest or shift schedules, which causes more or less misalignment in circadian rhythms and disorders as a consequence. In this work, we conducted a sleep deprivation (SD) and non-24-h working and rest schedule (8 h on and 4 h off) experiment over 10 d in total and measured the changes in a series of physiologic and cognitive parameters. The results show that although the subjects could sleep during the schedule, their sleepiness increased significantly. Actigraphy data suggest that a 12-h schedule might result in chronic SD. Along with the increased sleepiness revealed by the Karolinska Sleepiness Scale questionnaire, the neurobehavioral psychomotor vigilance test data reveal that, compared with the control period, the reaction time of the subjects was significantly delayed. The saliva insulin levels were
significantly changed in the morning in SD and non-24-h cycles. Salivary biochemical parameters were also altered, including aspartate aminotransferase and K+. 16S rRNA-based analysis of the salivary microbiota showed differentially changed patterns in bacteria composition and concentration. Together, these data demonstrate that an abnormal working and rest schedule might produce comprehensive interference with circadian rhythms, metabolism, and cognition.—Ma, H., Li, Y., Liang, H., Chen, S., Pan, S., Chang, L., Li, S., Zhang, Y., Liu, X., Xu, Y., Shao, Y., Yang, Y., Guo, J. Sleep deprivation and a non-24-h working schedule lead to extensive alterations in physiology and behavior.

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Sleep disorders as a cause of motor vehicle collisions.

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Studies have shown that a large proportion of traffic accidents around the world are related to inadequate or disordered sleep. Recent surveys have linked driver fatigue to 16% to 20% of serious highway accidents in the UK, Australia, and Brazil. Fatigue as a result of sleep disorders (especially obstructive sleep apnea), excessive workload and lack of physical and mental rest, have been shown to be major contributing factors in motor vehicle accidents. A number of
behavioral, physiological, and psychometric tests are being used increasingly to evaluate the impact of fatigue on driver performance. These include the oculography, polysomnography, actigraphy, the maintenance of wakefulness test, and others. Various strategies have been proposed for preventing or reducing the impact of fatigue on motor vehicle accidents. These have included: Educational programs emphasizing the importance of restorative sleep and the need for drivers to recognize the presence of fatigue symptoms, and to determine when to stop to sleep; The use of exercise to increase alertness and to promote restorative sleep; The use of substances or drugs to promote sleep or alertness (i.e. caffeine, modafinil, melatonin and others), as well as specific sleep disorders treatment; The use of CPAP therapy for reducing excessive sleepiness among drivers who have been diagnosed with obstructive sleep apnea. The evidence cited in this review justifies the call for all efforts to be undertaken that may increase awareness of inadequate sleep as a cause of traffic accidents. It is strongly recommended that, for the purpose of promoting highway safety and saving lives, all disorders that cause excessive sleepiness should be investigated and monitored.

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The Sleep Disorders Inventory: an instrument for studies of sleep disturbance in persons with Alzheimer's disease.

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The Sleep Disorders Inventory (SDI) is an expanded version of one item of the Neuropsychiatric Inventory (NPI). It describes the frequency, severity, and caregiver burden of sleep-disturbed behaviors during a period prior to its administration. We carried out post hoc analyses on baseline responses to the SDI in 104 persons with Alzheimer's disease (AD) and live-in caregivers who had been recruited for a trial of melatonin in the treatment of sleep disturbance. These patient-participants averaged <7 h of sleep per night, measured by actigraph (sleep disturbance), for the 2–3-week period prior to administration of SDI. Data were from the 2 weeks prior to the baseline visit (SDI, NPI) including actigraph-derived sleep variables and 2 weeks' worth of sleep quality ratings (SQR) kept in a diary by caregivers, plus Mini-Mental State Examination and activities of daily living assessment at baseline. The prevalence of sleep disorder symptoms ranged from 34% (waking up at night thinking it is daytime) and 82% (getting up during the night). Worse SDI scores were associated with worse cognitive, functional, and behavioral status, but not with sex, age, education or duration of dementia. SDI scores were significantly worse in individuals meeting independently established criteria for a diagnosis of 'sleep disturbance' (<6 h total sleep time per night) whereas demographic variables and scores reflecting cognition and function were not significantly different across this grouping. The SDI covers a wide range of sleep behaviors and provides information independent of sleep time and SQR.

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Sleep disruption and duration in late pregnancy is associated with excess gestational weight gain among overweight and obese women.

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BACKGROUND: Poor sleep during pregnancy has been associated with poorer birth outcomes. High body mass index (BMI) is often associated with poor sleep, but little is known about the relationship between gestational weight gain and sleep in late pregnancy. The purpose of this study was to evaluate the relationships of both gestational weight gain and pre-pregnancy BMI to objective and subjective measures of sleep during late pregnancy.

METHODS: Pregnant women (n=128) were recruited from prenatal clinics and childbirth classes primarily serving low-income women. Their sleep (disruption and duration) was objectively assessed in their last month of pregnancy with 72 hours of wrist actigraphy monitoring. Their perceived sleep quality was assessed with the Pittsburgh Sleep Quality Index. Pre-pregnancy and late pregnancy height and weight were assessed by self-report and used to calculate BMI and gestational weight gain, which were then grouped into standardized categories.

RESULTS: Mean Pittsburgh Sleep Quality Index score was 6.8 ± 3.1 (range 2-16). Sixty percent had excess gestational weight gain and it was associated with poorer perceived sleep quality, but was unrelated to objective measures of sleep duration and disruption. Pre-pregnancy BMI was unrelated to all sleep parameters.
However, analyses of the interaction of pre-pregnancy BMI and gestational weight gain indicated that excess weight gain was associated with shorter sleep duration and more sleep disruption, but only among women who were overweight before pregnancy.

CONCLUSION: Pregnancy is an opportunity to promote long-term women's health with a better understanding of the relationship between weight management and healthy sleep habits.

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Sleep disruption explains age-related prospective memory deficits: implications for cognitive aging and intervention.


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The high prevalence of sleep disruption among older adults may have implications for cognitive aging, particularly for higher-order aspects of cognition. One domain where sleep disruption may contribute to age-related deficits is prospective memory—the ability to remember to perform deferred actions at the appropriate time in the future. Community-dwelling older adults (55–93 years, N = 133) undertook assessment of sleep using actigraphy and participated in a laboratory-based prospective memory task. After controlling for education, sleep disruption (longer awakenings) was associated with poorer prospective memory. Additionally, longer awakenings mediated the relationship between older age and poorer prospective memory. Other metrics of sleep disruption, including sleep efficiency and wake after sleep onset, were not related to prospective memory, suggesting that examining the features of individual wake episodes rather than total wake time may help clarify relationships between sleep and cognition. The mediating role of awakening length was partially a function of greater depression and poorer executive function (shifting) but not retrospective memory. This study is among the first to examine the association between objectively measured sleep and prospective memory in older adults. Furthermore, this study is novel in suggesting sleep disruption might contribute to age-related prospective memory deficits; perhaps, with implications for cognitive aging more broadly. Our results suggest that there may be opportunities to prevent prospective memory decline by treating sleep problems.

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Sleep disruption in young foster children.

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In the current study, sleep actigraphy and parent-report measures were used to investigate differences in sleeping behavior among four groups of 3-to 7-year-olds (N = 79): children in regular foster care (n = 15); children receiving a therapeutic intervention in foster care (n = 17); low income community children (n = 18); and upper middle income community children (n = 29). The children in therapeutic foster care exhibited longer sleep latency and increased variability of sleep duration than the upper middle income community children. In addition, there was an indication of a treatment effect: the therapeutic foster care children slept longer than the regular foster care and low income community children and had earlier bedtimes, fell asleep earlier, and spent more time in bed than the regular foster care children. The results are discussed in terms of the effectiveness of early intervention for enhancing sleep in foster children.

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PMID: 20221849 [Indexed for MEDLINE]


Sleep disturbance, fatigue, and stress among Chinese-American parents with ICU hospitalized infants.

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The purpose of this study is to describe Chinese-American parents' sleep disturbances and fatigue in relation to their stress levels, resulting from the hospitalization of their infants in intensive care units (ICUs). Four sets of data were collected: (1) Parents' demographic data and infant's medical records; (2) Subjective sleep data gathered from the General Sleep Disturbance Scale, from sleep diary descriptions, and objective sleep data from wrist actigraphy recordings; (3) Fatigue severity from the Numerical Rating Scale-Fatigue; and (4) Data from the Parental Stressor Scale: Infant Hospitalization. A majority of the mothers (93%) and fathers (60%) experienced sleep problems after their infants were admitted to the ICU. Mothers reported greater sleep disturbances and more severe fatigue than did fathers. Actigraphy records showed that mothers experienced much more wakeful time during the night than did fathers. In both gender categories, less total sleep time was related to reports of higher parental stress, and higher morning fatigue was related to subjectively reported sleep disturbances. Findings from this preliminary study demonstrate significant relationships among parents' perceived stress, impaired sleep, and fatigue severity during the infant's hospitalization period. Findings suggest implications for education of both ICU parents and staffs. This study could be replicated with a bigger sample size to further examine the relationships between parental stress and well-being.

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Sleep disturbance in children with moderate/severe atopic dermatitis: A case-control study.

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BACKGROUND: Sleep is disturbed in 60% of children with atopic dermatitis (AD).
OBJECTIVE: To characterize sleep in a cohort of children with moderate-to-severe AD and determine methods for assessment of sleep disturbance.
METHODS: A case-control study compared children age 6 to 17 years who have moderate-to-severe AD with age- and sex-matched healthy controls. Participants wore actigraphy watches and completed sleep- and disease-specific questionnaires.
RESULTS: Nineteen patients with AD and 19 controls completed the study. The patients with AD experienced wake after sleep onset (WASO) for 103 plus or minus 55 minutes as compared with 50 plus or minus 27 minutes in the controls (P < .01). They had a higher frequency of restless sleep, daytime sleepiness, difficulty falling back to sleep at night, and teacher-reported daytime sleepiness. Disease severity correlated well with WASO (total SCORing Atopic
Dermatitis score: \( r = 0.61, P < .01 \); objective SCORing Atopic Dermatitis score:  
\( r = 0.58, P = .01 \); and Eczema Area and Severity Index: \( r = 0.68, P < .01 \). The  
Children’s Dermatology Life Quality Index sleep question correlated with WASO  
(\( r = 0.52, P = .03 \)), but self-reported itch severity did not  
(\( r = 0.28, P = .30 \)).  
LIMITATIONS: The study cohort was small.  
CONCLUSION: Children with moderate-to-severe AD experience more WASO and lower  
sleep efficiency than healthy controls but similar bedtime and wake  
time, sleep  
duration, and sleep onset latency.

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Sleep Disturbance in Female Flight Attendants and Teachers.
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BACKGROUND: Flight attendants (FAs) may experience circadian disruption due to  
travel during normal sleep hours and through multiple time zones. This study  
investigated whether FAs are at higher risk for sleep disturbance compared to  
teachers, as assessed by questionnaire, diary, and activity monitors.  
METHODS: Sleep/wake cycles of 45 FAs and 25 teachers were studied. For one  
menstrual cycle, participants wore an activity monitor and kept a daily diary.  
Sleep metrics included total sleep in the main sleep period (MSP), sleep  
efficiency (proportion of MSP spent sleeping), and nocturnal sleep fraction
Relationships between sleep metrics and occupation were analyzed with mixed and generalized linear models.

RESULTS: Both actigraph and diary data suggest that FAs sleep longer than teachers. However, several actigraph indices of sleep disturbance indicated that FAs incurred significant impairment of sleep compared to teachers. FAs were more likely than teachers to have poor sleep efficiency [adjusted odds ratio (OR) for lowest quartile of sleep efficiency = 1.9, 95% Confidence Interval (CI) 1.2 – 3.0] and to have a smaller proportion of their sleep between 10 p.m. and 8 a.m. home time (adjusted OR for lowest quartile of nocturnal sleep fraction = 3.1, CI 1.1 – 9.0).


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Sleep disturbance relates to neuropsychological functioning in late-life depression.


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BACKGROUND: Sleep–wake disturbance in older people is a risk factor for
depression onset and recurrence. The aim of this study was to determine if objective sleep-wake disturbance in late-life depression relates to neuropsychological functioning.

METHODS: Forty-four older patients with a lifetime history of major depression and 22 control participants underwent psychiatric, medical and neuropsychological assessments. Participants completed self-report sleep measures, sleep diaries and wore wrist actigraphy for two weeks. Outcome measures included sleep latency, the number and duration of nocturnal awakenings and the overall sleep efficiency.

RESULTS: Patients with depression had a greater duration of nocturnal awakenings and poorer sleep efficiency, in comparison to control participants. Sleep disturbance in patients was associated with greater depression severity and later ages of depression onset. It also related to poorer psychomotor speed, poorer verbal and visual learning, poorer semantic fluency as well as poorer performance on tests of executive functioning. These relationships largely remained significant after controlling for depression and estimated apnoea severity.

LIMITATIONS: This sample had only mild levels of depression severity and results require replication in patients with moderate to severe depression. The inclusion of polysomnography and circadian markers would be useful to delineate the specific features of sleep-wake disturbance that are critical to cognitive performance.

CONCLUSIONS: Sleep-wake disturbance in older patients with depression is related to neuropsychological functioning and to later ages of illness onset. This study suggests that common neurobiological changes may underpin these disease features, which may, in turn, warrant early identification and management.

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Sleep disturbances and circadian CLOCK genes in borderline personality disorder.

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Borderline personality disorder (BPD) is characterised by a deep-reaching pattern of affective instability, incoherent identity, self-injury, suicide attempts, and disturbed interpersonal relations and lifestyle. The daily activities of BPD patients are often chaotic and disorganized, with patients often staying up late while sleeping during the day. These behavioural patterns suggest that altered circadian rhythms may be associated with BPD. Furthermore, BPD patients frequently report suffering from sleep disturbances. In this review, we overview the evidence that circadian rhythms and sleep are disturbed in BPD, and we explore the possibility that personality traits that are pertinent for BPD may be associated with circadian typology, and perhaps to circadian genotypes. With regards to sleep architecture, we review the evidence that BPD patients display altered non-REM and REM sleep. A possible cue to a deeper understanding of this temporal dysregulation might be an analysis of the circadian clock at the molecular and cellular level, as well as behavioural studies using actigraphy and we suggest avenues for further exploration of these factors.

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Sleep Disturbances and Depression in the Multi-Ethnic Study of Atherosclerosis.

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STUDY OBJECTIVES: We examined the association of objectively and subjectively measured sleep disturbances with depression, and explored if race/ethnicity, socioeconomic status, and sex modified these associations.

METHODS: We used data from the cross-sectional Multi-Ethnic Study of Atherosclerosis Sleep Study. Participants included 1,784 adults (ages 54–93 y), 36.8% non-Hispanic Whites, 28.0% African Americans, 23.7% Hispanics, 11.5% Chinese, and 46.0% males. Sleep was assessed with actigraphy, polysomnography, and self-report. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression (CES-D) scale. We used relative risk regression to evaluate the association of sleep measures and depression (CES-D score ≥ 16) adjusting for site, sociodemographics, and behavioral and medical risk factors.

RESULTS: Overall, 14.5% had depression, 29.3% had insomnia symptoms, 14.1% had excessive daytime sleepiness (EDS), 15.1% had apnea-hypopnea index (AHI) ≥ 30,
and 30.4% experienced short sleep (< 6 h). Depression was associated with short sleep duration (adjusted prevalence ratio [PR] = 1.47, 95% confidence interval [CI] = 1.11, 1.94), < 10% rapid eye movement [REM] sleep (PR = 1.57, 95% CI = 1.08, 2.27), ≥ 25% REM sleep (PR = 1.42, 95% CI = 1.03, 1.95), insomnia (PR = 1.83, 95% CI = 1.39, 2.40), excessive daytime sleepiness (EDS) (PR = 1.61, 95% CI = 1.19, 2.18), and AHI > 15 + EDS (PR = 1.55, 95% CI = 1.01, 2.39).

Short sleep duration was associated with depression among those with high school education or beyond, but not among those with less education. Insomnia was more strongly associated with depression among men than women.

CONCLUSIONS: Sleep disturbances are associated with depression among middle-aged and older adults; these associations may be modified by education and sex. Future research should further test these hypotheses, evaluate whether early detection or treatment of sleep disturbances ameliorate depression, and explore subpopulation differences.

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Sleep disturbances in obsessive-compulsive disorder: Association with non-response to repetitive transcranial magnetic stimulation (rTMS).

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Background Repetitive transcranial magnetic stimulation (rTMS) is a promising augmentation strategy for treatment-refractory OCD. However, a substantial group still fails to respond. Sleep disorders, e.g. circadian rhythm sleep disorders (CRSD), are highly prevalent in OCD and might mediate treatment response. The aims of the current study were to compare sleep disturbances between OCD patients and healthy subjects as well as between rTMS responders and non-responders, and most importantly to determine sleep-related predictors of rTMS non-response.

Methods 22 OCD patients received at least 10 sessions rTMS combined with psychotherapy. Sleep disturbances were measured using questionnaires and actigraphy. Sleep in patients was compared to healthy subjects. Treatment response was defined as >35% reduction on YBOCS. Treatment response prediction models were based on measures of CRSD and insomnia. Results Sleep disturbances were more prevalent in OCD patients than healthy subjects. The OCD group consisted of 12 responders and 10 non-responders. The CRSD model could accurately predict non-response with 83% sensitivity and 63% specificity, whereas the insomnia model could not. Conclusions CRSD is more prevalent in OCD patients than healthy subjects, specifically in rTMS non-responders. Therefore, CRSD may serve as a biomarker for different subtypes of OCD corresponding with response to specific treatment approaches.

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Sleep Duration and Blood Glucose Control in Women With Gestational Diabetes Mellitus.

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OBJECTIVE: To describe the relationship between objectively assessed sleep and blood glucose in a prospective cohort of women recently diagnosed with gestational diabetes mellitus (GDM).

METHODS: Women with GDM were enrolled immediately after attending a GDM education class. All patients were recruited during their first week of attempted dietary management of GDM. They were instructed on the use of a glucometer and on the principles of a GDM diet. Women wore an actigraph and completed a sleep log for 7 consecutive days. Glucose records were compared against the objective sleep data. Linear mixed model analysis was used to estimate the association of sleep duration on morning fasting and 1-hour postprandial blood glucose concentrations.

RESULTS: Thirty-seven participants provided data for 213 sleep intervals that corresponded to at least one glucose reading. Sleep duration was negatively associated with fasting and 1-hour postprandial blood glucose concentrations in analyses adjusted for age, gestational age, and body mass index, a 1-hour increase in sleep time was associated with statistically significant reductions in fasting glucose (-2.09 mg/dL, 95% confidence interval [CI] -3.98 to -0.20) as
well as postprandial glucose concentrations (lunch -4.62 mg/dL, 95% CI -8.75 to -0.50; dinner -6.07 mg/dL, 95% CI -9.40 to -2.73).

CONCLUSION: Short sleep durations are associated with worsened glucose control in women with gestational diabetes. Educating women on healthy sleep and screening for and treating sleep disorders during pregnancy may have a role in optimizing blood glucose control in gestational diabetes. LEVEL OF EVIDENCE: II.

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Sleep Duration and Sleep Quality in Caregivers of Patients With Dementia: A Systematic Review and Meta-analysis.

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Importance: In the United States, 16 million family caregivers provide long-term care for patients with dementia. Although one's physical, mental, and cognitive health depends on sleep, many caregivers experience chronic stress, and stress is typically associated with worse sleep quantity and quality.

Objective: To quantify the extent, nature, and treatability of sleep problems in dementia caregivers.

Data Sources: PubMed and Scopus databases were systematically searched for articles published through June 2018 using the following keywords: caregiver or spouse or caretaker AND sleep or circadian AND dementia or Alzheimer. Backward citation tracking was performed, and corresponding authors were contacted for additional data to conduct meta-analyses and pooled analyses.

Study Selection: Two reviewers independently screened 805 studies to
identify those that reported sleep duration or sleep quality in caregivers of patients with dementia.

Data Extraction and Synthesis: Following the PRISMA guidelines, 2 reviewers independently extracted data from all studies and conducted National Heart, Lung, and Blood Institute study quality assessments. Meta-analyses with random-effects models were performed to evaluate sleep duration, sleep quality, and sleep interventions in dementia caregivers.

Main Outcomes and Measures: Sleep quality and total sleep time were measured by polysomnography, actigraphy, and self-report.

Results: Thirty-five studies were analyzed with data from 3268 caregivers (pooled mean age [SD of sample means], 63.48 [5.99] years; 76.7% female) were analyzed. Relative to age-matched control noncaregiver adults, caregivers had lower sleep durations akin to losing 2.42 to 3.50 hours each week (Hedges $g = -0.29; 95\% \text{ CI}, -0.48 \text{ to } -0.09; P = .01$). Sleep quality was significantly lower in caregivers (Hedges $g = -0.66; 95\% \text{ CI}, -0.89 \text{ to } -0.42; P < .001$), but caregivers who underwent sleep intervention trials had better sleep quality than caregivers who did not receive a sleep intervention (Hedges $g = 0.35; 95\% \text{ CI}, 0.20\text{ to } 0.49; P < .001$).

Conclusions and Relevance: Sleep debt is known to have cumulative associations with physical, mental, and cognitive health; therefore, poor sleep quality in dementia caregivers should be recognized and addressed. Although the caregiving role is stressful and cognitively demanding by its nature, better sleep quality was observed in caregivers who received low-cost behavioral interventions.

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Sleep Duration and Telomere Length in Children.


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OBJECTIVE: To test the association between sleep duration and telomere length in a pediatric population.

STUDY DESIGN: We analyzed cross-sectional data for 1567 children from the age 9 study wave of the Fragile Families and Child Wellbeing Study, a population-based birth cohort of children born between 1998 and 2000 in large American cities (population >200 000). We measured telomere length using quantitative polymerase chain reaction, and children's typical nightly sleep duration was reported by their primary caregivers. Using linear regression, we estimated the association between sleep duration and telomere length both in unadjusted models and adjusting for a number of covariates.

RESULTS: We found that children with shorter sleep durations have shorter telomeres than children with longer sleep durations. Each hour less of nightly sleep duration is associated with having telomeres that are 0.015 log-kilobases per chromosome shorter (P < .05). We found no difference in this association by race, sex, or socioeconomic status.

CONCLUSIONS: We provide preliminary evidence that children with shorter sleep durations have shorter telomeres. This finding is consistent with a broader literature indicating that suboptimal sleep duration is a risk for...
increased physiological stress and impaired health. Future research should address the limitations of our study design by using longitudinal study designs and telomere measurements, measuring sleep duration via polysomnography or actigraphy, and assessing the intermediate biological mechanisms of the link between sleep and telomere dynamics.

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Sleep Duration Is Associated with Academic Achievement of Adolescent Girls in Mathematics.

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Purpose: To examine the associations between objective measures of sleep during the school week and academic achievement in mathematics and languages in typically developing adolescent girls.

Methods: Eighty adolescent girls aged 12–17 years (M=14.74, SD=1.3) participated.

For five consecutive weeknights, sleep was assessed in the home environment using an actigraph. Academic achievement was assessed using report card
grades.
Results: Girls who obtained on average less sleep than the recommended amount of 8 to 10 hrs per night had significantly lower grades in mathematics compared to girls who obtained the recommended amount (77.61 vs 86.16, respectively; ηp2=0.11). Hierarchical regression analyses adjusted for age, pubertal status, and socioeconomic status revealed that longer average sleep time was significantly associated with higher grades in mathematics (B=4.78, 95% CI [2.03,7.53]). No significant associations were found between sleep variables and grades in languages.
Conclusion: Longer average weekday sleep duration is associated with academic achievement of adolescent girls in mathematics.

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Conflict of interest statement: The authors report no conflicts of interest in this work.

Sleep duration is associated with increased risk for cardiovascular outcomes: a pilot study in a sample of community dwelling adults in Ghana.


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BACKGROUND: Associations between sleep duration and cardiovascular disease (CVD) risk factors have been demonstrated in past studies. However, previous studies have not investigated these relationships using objective sleep measures in sub-Saharan Africa. Our objective was to investigate the association between sleep duration and cardiovascular risk factors in a sample of community-dwelling Ghanaian adults.

METHODS: We used wrist actigraphy along with a seven-day sleep diary to measure sleep duration, wake after sleep onset, sleep latency, and sleep quality. Participants were randomly selected from among those participating in the RODAM study in rural and urban Ghana. Outcome measurements included 10-year risk of CVD events, prevalent CVD, and metabolic syndrome. Additional participant characteristics were assessed using a structured questionnaire. Linear and logistic regression analyses were used to assess the relationships between sleep measures and CVD risk.

RESULTS: A total of 263 participants from rural and urban Ghana participated. Total sleep time was positively associated with a 10-year CVD risk; this association remained after adjusting for age, sex, urban vs rural...
location, socio-economic status, physical activity, and sleep disturbance ($\beta = 0.990$, $p = 0.015$). Short sleep, defined as sleeping less than seven hours per night on average, was negatively associated with a 10-year CVD risk, and this relationship remained in the fully adjusted model ($\beta = -2.100$, $p = 0.011$). Sleep duration was not associated with prevalence of CVD or metabolic syndrome.

CONCLUSION: Using actigraphy to measure sleep duration among a population of community-dwelling adults in sub-Saharan Africa is feasible. We found a positive association between sleep and CVD risk. No association was found between sleep duration and prevalent CVD or metabolic syndrome. The implications and new directions relating to these findings are stated.

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Sleep duration partially accounts for race differences in diurnal cortisol dynamics.

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OBJECTIVE: Emerging research demonstrates race differences in diurnal cortisol slope, an indicator of hypothalamic-pituitary-adrenocortical (HPA)-axis functioning associated with morbidity and mortality, with African Americans showing flatter diurnal slopes than their White counterparts. Sleep characteristics are associated with both race and with HPA-axis
functioning. The present report examines whether sleep duration may account for race differences in cortisol dynamics.

METHOD: Participants were 424 employed African American and White adults (mean age = 42.8 years, 84.2% White, 53.6% female) with no cardiovascular disease (Adult Health and Behavior Project–Phase 2 [AHAB–II] cohort, University of Pittsburgh). Cortisol slope was calculated using 4 salivary cortisol readings, averaged over each of 4 days. Demographic (age, sex), psychosocial (socioeconomic status [SES], affect, discrimination), and health behaviors (smoking, alcohol use, physical activity) variables were used as covariates, and sleep (self-report and accelerometry) was also assessed.

RESULTS: African Americans had flatter slopes than Whites (F(1, 411) = 10.45, B = .02, p = .001) in models adjusting for demographic, psychosocial, and health behavior covariates. Shorter actigraphy-assessed total sleep time was a second significant predictor of flatter cortisol slopes (F(1, 411) = 25.27, B = -.0002, p < .0001). Total sleep time partially accounted for the relationship between race and diurnal slope [confidence interval = .05 (lower = .014, upper .04)].

CONCLUSIONS: African Americans have flatter diurnal cortisol slopes than their White counterparts, an effect that may be partially attributable to race differences in nightly sleep duration. Sleep parameters should be considered in further research on race and cortisol. (PsycINFO Database Record (c) 2017 APA, all rights reserved).

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Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children.

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OBJECTIVE: The goal was to explore the effects of duration and regularity of sleep schedules on BMI and the impact on metabolic regulation in children.

METHODS: Sleep patterns of 308 community-recruited children 4 to 10 years of age were assessed with wrist actigraphs for 1 week in a cross-sectional study, along with BMI assessment. Fasting morning plasma levels of glucose, insulin, lipids, and high-sensitivity C-reactive protein also were measured for a subsample.

RESULTS: Children slept 8 hours per night, on average, regardless of their weight categorization. A nonlinear trend between sleep and weight emerged. For obese children, sleep duration was shorter and showed more variability on weekends, compared with school days. For overweight children, a mixed sleep pattern emerged. The presence of high variance in sleep duration or short sleep duration was more likely associated with altered insulin, low-density lipoprotein, and high-sensitivity C-reactive protein plasma levels. Children whose sleep patterns were at the lower end of sleep duration, particularly in the presence of irregular sleep schedules, exhibited the greatest health risk.

CONCLUSIONS: Obese children were less likely to experience "catch-up" sleep on weekends, and the combination of shorter sleep duration and more-variable sleep patterns was associated with adverse metabolic outcomes. Educational campaigns, aimed at families, regarding longer and more-regular sleep may promote decreases in obesity rates and may improve metabolic dysfunction trends in
Attentional networks are sensitive to sleep deprivation. However, variation in attentional performance as a function of normal sleep parameters is understudied. We examined whether attentional performance is influenced by (a) individual differences in sleep duration, (b) sleep duration variability, and/or (c) their interaction. A total of 57 healthy participants (61.4% female, Mage = 32.37 years, SD = 8.68) completed questionnaires, wore wrist actigraphy for 1 week, and subsequently completed the attention network test. Sleep duration and sleep duration variability did not predict orienting score, executive control score, or error rates. Sleep duration variability appeared to moderate the...
association between sleep duration with overall reaction time (\( \beta = -0.34, t = -2.13, p = .04 \)) and alerting scores (\( \beta = .43, t = 2.94, p = .01 \)), though further inspection of the data suggested that these were spurious findings. Time of testing was a significant predictor of alerting score (\( \beta = .35, t = 2.96, p = .01 \)), chronotype of orienting (\( \beta = .31, t = 2.28, p = .03 \)), and age of overall reaction time (\( \beta = .35, t = 2.70, p = .01 \)). Our results highlight the importance of examining the associations between variations in sleep-wake patterns and attentional networks in samples with greater variation in sleep, as well as the importance of rigorously teasing apart mechanisms of the sleep homeostat from those related to the circadian rhythm in studies examining cognition.

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Nine girls with Rett syndrome (mean age, 10.1 years) were monitored 24 hours a day over a period of 10 weeks using wrist actigraphy. Baseline sleep-wake patterns were assessed for 1 week. Subsequently, patients underwent a 4-week melatonin treatment period in a double-blind, placebo-controlled, crossover protocol that employed a 1-week washout between treatment trials. Melatonin doses ranged from 2.5 to 7.5 mg, based upon individual body weight. Baseline sleep
quality was poor compared with healthy children. At baseline the group demonstrated a low sleep efficiency (mean [+/- SE], 68.0+/-3.9%), long sleep-onset latency (42.1+/-12.0 minutes), and a short and fragmented total sleep time (7.5+/-0.3 hours; 15+/-2 awakenings per night). Melatonin significantly decreased sleep-onset latency to (mean +/- SE) 19.1+/-5.3 minutes (P<0.05) during the first 3 weeks of treatment. While the variability of individual responsiveness was high, melatonin appeared to improve total sleep time and sleep efficiency in the patients with the worse baseline sleep quality. Finally, a 4-week administration of melatonin appears to be a safe treatment as no adverse side effects were detected, yet long-term effects of chronic melatonin use in pediatric patients are unknown at this time.

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Sleep efficiency (but not sleep duration) of healthy school-age children is associated with grades in math and languages.

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OBJECTIVE: The objective of this study was to examine the associations between
objective measures of sleep duration and sleep efficiency with the grades obtained by healthy typically developing children in math, language, science, and art while controlling for the potential confounding effects of socioeconomic status (SES), age, and gender.

STUDY DESIGN: We studied healthy typically developing children between 7 and 11 years of age. Sleep was assessed for five week nights using actigraphy, and parents provided their child's most recent report card.

RESULTS: Higher sleep efficiency (but not sleep duration) was associated with better grades in math, English language, and French as a second language, above and beyond the contributions of age, gender, and SES.

CONCLUSION: Sleep efficiency, but not sleep duration, is associated with academic performance as measured by report-card grades in typically developing school-aged children. The integration of strategies to improve sleep efficiency might represent a successful approach for improving children's readiness and/or performance in math and languages.

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Sleep enhances memory consolidation in children.

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Sleep is an active state that plays an important role in the consolidation of memory. It has been found to enhance explicit memories in both adults and children. However, in contrast to adults, children do not always show
a sleep-related improvement in implicit learning. The majority of research on sleep-dependent memory consolidation focuses on adults; hence, the current study examined sleep-related effects on two tasks in children. Thirty-three typically developing children aged 6–12 years took part in the study. Actigraphy was used to monitor sleep. Sleep-dependent memory consolidation was assessed using a novel non-word learning task and the Tower of Hanoi cognitive puzzle, which involves discovering an underlying rule to aid completion. Children were trained on the two tasks and retested following approximately equal retention intervals of both wake and sleep. After sleep, children showed significant improvements in performance of 14% on the non-word learning task and 25% on the Tower of Hanoi task, but no significant change in score following the wake retention interval. Improved performance on the Tower of Hanoi may have been due to children consolidating explicit aspects of the task, for example rule-learning or memory of previous sequences; thus, we propose that sleep is necessary for consolidation of explicit memory in children. Sleep quality and duration were not related to children's task performance. If such experimental sleep-related learning enhancement is generalizable to everyday life, then it is clear that sleep plays a vital role in children's educational attainment.

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Sleep, fatigue, depression, and circadian activity rhythms in women with breast cancer before and after treatment: a 1-year longitudinal study.
PURPOSE: Sleep disturbance, fatigue and depression are common complaints in patients with cancer, and often contribute to worse quality of life (QoL). Circadian activity rhythms (CARs) are often disrupted in cancer patients. These symptoms worsen during treatment, but less is known about their long-term trajectory.

METHODS: Sixty-eight women with stage I-III breast cancer (BC) scheduled to receive ≥4 cycles of chemotherapy, and age-, ethnicity-, and education-matched normal, cancer-free controls (NC) participated. Sleep was measured with actigraphy (nocturnal total sleep time [nocturnal TST] and daytime total nap time [NAPTIME]) and with the Pittsburgh Sleep Quality Index (PSQI); fatigue with the Multidimensional Fatigue Symptom Inventory—Short Form (MFSI-SF); depression with the Center of Epidemiological Studies—Depression (CES-D). CARs were derived from actigraphy. Several measures of QoL were administered. Data were collected at three time points: before (baseline), end of cycle 4 (cycle 4), and 1 year post-chemotherapy (1 year).

RESULTS: Compared to NC, BC had longer NAPTIME, worse sleep quality, more fatigue, more depressive symptoms, more disrupted CARs, and worse QoL at baseline (all p values <0.05). At cycle 4, BC showed worse sleep, increased fatigue, more depressive symptoms, and more disrupted CARs compared to their own baseline levels and to NC (all p values <0.05). By 1 year, BC's fatigue, depressive symptoms, and QoL returned to baseline levels but were still worse than those of
NC, while NAPTIME and CARs did not differ from NC's.
CONCLUSION: Additional research is needed to determine if beginning treatment of these symptoms before the start of chemotherapy will minimize symptom severity over time.

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Sleep fragmentation and evidence for sleep debt in alcohol-exposed infants.
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BACKGROUND: Infants exposed prenatally to alcohol are at increased risk for poor neurodevelopmental outcome including Sudden Infant Death Syndrome. AIM: To examine the relationship between prenatal alcohol exposure, sleep, arousal and sleep-related spontaneous motor movements in early infancy.
STUDY DESIGN: Low-income women (N=13) were interviewed regarding pre- and pregnancy rates of alcohol, cigarette smoking and other substance use in the perinatal period. Infants were examined in a laboratory nap study using EEG, videography and actigraphy at 6-8 weeks of age. Estimates of maternal pre- and pregnancy alcohol use were used to divide infants into high vs. low maternal alcohol use groups.
SUBJECTS: Mother-infant dyads recruited from a family practice clinic.
OUTCOME MEASURES: Sleep-related spontaneous movements, behavioral state, and maternal assessments of infant alertness and irritability.
RESULTS: Pre-pregnancy rates of alcohol consumption including binge drinking
correlated with maternal report of poor infant alertness, and increased irritability. High maternal exposure groups showed increased sleep fragmentation, e.g., frequency and duration of wakefulness following sleep onset and decreased active sleep. Bout analysis of the temporal structure of sleep-related spontaneous movements showed significantly reduced bout duration associated with high maternal alcohol use.

CONCLUSION: These results present evidence that prenatal alcohol exposure disrupts postnatal sleep organization and suppresses spontaneous movements during sleep, and increased sleep fragmentation promotes sleep deprivation. Results are consistent with the SIDS model of chronic sleep debt and suggest that attenuated sleep-related movements should be examined as an important modulator of cardiorespiratory functions during sleep in high-risk groups.

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Sleep Fragmentation and the Risk of Incident Alzheimer's Disease and Cognitive Decline in Older Persons.

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OBJECTIVE: Cross-sectional studies suggest that sleep fragmentation is associated with cognitive performance in older adults. We tested the hypothesis that sleep fragmentation is associated with incident Alzheimer's disease (AD) and the rate of cognitive decline in older adults.

DESIGN: Prospective cohort study.

SETTING: Community-based.

PARTICIPANTS: 737 community dwelling older adults without dementia.

MEASUREMENTS AND RESULTS: Sleep fragmentation was quantified from up
to 10 consecutive days of actigraphy. Subjects underwent annual evaluation for AD with 19 neuropsychological tests. Over a follow-up period of up to 6 years (mean 3.3 years), 97 individuals developed AD. In a Cox proportional hazards model controlling for age, sex, and education, a higher level of sleep fragmentation was associated with an increased risk of AD (HR = 1.22, 95%CI 1.03-1.44, P = 0.02 per 1SD increase in sleep fragmentation). An individual with high sleep fragmentation (90th percentile) had a 1.5-fold risk of developing AD as compared with someone with low sleep fragmentation (10th percentile). The association of sleep fragmentation with incident AD did not vary along demographic lines and was unchanged after controlling for potential confounders including total daily rest time, chronic medical conditions, and the use of common medications which can affect sleep. In a linear mixed effect analysis, a 0.01 unit increase in sleep fragmentation was associated with a 22% increase in the annual rate of cognitive decline relative to the average rate of decline in the cohort (Estimate = -0.016, SE = 0.007, P = 0.03).

CONCLUSIONS: Sleep fragmentation in older adults is associated with incident AD and the rate of cognitive decline.

CITATION: Lim ASP; Kowgier M; Yu L; Buchman AS; Bennett DA. Sleep fragmentation and the risk of incident alzheimer's disease and cognitive decline in older persons. SLEEP 2013;36(7):1027-1032.

DOI: 10.5665/sleep.2802
PMCID: PMC3669060
PMID: 23814339
Amongst HIV+ individuals, sleep complaints have been recognized as common and debilitating; but have rarely been formally assessed or compared to controls using validated sleep tools. In this study we conducted structured interview for sleep disorders, polysomnography, 2-week home (ambulatory) monitoring and validated sleep/functional questionnaires. 56% (14/25) of HIV+ participants and 0% (0/19) of controls fulfilled the diagnostic criteria for insomnia. Insomnia severity scores were correlated with fatigue and anxiety symptoms. Sleep latency on 2-week actigraphy was significantly longer ($P = 0.027$) for HIV+ participants and associated with lower MOS-HIV scores. Sleep quality was significantly reduced in HIV+ participants based on validated questionnaires of overall sleep quality ($P = 0.0017$) and insomnia related symptoms ($P < 0.001$) even after adjusting for education and affective symptoms. HIV+ individuals are suffering with under-diagnosed sleep disorders that are negatively impacting quality of life and functional capabilities. Further studies aimed at improving recognition of sleep disorders and implementation of efficacious medical and behavioral treatment could improve functioning and disease management.

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Sleep habits, alertness, cortisol levels, and cardiac autonomic activity in
short-distance bus drivers: differences between morning and afternoon shifts.

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OBJECTIVE: To evaluate sleep, alertness, salivary cortisol levels, and autonomic activity in the afternoon and morning shifts of a sample of short-distance bus drivers.

METHODS: A sample of 47 bus drivers was evaluated. Data regarding subjects and working characteristics, alertness (psychomotor vigilance task), sleep habits (Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, Actigraphy), endocrine stress response (salivary cortisol), and autonomic activity (heart-rate variability) were collected.

RESULTS: Sleep restriction was highly prevalent. Drivers in the morning shift slept 1 hour less than those in the afternoon shift, showed lower reaction time performance, a flattening of cortisol morning–evening difference, and higher overweight prevalence.

CONCLUSIONS: The differences found between morning and afternoon shifts point out to the need of the implementation of educational strategies to compensate the sleep loss associated with an early work schedule.

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Sleep Health and Predicted Cardiometabolic Risk Scores in Employed Adults From Two Industries.

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STUDY OBJECTIVES: Sleep disorders and sleep deficiency can increase the risk for cardiovascular disease. Less is known about whether multiple positive attributes of sleep health known as the SATED (satisfaction, alertness, timing, efficiency, and duration) model, can decrease future cardiovascular disease risks. We examined whether and how a variety of indicators of sleep health predicted 10-year estimated cardiometabolic risk scores (CRS) among employed adults.

METHODS: Workers in two industries—extended care (n = 1,275) and information technology (IT; n = 577)—reported on habitual sleep apnea symptoms and sleep sufficiency, and provided 1 week of actigraphy data including nighttime sleep duration, wake after sleep onset (WASO), sleep timing, and daytime napping. Workers also provided biomarkers to calculate future cardiometabolic risk.

RESULTS: More sleep apnea symptoms predicted higher CRS in both
industries. More sleep sufficiency, less WASO, and less daytime napping (having no naps, fewer naps, and shorter nap duration) were also linked to lower CRS, but only in the extended care workers. There was no effect of sleep duration in both industries. In the IT employee sample, shorter sleep duration (≤ 6 hours versus 6-8 hours) and more naps strengthened the link between sleep apnea and CRS.

CONCLUSIONS: Sleep health, measured by both subjective and objective methods, was associated with lower cardiometabolic disease risks among extended care workers (lower to middle wage workers). Sleep apnea was an important predictor of CRS; for the IT workers, the link between sleep apnea and CRS was exacerbated when they had poorer sleep health behaviors.

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Sleep health disparity: the putative role of race, ethnicity and socioeconomic status.


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Sleep plays a pivotal role in both physical and mental health. Sleep quality can be affected by many socio demographic factors, such as race and/or ethnicity, as well as socio economic status (SES). Chronic sleep deprivation is associated with
unhealthy behaviors such as alcohol abuse and also places individuals at risk for chronic diseases including obesity, cardiovascular disease (CVD), depression, and/or anxiety. This review explores the common socio demographic factors and SES that can lead to sleep disturbances. Among these factors are shift work, poor dietary habits, smoking and alcohol abuse. Such factors need to be considered by health care providers in the clinical assessment and management plans of patients with sleep disorders.

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Conflict of interest statement: Conflicts of interest The author declares that there is no conflict of interests.


Sleep health epidemiology in low and middle-income countries: a systematic review and meta-analysis of the prevalence of poor sleep quality and sleep duration.

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Sleep research has been dominated by high income countries (HIC). Sleep may be different in low and middle income countries (LMIC) due to cultural, demographic, geographical and health factors. We systematically reviewed the epidemiological literature reporting sleep parameters in the adult population in LMIC and meta-analyzed the prevalence of subjective poor sleep quality and sleep duration.

We identified 45 publications; over 50% of which came from China and Brazil. Of the 45 identified studies, 32 contained data on sleep quality and 17 on self-reported sleep duration. Only one study utilized polysomnography and only one study utilized actigraphy. This review provides evidence that sleep parameters in LMIC appear to be similar to those in HIC but the variability and bias found suggests any attempt to extract a universal prevalence estimate or average sleep duration from the current data is very likely flawed and should be taken with caution. In our meta-analysis we found an enormous variability that was not explicable by regional, rurality, gender, age group or sleep assessment method. Further, there was a suggestion of significant small study effect, with smaller studies reporting worse sleep. There is surprisingly little consistent high-quality data that could be used for policy, planning, or scientific purposes at a global level in low and middle-income countries about what humans spend a third of their lives doing. High-quality epidemiological research about basic sleep health parameters is needed that focuses on the whole-population in LMIC, and that uses standardized, well-validated and culturally applicable measures.
Sleep health in young children living with socioeconomic adversity.

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Racially and ethnically diverse young children who live with socioeconomic adversity are at high risk for sleep deficiency, but few behavioral sleep interventions (BSIs) are tailored to their needs. To support the future development of a feasible, acceptable, and culturally relevant sleep intervention, we conducted a community-engaged, mixed-methods study with 40 low-income, racially, and ethnically diverse parents to describe sleep characteristics, sleep habits, and parental sleep knowledge of their 6-36-month-old children and to examine the associations between children's sleep characteristics and sleep habits. This report presents quantitative data from this mixed-methods study. We measured objective (actigraphy) and parent-reported sleep (Brief Infant Sleep Questionnaire) characteristics, sleep habits at bedtime, sleep onset, and during night awakenings, parental sleep knowledge, psychological function (Brief Symptom Inventory), and parenting stress (Parenting Stress Index). Children had low sleep duration (537.2 ± 54.7 nighttime and 111.2 ± 29.8 nap minutes), late bedtimes (22:36 ± 1.5 hr), and high bedtime variability (mean squared successive difference = 3.68 ± 4.31 hr) based on
actigraphy. Parental knowledge about sleep recommendations was limited. Sleep habits before bedtime, at sleep onset, and during night awakenings were varied. Sixty-five percent of parents reported co-sleeping. Feeding near bedtime or during the night was associated with later bedtimes, more fragmented sleep, and increased bedtime variability. These findings suggest the need for BSIs to support earlier bedtimes and improve sleep duration and continuity by addressing modifiable behaviors. Tailored BSIs that consider socioecological influences on the development of sleep habits are needed.

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A Sleep Hygiene and Relaxation Intervention for Children With Acute Lymphoblastic Leukemia: A Pilot Randomized Controlled Trial.

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BACKGROUND: Sleep disturbance and fatigue are common and distressing pediatric cancer-related outcomes. Sleep hygiene education and relaxation techniques are recommended to improve sleep in healthy children and adult cancer
survivors. No studies have tested these interventions to improve sleep and fatigue for children with acute lymphoblastic leukemia (ALL) in the home setting. OBJECTIVES: The aim of this study is to establish the feasibility and acceptability of a sleep hygiene and relaxation intervention to improve sleep and fatigue for children receiving maintenance chemotherapy for ALL. The child's fatigue and sleep data were collected to inform sample size calculations for a future trial.

METHODS: In this pilot randomized controlled trial, 20 children were allocated randomly to the sleep intervention or control group. The sleep intervention group received a 60-minute educational session to discuss sleep and fatigue in children with cancer and strategies to improve sleep, including use of 2 storybooks to teach deep breathing and progressive muscle relaxation. Objective sleep data were collected using actigraphy and fatigue was measured using the Childhood Cancer Fatigue Scale.

RESULTS: The intervention was acceptable to families, and feasibility of the intervention and data collection was clearly established. Although not statistically significant, increases in mean nighttime sleep and decreases in mean wake time after sleep onset in the sleep intervention group represented clinically important improvements.

CONCLUSIONS: This pilot study demonstrated the feasibility and acceptability of a sleep hygiene and relaxation intervention for children undergoing maintenance chemotherapy for ALL.

IMPLICATIONS FOR PRACTICE: Given the clinically important improvements in sleep observed, replication in a larger, adequately powered randomized controlled trial is merited.

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Sleep Hygiene and Sleep Quality of Third-Trimester Pregnant Women.

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The purpose of this descriptive study was to examine the associations of sleep hygiene and actigraphy measures of sleep with self-reported sleep quality in 197 pregnant women in northern Taiwan. Third-trimester pregnant women completed the Sleep Hygiene Practice Scale (SHPS) and the Pittsburgh Sleep Quality Index (PSQI) as well as the Center for Epidemiologic Studies-Depression Scale (CES-D), and wore an actigraph for 7 consecutive days. Student's t-test was used to compare the SHPS scores and means as well as variability of actigraphy sleep variables between poor sleepers (i.e., PSQI global score >5) and good sleepers (i.e., PSQI global score ≤5). Compared to good sleepers, poor sleepers reported significantly worse sleep hygiene, with higher SHPS scores and higher sleep schedule, arousal-related behavior, and sleep environment subscale scores. Poor sleepers had significantly greater intra-individual variability of sleep onset latency, total nighttime sleep, and wake after sleep onset than good sleepers. In stepwise linear regression, older maternal age (p = .01), fewer employment hours per week (p = .01), higher CES-D total score (p < .01), and higher SHPS arousal-related behavior subscale scores (p < .01) predicted self-reported global
Findings support avoiding physically, physiologically, emotionally, or cognitively arousing activities before bedtime as a target for sleep-hygiene intervention in women during pregnancy.

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Sleep-hygiene Education improves Sleep Indices in Elite Female Athletes.

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The importance of sleep in providing psychophysiological recovery in elite athletes is often overlooked. In other populations (eg shift workers and adolescent students), sleep hygiene education may serve to acutely improve sleep indices. However, this is yet to be examined in an elite athlete setting. Therefore, the aim of the current study was to evaluate the effect of a sleep hygiene education session on sleep indices in elite athletes. The study involved 26 elite female netball athletes performing one week of baseline sleep monitoring (PRE), followed by a sleep hygiene education session and a further week of sleep monitoring (POST) in a single group, pre- post design. The sleep hygiene education session focused on providing information on the importance of sleep for athletes and practical tips to improve sleep quality and quantity. Sleep monitoring was performed using wrist actigraphy to assess total sleep time (TST), sleep efficiency (SE%), total time in bed (TTB), sleep latency (SL), wake episodes per night (WE), sleep onset variance (SOV), wake variance (WV) wake
episode duration (WED), sleep onset time (SOT), and wake time (WT). There was a significant improvement in TST (mean ± SD; 22.3 ± 39.9 minutes, p=0.01) PRE to POST sleep hygiene education session, the difference associated with a small effect (ES: 0.39). A significant improvement PRE to POST was found for WV (p=0.03), and for WED (p=0.03). There were no significant differences for SE%, SL, TTB, WE, SOV, SOT, WT. The current study reports that a sleep hygiene education session is effective in improving sleep quantity in elite female athletes in an acute setting.

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Sleep in a Gymnasium: A Study to Examine the Psychophysiological and Environmental Conditions in Shelter-Analogue Settings.


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We aimed to examine sleep in shelter-analogue settings to determine the sleep and environmental conditions in evacuation shelters. A summer social/educational event was conducted in an elementary school, wherein children and their parents (n = 109) spent one night in the school gymnasium; a total of 15 children and 7
adults completed the study. Data were recording using wrist actigraphy and questionnaires, from two days before the event to two days after the event. During the night in the gymnasium, sleep initiation in the children was found to be significantly delayed, whereas adults did not show any significant change in actigraphic sleep parameters. Although 57% of adults complained of stiffness of the floor, only 7% of children had the same complaint. The nocturnal noise recorded at four locations in the gymnasium showed that the percentage of 1-min data epochs with a noise level >40 dB ranged from 53% to 74% during lights-out. The number of subjects that woke up during the night showed a similar pattern with the changes in the noise level. The changes in sleep might represent event-specific responses, such as to a noisy environment, and the different complaints between adults and children could be useful in shelter management.

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Sleep in Children With Autism Spectrum Disorders: How Are Measures of Parent Report and Actigraphy Related and Affected by Sleep Education?

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Sleep disturbance is common in children with autism, resulting in a great need for effective treatments. To evaluate treatments for sleep disturbance in this population, it is critical to understand the relationship between measures of sleep captured by parent report and objective measures. The Children's Sleep Habits Questionnaire (CSHQ) and actigraphy-measured data from 80 children with autism and sleep-onset delay were evaluated. Reported problems with sleep-onset delay were concurrent with sleep duration problems in 66% of children, night wakings in 72% of children, and bedtime resistance in 66% of children; 38% of children were reported to have problems with all CSHQ insomnia domains. Actigraphy-measured sleep duration was correlated with estimates using CSHQ-reported bed and wake times.

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Sleep in children with cancer: case review of 70 children evaluated in a comprehensive pediatric sleep center.
GOAL: The goal of this study was to characterize the sleep problems of children with cancer who were referred for a comprehensive sleep evaluation. MATERIALS AND METHODS: A retrospective case series review was conducted of all children with cancer referred to the pediatric sleep clinic from 1994 to 2009 for evaluation of a sleep problem. Seventy children were seen and evaluated during this interval; all had a complete sleep history taken, and further objective sleep evaluations were performed as part of their evaluation only when clinically indicated. An overnight polysomnogram was performed in 53 children. In 36 children with a history of excessive daytime sleepiness (EDS), a multiple sleep latency study was performed the following day. Seven children had a 3-4-week actigraphic study. RESULTS: Children with neoplasms of central nervous system (CNS) involving the hypothalamus, thalamus, and brainstem were the most commonly referred children and had the most frequent and severe sleep problems. Excessive daytime sleepiness was the most common sleep problem, seen in 60% of children with cancer and in 80% of children with CNS neoplasms involving the hypothalamus, thalamus, and brainstem. Sleep disordered breathing (SDB) was present in 40% of the entire group of children with cancer and 46% of children with neoplasms involving the hypothalamus, thalamus, and brainstem. Children with CNS neoplasms often had more than one sleep problem, most commonly EDS and SDB. In these children, correction of the SDB often did not eliminate the EDS. In children with leukemia, insomnia was the most common sleep problem identified, present in 39%. The causes of the sleep problems were varied and included neurologic injury caused by
the neoplasm
and/or the CNS-directed treatments; seizures, adenotonsillar
hypertrophy,
medication side effects, obesity, pain, anxiety, and drug abuse. Some
of the
sleep problems were present before the diagnosis of cancer, though
most developed
after treatment was begun. A wide range of intervention strategies
were utilized
to address the sleep problems and included sleep hygiene/sleep
restriction,
behavioral counseling, continuous positive airway pressure, bilevel
positive
airway pressure, tracheotomy with and without a ventilator,
diaphragmatic pacers,
sedative hypnotics, stimulants, anticonvulsants, and antidepressants.
When the
sleep problems and their causes were correctly identified and
treatments were
directed to the specific cause of the problem, the treatments were
generally
successful.
CONCLUSIONS: The sleep problems of children with cancer span the full
spectrum of
clinical sleep disorders (hypersomnia, sleep disordered breathing,
insomnia,
parasomnias, and circadian rhythm disorders) and are often present in
combinations. Children with neoplasms involving the brainstem,
thalamus, and
hypothalamus were the most frequently referred for a sleep evaluation,
and their
sleep problems were most commonly EDS or SDB. Expertise in pediatric
sleep
disorders can be a valuable resource in the ongoing care of children
with cancer.

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Sleep in children with epilepsy: the role of maternal knowledge of
childhood
sleep.

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Study Objectives: To examine maternal knowledge of childhood sleep and its relation to sleep quantity, quality, and variability in a clinic sample of mothers of toddlers and preschool-age children with epilepsy.

Methods: A total of 112 epileptic children wore a wrist actigraphy to objectively assess daily sleep duration and its variability across 7 days. Mothers completed the Parents' Sleep Knowledge Inventory and Children's Sleep Habits Questionnaire (CSHQ). Multivariate linear regression models were performed to predict CSHQ sleep disturbance scores, daily sleep duration, and daily sleep duration variability in children with epilepsy.

Results: On average, mothers answered 30.5 per cent of the questions correctly about normal childhood sleep patterns. Only six (5.3%) of the mothers answered half or more of the questions correctly. Mothers more frequently answered "don't know" to questions about dreams, symptoms of sleep-disordered breathing, and adequate amounts of sleep required by children and adolescents. After adjusting for the child's age, gender, bed-sharing, and relevant clinical and epilepsy variables, poorer maternal sleep knowledge was the independent predictor of higher CSHQ sleep disturbance scores and greater intraindividual variability of daily sleep duration in epileptic children (p < 0.05).

Conclusions: Maternal knowledge about childhood sleep is inadequate and decreased maternal sleep knowledge is associated with poorer and more variable sleep in children with epilepsy. Findings from this study document the need to
provide
parental education about childhood sleep, particularly emphasizing the
recommended sleep duration for children across different developmental
stages and
addressing the symptoms of sleep disorders commonly comorbid with
epilepsy.
Trial registration: This trial has been registered at
www.clinicaltrials.gov
(trial name: Sleep Intervention for Pediatric Epilepsy; registration
number: NCT02514291).

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PMID: 30137598  [Indexed for MEDLINE]

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23.

Sleep in cluster headache revisited: Results from a controlled
actigraphic study.

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BACKGROUND AND AIM: Cluster headache attacks exhibit a nocturnal
predilection,
but little is known of long-term sleep and circadian rhythm. The aim
was to
compare actigraphy measures, firstly in episodic cluster headache
patients in
bout and in remission and, secondly, to compare each disease phase
with controls.
METHODS: Episodic cluster headache patients (ICHD III-beta), from the
Danish
Headache Center and healthy, age- and sex-matched controls
participated. Sleep
and activity were measured using actigraphy continuously for 2 weeks,
RESULTS: Patients in bout (n = 17, 2.3 attacks/day) spent more time in bed (8.4 vs. 7.7 hours, p = 0.021) and slept more (7.2 vs. 6.6 hours, p = 0.036) than controls (n = 15). In remission (n = 11), there were no differences compared with controls. Neither were there differences between patients in the two disease phases. In five patients, attacks/awakenings occurred at the same hour several nights in a row.

CONCLUSION: Actigraphy offers the possibility of a continuous and long study period in a natural (non-hospital) environment. The study indicates that sleep does not differ between the bout and remission phase of episodic cluster headache. The repeated attacks/awakenings substantiate that circadian or homeostatic mechanisms are involved in the pathophysiology. The protocol was made available at ClinicalTrials.gov (NCT02853487).

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Sleep in healthy black and white adolescents.

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BACKGROUND AND OBJECTIVES: Inadequate sleep among adolescents has negative consequences for self-regulation, emotional well-being, and risk
behaviors. Using multiple assessment methods, we evaluated the adequacy of sleep among healthy adolescents from a lower socioeconomic community and expected differences by race.

METHODS: A total of 250 healthy high school students enrolled in public school (mean age: 15.7 years; 57% black, 54% female) from families of low to middle class according to the Hollingshead scale participated in weeklong assessments of sleep duration and fragmentation, assessed by using actigraphy; sleep duration and perceived quality, assessed by using daily diaries; and daytime sleepiness and sleep delay, assessed by using a questionnaire.

RESULTS: Students slept during the school week a mean ± SD of 6.0 ± 0.9 hours per night according to actigraphy and 6.8 ± 1.1 hours according to daily diary, and during the weekend, a mean of 7.4 ± 1.2 and 8.7 ± 1.4 hours, respectively. Black participants and male participants slept less and had more fragmented sleep; female participants reported poorer quality of sleep in their daily diaries and more daytime sleepiness. The results remained significant after adjustments for age, physical activity, smoking status, and percentile BMI.

CONCLUSIONS: Most students slept less than the 8 to 9 hours suggested by the guidelines of the Centers for Disease Control and Prevention. Black male participants had the least amount of sleep, which may play a role in the substantial risks experienced by this demographic group. Our findings are consistent with recommendations that pediatricians should routinely screen their adolescent patients about their sleep, especially those from at-risk subgroups.

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OBJECTIVES: To (1) investigate differences by ethnicity and socioeconomic status (SES), in objective measures of sleep in children aged 7–9 years and (2) determine whether measures of sleep predict child achievement in reading or mathematics after controlling for ethnicity and SES.

METHODS: Four groups of parent-child dyads were recruited: Māori, low-SES schools (n = 18); Māori, high-SES schools (n = 17); NZ European, low-SES schools (n = 18); NZ European, high-SES schools (n = 17). Child sleep was measured by actigraphy. Parents and teachers reported child daytime sleepiness and behavior, and children completed a self-report of anxiety symptoms. Teachers also reported on child achievement in reading and mathematics.

RESULTS: Children from low-SES schools went to bed later on school nights (F(1,68) = 12.150, p = 0.001) and woke later (F(1, 68) = 15.978, p < 0.001) than children from high-SES schools but had similar sleep duration. There were no differences related to ethnicity. Children from low-SES schools were almost three times more likely to be below national standards for mathematics. Children not meeting academic standards in mathematics had a later sleep start time, lower sleep period efficiency and a decreased total sleep time. However, when SES and sleep period efficiency were modelled together neither were found to significantly influence achievement in mathematics.
CONCLUSIONS: In this study, SES influenced sleep timing, but not the quality and quantity of sleep in 7-9-year-old children and a significant independent effect of sleep efficiency on learning could not be demonstrated.

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Sleep in overweight adolescents: shorter sleep, poorer sleep quality, sleepiness, and sleep-disordered breathing.

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OBJECTIVE: To document the sleep of overweight adolescents and to explore the degree to which weight-related sleep pathology might account for diminished psychosocial outcome.

METHODS: Sixty children aged 10-16.9 from a weight-management clinic were compared to 22 healthy controls using comprehensive actigraphic, polysomnographic, and parent- and self-report questionnaire assessments.

RESULTS: Overweight participants averaged more symptoms of sleep-disordered breathing, later sleep onset, shorter sleep time, and more disrupted sleep than controls. Although the groups did not differ in self-reported sleep habits, multiple concerns were reported by parents of overweight participants, including daytime sleepiness, parasomnias, and inadequate sleep. Group differences in academic grades and depressive symptoms were at least partially accounted for by
short sleep and daytime sleepiness.  

CONCLUSIONS: Excessive weight is associated with an increased risk of sleep problems. There is a need for further research in this area and for clinicians who work with overweight children to evaluate their sleep.

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Sleep in remitted bipolar disorder: a naturalistic case-control study using actigraphy.

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INTRODUCTION: Findings from actigraphic studies suggesting that sleep and circadian rhythms are disrupted in bipolar disorder (BD) patients have been undermined by methodological heterogeneity and the failure to adequately address potential confounders.

METHOD: Twenty-six euthymic BD cases and 29 healthy controls (HC), recruited from University Paris-Est and matched for age and gender, were compared on subjective (Pittsburgh Sleep Questionnaire Inventory; PQSI) and objective (mean scores and variability in actigraphy) measures of sleep as recorded by over 21 consecutive days.

RESULTS: Multivariate generalized linear modelling (GLM) revealed significant differences between BD cases and HC for five PSQI items (total score and four subscales), four actigraphy variables (mean scores) and five actigraphy variability measures. Backward stepwise linear regression (BSLR) indicated that a combination of four variables (mean sleep duration, mean sleep latency, variability of the fragmentation index over 21 days, and mean score on PSQI daytime dysfunction sub-scale) correctly classified 89% of study participants as cases or controls (Chi-square=39.81; df=6; p=0.001).

LIMITATIONS: The sample size (although larger than most actigraphy studies) and incomplete matching of cases and controls may have influenced our findings. It was not possible to control for potential effects of psychotropic medication or differences in employment status between groups.

CONCLUSIONS: When potential confounders of sleep and circadian profiles are adequately taken into account (particularly age, gender, daytime sleepiness, mood symptoms, body mass index, and risk of sleep apnoea), a selected subset of quantitative (mean scores) and qualitative (variability) features...
Sleep inconsistency between weekends and weekdays is associated with changes in brain function during task and rest.

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STUDY OBJECTIVES: Sleep deprivation and circadian disruptions impair brain function and cognitive performance, but few studies have examined the effect of sleep inconsistency. Here, we investigated how inconsistent sleep duration and sleep timing between weekends (WE) and weekdays (WD) correlated with changes in behavior and brain function during task and at rest in 56 (30 female) healthy human participants.

METHODS: WE-WD differences in sleep duration and sleep midpoint were calculated using 1-week actigraphy data. All participants underwent 3 Tesla blood-oxygen-level-dependent functional Magnetic Resonance Imaging (fMRI) to measure brain activity during a visual attention task (VAT) and in resting-state condition.

RESULTS: We found that WE-WD inconsistency of sleep duration and sleep midpoint were uncorrelated with each other ($r = .08$, $p = .58$) and influenced behavior and
brain function differently. Our healthy participants showed relatively small WE-WD differences (WE-WD: 0.59 hours). Longer WE sleep duration (relative to WD sleep duration) was associated with better attentional performance (3-ball: $\beta = 0.30, t = 2.35, p = 0.023$; 4-ball: $\beta = 0.30, t = 2.21, p = 0.032$) and greater deactivation of the default mode network (DMN) during VAT ($p < 0.05$, cluster-corrected) and greater resting-state functional connectivity (RSFC) between anterior DMN and occipital cortex ($p < 0.01$, cluster-corrected). In contrast, later WE sleep timing (relative to WD sleep timing) (WE-WD: 1.11 hours) was associated with worse performance (4-ball: $\beta = -0.33, t = -2.42, p = 0.020$) and with lower occipital activation during VAT and with lower RSFC within the DMN.

CONCLUSIONS: Our results document the importance of consistent sleep timing for brain function in particular of the DMN and provide evidence of the benefits of WE catch-up sleep in healthy adults.

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STUDY OBJECTIVES: To describe the feasibility, acceptability and preliminary efficacy of a novel Sleep Intervention for Kids and Parents (SKIP). Parent and child primary sleep outcomes were total sleep time (TST), wake after sleep onset (WASO), sleep efficiency (SE), and bedtime range.

METHODS: Children aged 6-11 years with asthma and one parent, both with behavioral sleep disturbance, enrolled in this single-group pilot. The 8-week shared management intervention included weekly online educational modules, goal setting, and progress reporting. Feasibility was measured by the number of dyads who were eligible, enrolled, and retained. Acceptability was measured by survey and semi-structured interview. TST, WASO, SE and bedtime range were measured by actigraphy at baseline, post-intervention, and 12-week follow-up. Mixed-effects regression models were used to determine change in sleep outcomes from baseline.

RESULTS: Thirty-three out of 39 eligible dyads enrolled; of 29 dyads that started the intervention, 25 (86%) completed all study visits. SKIP was acceptable for 61% of children and 92% of parents. Compared to baseline, at follow-up children had significantly improved WASO (-37 min [95% CI = -44.5 to -29.7], p < .001), SE (5.4% [4.2 to 6.5], p < .001), and bedtime range (-35.2 min [-42.9 to -27.5], p < .001). Parents also had significantly improved WASO (-13.9 min [-19.5 to -8.2], p < .001).
p<.001), SE (2.7% [1.7 to 3.7], p<.001), and bedtime range (-35.3 min [-51.0 to -19.7], p<.001).
CONCLUSIONS: SKIP was feasible, acceptable, and we observed improved child and parent sleep outcomes except TST. Following refinements, further testing of SKIP in a controlled clinical trial is warranted.

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BACKGROUND: The cardiovascular system exhibits strong circadian rhythms to maintain normal functioning. Irregular sleep schedules, characterized by high day-to-day variability in sleep duration or timing, represent possibly milder but much more common and chronic disruption of circadian rhythms in the general population than shift work.
OBJECTIVES: This study aimed to prospectively examine the association between sleep regularity and risk of cardiovascular disease (CVD).
METHODS: In MESA (Multi-Ethnic Study of Atherosclerosis), 1,992 participants free
of CVD completed 7-day wrist actigraphy for sleep assessment from 2010 to 2013 and were prospectively followed through 2016. The study assessed sleep regularity using the SD of actigraphy–measured sleep duration and sleep–onset timing across 7 days. Incident CVD included nonfatal and fatal cardiovascular events. A Cox proportional hazards model was used to estimate hazard ratios (HRs) for incident CVD according to SD of sleep duration and timing, adjusted for traditional CVD risk factors (including CVD biomarkers) and other sleep–related factors (including average sleep duration).

RESULTS: During a median follow-up of 4.9 years, 111 participants developed CVD events. The multivariable-adjusted HRs (95% confidence intervals) for CVD across categories of sleep duration SD were 1.00 (reference) for ≤60 min, 1.09 (0.62 to 1.92) for 61 to 90 min, 1.59 (0.91 to 2.76) for 91 to 120 min, and 2.14 (1.24 to 3.68) for >120 min (p trend = 0.002). Similarly, compared with participants with a sleep timing SD ≤30 min, the HRs (95% confidence intervals) for CVD were 1.16 (0.64 to 2.13) for 31 to 60 min, 1.52 (0.81 to 2.88) for 61 to 90 min, and 2.11 (1.13 to 3.91) for >90 min (p trend = 0.002). Exclusion of current shift workers yielded similar results.

CONCLUSIONS: Irregular sleep duration and timing may be novel risk factors for CVD, independent of traditional CVD risk factors and sleep quantity and/or quality.

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Sleep is related to physical function and emotional well–being after cardiac
BACKGROUND: Emotional well-being and physical function are important quality-of-life outcomes after cardiac surgery. Alterations in sleep patterns, including sleep deprivation and altered circadian patterning, also are common. The relations among sleep pattern alterations, physical function, and emotional well-being are not well understood.

OBJECTIVE: This study aimed to examine the relations of sleep patterns to physical function and emotional well-being 4 and 8 weeks after cardiac surgery.

METHODS: Cardiac surgery patients (n = 72) wore wrist actigraphs and completed sleep diaries for 3 days during postoperative weeks 4 and 8. They also completed the Epworth Sleepiness Scale, the Pittsburgh Sleep Quality Index, and the Medical Outcomes Survey Short Form 36 preoperatively and at postoperative weeks 4 and 8. Pearson correlations and hierarchical multiple regression analysis were used to analyze the data.

RESULTS: Mean sleep efficiency was 71% at 4 weeks and 74% at 8 weeks, as measured with wrist actigraphy. According to participants' self-report, 64% experienced sleep disturbance at 4 weeks and 47% at 8 weeks. Sleep pattern variables, including sleep efficiency and self-reported sleep quality, explained 16% of the variance in physical function at 4 weeks. Self-reported sleep quality explained 8% of the variance in physical function at 8 weeks as well as 12% of the variance in emotional well-being at postoperative week 4 and 13% of the variance at postoperative week 8, after control was used for the contributions of baseline physical function, emotional well-being, age, and sex.

CONCLUSIONS: The results suggest that sleep contributes to both
physical functional and emotional well-being 4 and 8 weeks after cardiac surgery.

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Sleep logs of young adults with self-selected sleep times predict the dim light melatonin onset.

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The purpose of this study was to determine whether a sleep log parameter could be used to estimate the circadian phase of normal, healthy, young adults who sleep at their normal times, and thus naturally have day-to-day variability in their times of sleep. Thus, we did not impose any restrictions on the sleep schedules of our subjects (n = 26). For 14 d, they completed daily sleep logs that were verified with wrist activity monitors. On day 14, salivary melatonin was sampled every 30 min in dim light from 19:00 to 07:30 h to determine the dim light melatonin onset (DLMO). Daily sleep parameters (onset, midpoint, and wake) were taken from sleep logs and averaged over the last 5, 7, and 14 d before determination of the DLMO. The mean DLMO was 22:48 +/- 01:30 h. Sleep onset and wake time averaged over the last 5 d were 01:44 +/- 01:41 and 08:44 +/- 01:26 h, respectively. The DLMO was significantly correlated with sleep onset, midpoint, and wake time, but was most strongly correlated with the mean midpoint of sleep from the last 5 d (r = 0.89). The DLMO predicted using the mean midpoint of sleep from the last 5 d was within 1 h of the DLMO determined from salivary melatonin
for 92% of the subjects; in no case did the difference exceed 1.5 h. The correlation between the DLMO and the score on the morningness–eveningness questionnaire was significant but comparatively weak ($r = -0.48$). We conclude that the circadian phase of normal, healthy day-active young adults can be accurately predicted using sleep times recorded on sleep logs (and verified by actigraphy), even when the sleep schedules are irregular.

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Sleep loss and performance of anaesthesia trainees and specialists.

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Fatigue risk associated with work schedules of hospital doctors is coming under increasing scrutiny, with much of the research and regulatory focus on trainees. However, provision of 24 h services involves both trainees and specialists, who have different but interdependent work patterns. This study examined work patterns, sleep (actigraphy, diaries) and performance (psychomotor vigilance task pre- and post-duty) of 28 anaesthesia trainees and 20 specialists across a two-week work cycle in two urban public hospitals. Trainees at one hospital worked back-to-back 12 h shifts, while the others usually worked 9 h day shifts but periodically worked a 14 h day (08:00-22:00 h) to maintain cover until arrival of the night shift (10 h). On 11% of day shifts and 23% of night shifts, trainees were working with $>2$ h of acute sleep loss. However, average sleep
loss was not greater on night shifts, possibly because workload at night in one hospital often permitted some sleep. Post-night shift performance was worse than post-day shift performance for the median (t(131))=3.57, p<0.001) and slowest 10% of reaction times (t(134))=2.91, p<0.01). At the end of night shifts, poorer performance was associated with longer shift length, longer time since waking, greater acute sleep loss, and more total work in the past 24 h. Specialists at both hospitals had scheduled clinical duties during the day and were periodically scheduled on call to cover after-hours services. On 8% of day shifts and 14% of day+call schedules, specialists were working with ≥2 h of acute sleep loss. They averaged 0.6 h less sleep when working day shifts (t(23.5))=2.66, p=0.014) and 0.8 h less sleep when working day shifts+call schedules (t(26.3))=2.65, p=0.013) than on days off. Post-duty reaction times slowed linearly across consecutive duty days (median reaction time, t(131))=-3.38, p<0.001; slowest 10%, t(160))=-3.33, p<0.01; fastest 10%, t(138))=-2.67, p<0.01). Poorer post-duty performance was associated with greater acute sleep loss and longer time since waking, but better performance was associated with longer day shifts, consistent with circadian improvement in psychomotor performance across the waking day. This appears to be the first study to document sleep loss among specialist anaesthetists. Consistent with observations from experimental studies, the sleep loss of specialists across 12 consecutive working days was associated with a progressive decline in post-duty PVT performance. However, this decline occurred with much less sleep restriction (< 1 h per day) than in laboratory studies, suggesting an exacerbating effect of extended wakefulness and/or cumulative fatigue associated with work demands. For both trainees and specialists, robust circadian variation in PVT performance was evident in this complex work setting, despite the potential confounds of variable
shift durations
and workloads. The relationship between PVT performance of an
individual and the
safe administration of anaesthesia in the operating theater is
unknown. Nevertheless, the findings reinforce that any schedule changes to
reduce
work-related fatigue need to consider circadian performance variation
and the
potential transfer of workload and fatigue risk between trainees and
specialists.

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Sleep Measurement in Toddlers From Low-income Families.

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OBJECTIVES: (1) To examine toddler sleep in a low-income sample by
comparing
sleep diaries and actigraphy and (2) to assess whether toddlers are
meeting the
National Sleep Foundation recommendations (11-14 hours of sleep/24
hours and
bedtime before 9 PM).
METHODS: A convenience sample of mother-toddler dyads was recruited
from 2 health
care sites serving low-income communities. An actigraph was placed on
the
toddler's ankle and was worn for 3 days and nights. Mothers
concurrently
completed a sleep diary. Bedtime, nighttime sleep duration, nap
duration, and
24-hour sleep duration were collected by both measures. Actigraphy data were analyzed using a combination of manufacturer's scoring algorithm and manual editing. Descriptive statistics and paired samples t-tests were conducted to examine the differences between sleep estimates by a sleep diary and actigraphy.

RESULTS: Twenty toddlers (aged 13–42 months) were included in the analyses. Based on actigraphy, 1 toddler went to bed by 9 PM on all 3 nights. Six toddlers achieved 11 to 14 hours of sleep measured in a 24-hour period for 1 of the 3 days, but when sleep was averaged across the study, none achieved this goal. Compared with actigraphy, sleep diaries underestimated bedtime by 1 hour, overestimated nighttime sleep duration by 2.5 hours, and overestimated 24-hour sleep duration by 2.3 hours, on average for all 3 nights.

CONCLUSION: Mothers reported significantly earlier bedtimes and longer sleep durations for their toddlers compared with actigraphy, suggesting that objective measures differ from sleep diaries in assessing sleep in toddlers from low-income families. Findings should not be generalized to populations of low-income families without replication.

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Sleep misalignment and circadian rhythm impairment in long-haul bus drivers under a two-up operations system.

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OBJECTIVES: The objective of the study was to describe working and sleep conditions and to assess how sleep opportunities are associated with obtained sleep and alertness, in a sample of long-haul bus drivers working with a two-up operations system.

METHODS: Measures of subjective sleep and sleepiness, actigraphy, circadian temperature rhythm, and psychomotor vigilance tasks were obtained from a sample of 122 drivers from Argentina. Variables were compared between high and low fatigue risk groups, which were formed using a median split of a fatigue risk score. The score was calculated based on drivers' total working hours, maximum
shift duration, minimum short break duration, maximum night work per seven days, and long break frequencies.

RESULTS: Considering a standardized one-day period, sleep in the bus accounted for 1.9±0.1 h of total sleep (57±1% efficiency), sleep at destination for 1.6±0.2 h of total sleep (90±1% efficiency), and sleep at home for 3.8±0.2 h of total sleep (89±1% nap efficiency and 90±1% anchor sleep efficiency). In drivers exposed to high-risk working schedules, the circadian temperature rhythm was weaker (lower % of variance explained by the model) (22.0±1.7% vs. 27.6±2.0%, p <0.05) and without a significant acrophase.

CONCLUSIONS: Drivers obtained a total amount of weekly sleep similar to the recommended levels for adults, but distributed at different locations and at different times during the day. High-risk working schedules were associated with disruption of circadian temperature rhythms. These results point out to the need of the implementation of shift-work scheduling strategies to minimize sleep misalignment and circadian desynchronization in long-haul bus drivers.

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The sleep of remitted bipolar outpatients: a controlled naturalistic study using actigraphy.

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BACKGROUND: Several sleep laboratory studies suggest sleep
abnormalities in bipolar disorder. However, this is the first study to compare remitted bipolar subjects with controls on actigraphic and subjective sleep parameters in a naturalistic setting over 5 nights.

METHODS: Nineteen subjects with Bipolar I Disorder and 19 age- and gender-matched healthy controls were included. Objective sleep parameters were estimated using wrist actigraphs. Subject-rated sleep diaries and mood ratings were also completed. Sleep data were averaged for each subject across nights, and raw score standard deviations were calculated as a measure of within-subject variability.

RESULTS: Multivariate analyses of variance found significant group differences for both actigraphic ($F(4,33)=3.80, P=0.012$) and subjective measures ($F(4,31)=3.18, P=0.027$). Univariate analyses identified reliable differences in sleep onset latency (subjective), sleep duration (subjective), and variability of sleep duration and night wake time (actigraphic). Binary backward stepwise logistic regression demonstrated that a combination of three sleep measures correctly predicted disorder status in 84% of cases.

LIMITATIONS: Failure to match on sociodemographic and employment status is a limitation that may provide an alternative explanation for some findings. Furthermore, in the bipolar group 18 of 19 subjects were in receipt of psychotropic medication, compared to none of the healthy control group. Also, no information was recorded about family history of mental disorders in the control group.

CONCLUSIONS: The study suggests that the sleep of remitted bipolar outpatients measured in naturalistic settings is characteristically different from controls: bipolar subjects sleep longer, report longer onset latencies, and display greater variability across nights.

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INTRODUCTION: Layovers are critical for pilot recovery between flights and minimum layover durations are required by regulation. However, research on the factors affecting layover sleep and safety performance indicators (SPIs) before subsequent flights is relatively sparse. The present project combined data from 6 studies, including 8 long-range and 5 ultra-long range out-and-back trips across a range of different layover destinations (299 pilots in 4-person crews, 410 layovers, 1–3 d layover duration).

METHODS: Sleep was monitored via actigraphy from 3 d pre-trip to at least 3 d post-trip. Pilots rated their sleepiness (Karolinska Sleepiness Scale, KSS) and fatigue (Samn-Perelli scale, SP) at duty start for the inbound flight. Mixed model ANOVAs identified independent associations between fatigue and sleepiness SPIs and operational factors (domicile time of duty start for the inbound flight in six 4-h bins, layover duration, and total sleep time (TST) in the 24 h prior to inbound duty start).

RESULTS: TST was greatest on layovers ending between 1200–1559 domicile time (time in the city from which the outbound flight departed) and TST was a significant predictor of both KSS and SP ratings at duty start for the inbound flight.

DISCUSSION: TST in the 24 h prior to the inbound flight was greatest when duty start time allowed for the inclusion of a full domicile night time period. In this dataset, circadian end-time of layovers is a key determinant of pilot

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Sleep parameters assessed by actigraphy in Fabry's disease patients: a proof-of-concept.

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BACKGROUND: In a previous study developed by our group, we identified a phase inversion in 6-sulfatoxymelatonin – melatonin metabolite in urine – daily profile in Fabry's disease patients. Since melatonin is an endogenous marker, it could also be accompanied by behavioral changes in sleep-wake cycle, which impairs the overall patient's life quality.

OBJECTIVE: In this study, we evaluated sleep-wake cycle in Fabry disease patients. We hypothesized that patients would have increased daytime naps, given our previous results for urinary 6-sulfatoxymelatonin.

PATIENTS/METHODS: This was a cross-sectional and case-control study, performed between October 2016 and May 2017. Volunteers recorded activity and rest rhythm by actigraphy and answered Pittsburgh Sleep Quality Index (PSQI). From
actigraphy data, we calculated sleep parameters: sleep latency, wake after sleep onset, sleep (WASO) efficiency, awakenings index (PSQI), and the amount and duration of daytime naps. We included 16 Fabry disease patients with biochemical and molecular diagnosis and 10 control individuals matched by age and gender.

RESULTS: We did not observe significant differences for any of the parameters analyzed ($p > 0.05$). However, evaluating the magnitude of the effect, we found that patients dozed, on average, about 42 min longer ($d = 0.9$ – large effect size) than control group.

CONCLUSIONS: This is a preliminary study, a proof-of-concept, and our results indicate that changes in melatonin secretion phase may have behavioral consequences in sleep–wake cycle, with longer duration of daytime naps.

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Sleep patterns and cardiometabolic risk in schoolchildren from Cuenca, Spain.


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Sleep seems to have a significant influence on the metabolic syndrome (MetS). However, results in this association are still inconsistent in children. The aim of this study was to examine the influence of sleep characteristics in the MetS (index and factors) in Spanish children. Cross-sectional study including a sample of 210 children aged 8-to-11-years belonging to 20 schools from the province of Cuenca, Spain was conducted. Cardiometabolic risk and actigraphy sleep patterns were determined and analysed using correlation coefficients, ANCOVA models and a propensity score derivation model. Overall, children in the lower time in bed category and those who went to bed later (> 23:15h) showed worse values in the cardiometabolic profile and risk index. Differences were observed when the total time in bed was below 9h 15mins. Our study shows that short sleep duration could be a risk factor for cardiometabolic risk in children, and bedtime may independently influence this risk. In addition, our data suggests that children's sleep hygiene should be incorporated in parenting educational programs.

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Sleep Patterns and Obesity: Hispanic Community Health Study/Study of Latinos Sueño Ancillary Study.

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BACKGROUND: The relationship of poor sleep patterns to the increased risk of obesity has been reported, but the results are variable. This study evaluated the association between objectively measured sleep patterns and obesity in a representative adult population of Hispanic/Latino subjects living in the United States.

METHODS: This cross-sectional study was an analysis of a multicenter, community-based cohort of 2,156 participants aged 18 to 64 years from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Recruitment was conducted in San Diego, California; Chicago, Illinois; Bronx, New York; and Miami, Florida. Models were controlled for age, sex, ethnic background, site, income, education, and apnea-hypopnea index. Seven days of wrist actigraphy data were collected. Obesity was defined as BMI ≥ 30 kg/m^2, and abdominal obesity was defined as waist circumference ≥ 88 cm in women and ≥ 102 cm in men. Napping was defined as more than one 15-min nap per week.

RESULTS: An inverse linear relationship was found between sleep...
duration and prevalence of obesity (P linear trend ≤ 0.01). A reduction of 1 h sleep increased obesity prevalence by 4.1% (95% CI, 1.6-6.6; P = .002) and abdominal obesity prevalence by 3.6% (95% CI, 1.1-6.1; P = .007). Daytime napping increased obesity prevalence by 10.4% (95% CI, 3.5-17.3; P = .004) and abdominal obesity prevalence by 7.1% (95% CI, 1.0-13.2; P = .02).

CONCLUSIONS: In a population of young to older adult Hispanic/Latino subjects, we found an inverse linear association between sleep duration and the prevalence of obesity. Daytime napping was strongly associated with greater adiposity. Interventional and longitudinal studies are needed to better understand how abnormal sleep patterns contribute to the obesity epidemic.

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Sleep patterns and sleep disruptions in school-age children.

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This study assessed the sleep patterns, sleep disruptions, and sleepiness of school-age children. Sleep patterns of 140 children (72 boys and 68 girls; 2nd-, 4th-, and 6th-grade students) were evaluated with activity monitors (actigraphs). In addition, the children and their parents completed complementary sleep questionnaires and daily reports. The findings reflected significant age differences, indicating that older children have more delayed sleep onset times and increased reported daytime sleepiness. Girls were found to spend
more time in
sleep and to have an increased percentage of motionless sleep.
Fragmented sleep
was found in 18% of the children. No age differences were found in any
of the
sleep quality measures. Scores on objective sleep measures were
associated with
subjective reports of sleepiness. Family stress, parental age, and
parental
education were related to the child's sleep-wake measures.

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Sleep patterns and sleepiness among young students: A longitudinal
study before
and after admission as trainees and apprentices.

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In developing countries, youngsters start to work during the high
school years.
Several studies have shown the difficulties associated with double
shift, i.e. to
work and study concomitantly, and its negative health consequences.
Work and
study time, as social synchronizers, have significant effects on the
sleep-wake
cycle (SWC). The purpose of this study was to evaluate sleep patterns
and
sleepiness in young students before and after entering the workforce
as
apprentices or trainees. Participants were 40 adolescents (26 males),
15-18 years
old (mean = 15.8 years old) engaged in a first-job program at a non-
governmental
organization (NGO) while attending evening high school in the
outskirts of the
city of São Paulo, Brazil. The participants wore actigraphs (Ambulatory Monitoring, Inc.) and registered subjective sleepiness on KSS (Karolinska Sleepiness Scale) along 7 consecutive days, before and after admission to the job. Descriptive analyses were performed, and the variables were tested by means of the t-test and repeated measures ANOVA taking factors day of the week and time of the day into consideration. The participants' sleep duration on weekdays exhibited significant difference before and after starting work (F = 4.55; p = 0.04); the mean sleep duration was 492 min (SD = 44 min) before admission to the job to decrease to 405 min (SD = 58 min) after starting work. The mid-sleep time exhibited significant difference on weekdays before and after starting work (04:57 h; SD = 45 min versus 03:30 h; SD = 54 min; F = 4.91; p = 0.03). Finally, also sleepiness on weekdays (F = 6.41; p = 0.04) and at the waking time (F = 10.75; p < 0.01) exhibited significant difference before and after admission to the job. This article emphasizes the fact that social synchronizers like working during the day and studying in the evening changed the participants' SWC and were associated with sleep restriction. Brazilian governmental incentives notwithstanding, simultaneous performance of several activities by young workers should be considered as an occupational health hazard. Employment policies targeting young workers should take the dual shift - study and work - and its effects on the sleep-wake cycle into account.

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Sleep patterns in autistic children.
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Sleep disturbances are regarded as a common clinical feature in autistic children. This concept is based primarily on informal observations or studies conducted with questionnaires. In this study we compared data obtained by questionnaires to that obtained with actigraphy. Among 22 autistic children, 12 were reported as having sleep problems and 8 patients completed 72 hours actigraphy. While the employment of questionnaires disclosed that autistic children had an earlier morning awakening time and multiple and early night arousals, actigraphic monitoring showed that with the exception of an earlier morning arousal time (p = .045), sleep patterns of autistic children were similar to that of normal children. Parental oversensitivity to sleep disturbances of the autistic children may explain this phenomenon.

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Sleep patterns in high school and university students: a longitudinal study.

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We performed a longitudinal study to investigate whether changes in social zeitgebers and age alter sleep patterns in students during the transition from high school to university. Actimetry was performed on 24 high-school students (mean age+/−SD: 18.4+/−0.9 yrs; 12 females) for two weeks. Recordings were
repeated in the same subjects 5 yrs later when they were university students. The sleep period duration and its center, the mid-sleep time, and total sleep time were estimated by actimetry. Actigraphic total sleep time was similar when in high school and at the university on school days (6.31+/-0.47 vs. 6.45+/-0.80 h, p = ns) and longer on leisure days by 1.10+/-1.10 h (p < 0.0001 vs. school days) when in high school, but not at the university. Compared to the high school situation, the mid-sleep time was delayed when at the university on school days (03:11+/-0.6 vs. 03:55+/-0.7 h, p < 0.0001), but not on leisure days. Individual mid-sleep times on school and leisure days when in high school were significantly correlated with the corresponding values 5 yrs later when at the university (r = 0.58 and r = 0.55, p < 0.05, respectively). The large differences in total sleep time between school and leisure days when students attended high school and the delayed mid-sleep time on school days when students attended university are consistent with a circadian phase shift due to changes in class schedules, other zeitgebers, and lifestyle preferences. Age-related changes may also have occurred, although some individuality of the sleep pattern was maintained during the 5 yr study span. These findings have important implications for optimizing school and work schedules in students of different age and level of education.

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Sleep Patterns of Emergency Department Nurses on Workdays and Days Off.

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BACKGROUND: Shift workers, particularly night workers, are prone to disrupted circadian rhythms and sleep deprivation resulting in fatigue and sleepiness, thereby endangering patient safety. Little is known about the sleep patterns of emergency nurses who work highly variable around-the-clock schedules to meet the demands of fluctuating patient census and acuities throughout the 24-hour period.

PURPOSE: The purpose of this pilot study was to determine whether there are shift-related sleep pattern differences in emergency department nurses over seven consecutive 24-hour periods that include both workdays and days off.

METHODS: A New Jersey mailing list (1514 members) was rented from the Emergency Nurses' Association. Three hundred on this list were systematically sampled and invited by mail to participate. The final sample consisted of 35 emergency nurses. Participants wore actigraphs for 24 hours each day for 7 days and completed sleep diaries upon awakening from their daily main sleep periods. Queries included caffeine and hypnotics usage. The nurses also completed the Standard Shiftwork Index General Biographical Information Section for demographic and scheduling data. Participants received a $50 honorarium upon completion of the protocol. The actigraph data were downloaded into a personal computer using Act Millennium and analyzed with Action W software (Ambulatory Monitoring, Inc., Ardsley, NY, USA).

RESULTS: Sleep durations ranged from 6.6 to 8.1 hours on workdays and from 6.2 to 8.1 hours on days off. There were no significant shift- or workday-related differences in sleep patterns. However, trends indicated that, regardless of shift, workday sleep became more disturbed and less efficient toward the end of
the week. Daily caffeine usage was reported by 85.9% of the sample.

CONCLUSIONS/IMPLICATIONS FOR PRACTICE: Shift working nurses need to obtain adequate and consistent sleep on workdays and days off throughout the work week to reduce fatigue and to provide safe patient care. Understanding the sleep patterns of emergency nurses and their schedules is critical to facilitating the development of shift-specific sleep promotion interventions to enhance sleep and thereby counteract fatigue.

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Sleep, performance, circadian rhythms, and light-dark cycles during two space shuttle flights.

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Sleep, circadian rhythm, and neurobehavioral performance measures were obtained in five astronauts before, during, and after 16-day or 10-day space missions. In space, scheduled rest-activity cycles were 20–35 min shorter than 24 h. Light-dark cycles were highly variable on the flight deck, and daytime illuminances in other compartments of the spacecraft were very low (5.0–79.4 lx). In space, the amplitude of the body temperature rhythm was reduced and the circadian rhythm of urinary cortisol appeared misaligned relative to
the imposed non-24-h sleep-wake schedule. Neurobehavioral performance decrements were observed. Sleep duration, assessed by questionnaires and actigraphy, was only approximately 6.5 h/day. Subjective sleep quality diminished. Polysomnography revealed more wakefulness and less slow-wave sleep during the final third of sleep episodes. Administration of melatonin (0.3 mg) on alternate nights did not improve sleep. After return to earth, rapid eye movement (REM) sleep was markedly increased. Crewmembers on these flights experienced circadian rhythm disturbances, sleep loss, decrements in neurobehavioral performance, and postflight changes in REM sleep.

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Sleep quality and cognitive performance in 8-year-old children.


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OBJECTIVE: The present study examined how sleep duration and sleep quality are associated with cognitive performance in 8-year-old children using standardized neurocognitive tests.

METHODS: Two hundred ninety children aged 7.4–8.8 years participated in the study. Sleep duration and quality were measured using actigraphs and the Sleep Disturbance Scale for Parents. Cognitive performance was measured using four subtests of the Wechsler Intelligence Scale for Children III, the Beery Developmental Test of Visual–Motor Integration (VMI), and the
Narrative memory subtest of the Developmental Neuropsychological Assessment for Children.

RESULTS: When adjusting for age, sex, and maternal education, shorter sleep duration, but not sleep quality, was associated with lower visuospatial abilities (p-values 0.043). Sleep duration and quality were not associated with verbal abilities (p-values 0.18). With regard to the individual test results, shorter sleep duration was associated with worse performance in Visual-Motor Integration (p=0.028), and when excluding children with high depression scores the same was also true with Block Design (p-values 0.047). Moreover, poor sleep efficiency was associated with worse performance in Similarities (p=0.004).

CONCLUSIONS: In a community sample of 8-year-old children, those who slept less or had poorer sleep quality had lower test scores in cognitive tasks, particularly those pertaining to visuospatial performance, although the association was not very strong.

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Sleep quality and elevated blood pressure in adolescents.

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BACKGROUND: We assessed whether insufficient sleep is associated with prehypertension in healthy adolescents.
METHODS AND RESULTS: We undertook a cross-sectional analysis of 238 adolescents, all without sleep apnea or severe comorbidities. Participants underwent multiple-day wrist actigraphy at home to provide objective estimates of sleep
patterns. In a clinical research facility, overnight polysomnography, anthropometry, and 9 blood pressure measurements over 2 days were made. Exposures were actigraphy-defined low weekday sleep efficiency, an objective measure of sleep quality (low sleep efficiency < or =85%), and short sleep duration (< or =6.5 hours). The main outcome was prehypertension (> or =90th percentile for age, sex, and height), with systolic and diastolic blood pressures as continuous measures as secondary outcomes. Prehypertension, low sleep efficiency, and short sleep duration occurred in 14%, 26%, and 11% of the sample, respectively. In unadjusted analyses, the odds of prehypertension increased 4.5-fold (95% CI, 2.1 to 9.7) in adolescents with low sleep efficiency and 2.8-fold (95% CI, 1.1 to 7.3) in those with short sleep. In analyses adjusted for sex, body mass index percentile, and socioeconomic status, the odds of prehypertension increased 3.5-fold (95% CI, 1.5. 8.0) for low sleep efficiency and 2.5-fold (95% CI, 0.9 to 6.9) for short sleep. Adjusted analyses showed that adolescents with low sleep efficiency had on average a 4.0+/−1.2-mm Hg higher systolic blood pressure than other children (P<0.01).

CONCLUSIONS: Poor sleep quality is associated with prehypertension in healthy adolescents. Associations are not explained by socioeconomic status, obesity, sleep apnea, or known comorbidities, suggesting that inadequate sleep quality is associated with elevated blood pressure.

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Sleep quality and preclinical Alzheimer disease.

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IMPORTANCE: Sleep and circadian problems are very common in Alzheimer disease (AD). Recent animal studies suggest a bidirectional relationship between sleep and β-amyloid (Aβ), a key molecule involved in AD pathogenesis. OBJECTIVE: To test whether Aβ deposition in preclinical AD, prior to the appearance of cognitive impairment, is associated with changes in quality or quantity of sleep. DESIGN: Cross-sectional study conducted from October 2010 to June 2012. SETTING: General community volunteers at the Washington University Knight Alzheimer's Disease Research Center. PARTICIPANTS: Cognitively normal individuals (n = 145) 45 years and older were recruited from longitudinal studies of memory and aging at the Washington University Knight Alzheimer's Disease Research Center. Valid actigraphy data were recorded in 142. The majority (124 of 142) were recruited from the Adult Children Study, in which all were aged 45 to 75 years at baseline and 50% have a parental history of late-onset AD. The rest were recruited from a community volunteer cohort in which all were older than 60 years and healthy at baseline. MAIN OUTCOME MEASURES: Sleep was objectively measured using actigraphy for 2 weeks. Sleep efficiency, which is the percentage of time in bed spent asleep, was the primary measure of sleep quality. Total sleep time was the primary measure of sleep quantity. Cerebrospinal fluid Aβ42 levels were used to determine whether amyloid deposition was present or absent. Concurrent sleep diaries provided nap information.
RESULTS: Amyloid deposition, as assessed by Aβ42 levels, was present in 32 participants (22.5%). This group had worse sleep quality, as measured by sleep efficiency (80.4% vs 83.7%), compared with those without amyloid deposition, after correction for age, sex, and APOEε4 allele carrier status (P = .04). In contrast, quantity of sleep was not significantly different between groups, as measured by total sleep time. Frequent napping, 3 or more days per week, was associated with amyloid deposition (31.2% vs 14.7%; P = .03).

CONCLUSIONS AND RELEVANCE: Amyloid deposition in the preclinical stage of AD appears to be associated with worse sleep quality but not with changes in sleep quantity.

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Sleep Quality and Quantity in Low-Income Postpartum Women.

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PURPOSE: To describe and explore patterns of postpartum sleep, fatigue, and
depressive symptoms in low-income urban women.

STUDY DESIGN AND METHODS: In this descriptive, exploratory, nonexperimental study, participants were recruited from an inpatient postpartum unit. Subjective measures were completed by 132 participants across five time points. Objective sleep/wake patterns were measured by 72-hour wrist actigraphy at 4 and 8 weeks. Mean sample age was 25 years, high school educated with 3.1 children. Over half the sample reported an annual income less than 50% of the federal poverty level.

RESULTS: Objectively, total nighttime sleep was 5.5 hours (week 4) and 5.4 hours (week 8). Subjectively, 85% met criteria for "poor sleep quality" at week 4, and nearly half were persistently and severely fatigued through 8 weeks postpartum.

CLINICAL IMPLICATIONS: The majority (65%) of women in this study met the definition of "short sleep duration," defined as sleeping ≤ 6 hours per night. Adverse effects of this short sleep on physical and mental health as well as safety and functioning, especially within the context of poverty, may be profound. There is an urgent need for further research on sleep in low-income underrepresented women to identify interventions that can improve sleep and fatigue as well as discern the implications of sleep deprivation on the safety and physical and mental health of this population.

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Sleep Quality Changes during Overwintering at the German Antarctic Stations Neumayer II and III: The Gender Factor.

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PURPOSE: Antarctic residence holds many challenges to human physiology, like increased psycho-social tension and altered circadian rhythm, known to influence sleep. We assessed changes in sleep patterns during 13 months of overwintering at the German Stations Neumayer II and III from 2008 to 2014, with focus on gender, as many previous investigations were inconclusive regarding gender-based differences or had only included men.

MATERIALS & METHODS: Time in bed, sleep time, sleep efficiency, number of arousals, sleep latency, sleep onset, sleep offset, and physical activity level were determined twice per month during seven overwintering campaigns of n = 54 participants (37 male, 17 female) using actimetry. Data were analyzed using polynomial regression and analysis of covariance for change over time with the covariates gender, inhabited station, overwintering season and influence of physical activity and local sunshine radiation.

RESULTS: We found overall longer times in bed (p = 0.004) and sleep time (p = 0.014) for women. The covariate gender had a significant influence on time in bed (p<0.001), sleep time (p<0.001), number of arousals (p = 0.04), sleep latency (p = 0.04), and sleep onset (p<0.001). Women separately (p = 0.02), but not men (p = 0.165), showed a linear increase in number of arousals. Physical activity decreased over overwintering time for men (p = 0.003), but not for women (p = 0.174). The decline in local sunshine radiation led to a 48 minutes longer time
in bed (p<0.001), 3.8% lower sleep efficiency (p<0.001), a delay of 32 minutes in
sleep onset (p<0.001), a delay of 54 minutes in sleep offset
(p<0.001), and 11% less daily energy expenditure (p<0.001), for all participants in
reaction to the Antarctic winter's darkness-phase.
CONCLUSIONS: Overwinterings at the Stations Neumayer II and III are
associated with significant changes in sleep patterns, with dependences from
overwintering time and local sunshine radiation. Gender appears to be an influence,
as women showed a declining sleep quality, despite that their physical activity remained
unchanged, suggesting other causes such as a higher susceptibility to
psycho-social stress and changes in environmental circadian rhythm
during long-term isolation in Antarctica.

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Sleep quantity and quality is not compromised during planned burn
shifts of less than 12 h.

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Planned burning is a preventative strategy aimed at decreasing fuel
loads to
reduce the severity of future wildfire events. During planned burn
operations,
firefighters can work long shifts. Furthermore, remote burning locations may
require firefighters to sleep away from home between shifts. The existing evidence surrounding firefighters' sleep during such operations is exclusively anecdotal. The aims of the study were to describe firefighters' sleep during planned burn operations and evaluate the impact of the key operational factors (shift start time, shift length and sleeping location) that may contribute to inadequate sleep. Thirty-three salaried firefighters were recruited from Australia's fire agencies and sleep was measured objectively using wrist actigraphy for four weeks. All variables were examined in two conditions: (1) burn days, and (2) non-burn days. Time in bed, total sleep time, sleep latency and sleep efficiency were evaluated objectively. Subjective reports of pre- and post-sleep fatigue, sleep location, sleep quality, sleep quantity, number of times woken and sleep timing were also recorded. Analyses revealed no differences in measures of sleep quantity and quality when comparing non-burn and burn days. Total sleep time was less when planned burn shifts were >12 h. However, on burn days, work shift start time as well as sleeping location did not impact firefighters' sleep quantity. Self-reported levels of pre- and post-sleep fatigue were greater on burn days compared to non-burn days. These findings indicate that sleep quantity and quality are not compromised during planned burn operations <12 h in duration.

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Sleep Quantity and Quality of Ontario Wildland Firefighters Across a Low-Hazard Fire Season.

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OBJECTIVE: The aim of the study was to assess the sleep quality, quantity, and fatigue levels of Canadian wildland firefighters while on deployment.

METHODS: Objective and subjective sleep and fatigue measures were collected using actigraphy and questionnaires during non-fire (Base) and fire (Initial Attack and Project) deployments.

RESULTS: Suboptimal sleep quality and quantity were more frequently observed during high-intensity, Initial Attack fire deployments. Suboptimal sleep was also exhibited during non-fire (Base) work periods, which increases the risk of prefire deployment sleep debt. Self-reported, morning fatigue scores were low-to-moderate and highest for Initial Attack fire deployments.

CONCLUSIONS: The study highlights the incidence of suboptimal sleep patterns in wildland firefighters during non-fire and fire suppression work periods. These results have implications for the health and safety practices of firefighters given the link between sleep and fatigue, in a characteristically hazardous occupation.

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Sleep quantity, quality and optimism in children.


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We tested the relationship of objectively measured sleep quantity and quality with positive characteristics of the child. Sleep duration, sleep latency and sleep efficiency were measured by an actigraph for an average of seven (range = 3–14) consecutive nights in 291 8-year-old children (standard deviation = 0.3 years). Children's optimism, self-esteem and social competence were rated by parents and/or teachers. Sleep duration showed a non-linear, reverse J-shaped relationship with optimism (P = 0.02), such that children with sleep duration in the middle of the distribution scored higher in optimism compared with children who slept relatively little. Shorter sleep latency was related to higher optimism (P = 0.01). The associations remained when adjusting for child's age, sex, body mass index, and parental level of education and optimism. In conclusion, sufficient sleep quantity and good sleep quality are related to children's positive characteristics. Our findings may inform why sleep quantity and quality and positive characteristics are associated with wellbeing in children.

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Sleep, sleepiness, fatigue, and performance of 12-hour-shift nurses.

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Nurses working 12-h shifts complain of fatigue and insufficient/poor-quality sleep. Objectively measured sleep times have not been often reported. This study describes sleep, sleepiness, fatigue, and neurobehavioral performance over three consecutive 12-h (day and night) shifts for hospital registered nurses. Sleep (actigraphy), sleepiness (Karolinska Sleepiness Scale [KSS]), and vigilance (Performance Vigilance Task [PVT]), were measured serially in 80 registered nurses (RNs). Occupational fatigue (Occupational Fatigue Exhaustion Recovery Scale [OFER]) was assessed at baseline. Sleep was short (mean 5.5 h) between shifts, with little difference between day shift (5.7 h) and night shift (5.4 h). Sleepiness scores were low overall (3 on a 1-9 scale, with higher score indicating greater sleepiness), with 45% of nurses having high level of sleepiness (score > 7) on at least one shift. Nurses were progressively sleepier each shift, and night nurses were sleepier toward the end of the shift compared to the beginning. There was extensive caffeine use, presumably to preserve or improve alertness. Fatigue was high in one-third of nurses, with intershift fatigue (not feeling recovered from previous shift at the start of the next shift) being most prominent. There were no statistically significant differences in mean reaction time between day/night shift, consecutive work shift,
and time into shift. Lapsing was traitlike, with rare (39% of sample), moderate (53%), and frequent (8%) lapsers. Nurses accrue a considerable sleep debt while working successive 12-h shifts with accompanying fatigue and sleepiness. Certain nurses appear more vulnerable to sleep loss than others, as measured by attention lapses.

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Sleep stage classification based on multi-level feature learning and recurrent neural networks via wearable device.


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BACKGROUND: Automatic sleep stage classification is essential for long-term sleep monitoring. Wearable devices show more advantages than polysomnography for home use. In this paper, we propose a novel method for sleep staging using heart rate and wrist actigraphy derived from a wearable device.

METHODS: The proposed method consists of two phases: multi-level feature learning and recurrent neural networks-based (RNNs) classification. The feature learning phase is designed to extract low- and mid-level features. Low-level features are extracted from raw signals, capturing temporal and frequency domain properties. Mid-level features are explored based on low-level ones to learn compositions and structural information of signals. Sleep staging is a sequential problem with long-term dependencies. RNNs with bidirectional long short-term memory architectures are employed to learn temporally sequential patterns.

RESULTS: To better simulate the use of wearable devices in the daily scene, experiments were conducted with a resting group in which sleep was recorded in the resting state, and a comprehensive group in which both resting sleep and non-resting sleep were included. The proposed algorithm classified five sleep stages (wake, non-rapid eye movement 1-3, and rapid eye movement) and achieved weighted precision, recall, and F1 score of 66.6%, 67.7%, and 64.0% in the resting group and 64.5%, 65.0%, and 60.5% in the comprehensive group using leave-one-out cross-validation. Various comparison experiments demonstrated the
effectiveness of the algorithm.
CONCLUSIONS: Our method is efficient and effective in scoring sleep stages. It is
suitable to be applied to wearable devices for monitoring sleep at home.

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Sleep Timing, Stability, and BP in the Sueño Ancillary Study of the Hispanic
Community Health Study/Study of Latinos.

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BACKGROUND: Timing and stability of the sleep-wake cycle are potential modifiable risk factors for cardiometabolic disease. The aim of this study was to evaluate the relationship between objective measures of sleep-wake timing and stability with cardiometabolic disease risk. METHODS: In this multicenter, cross-sectional, population-based study, actigraphy data were obtained from the 2,156 adults, aged 18 to 64 years, recruited from the Sueño ancillary study of the Hispanic Community Health Study/Study of Latinos (2010–2013). These data were correlated with measures of cardiometabolic disease risk, including systolic and diastolic BPs, homeostatic assessment of insulin resistance, glycosylated hemoglobin, BMI, and hypertension and diabetes status. RESULTS: Each 10% decrease in interdaily stability was associated with a 3.0% absolute increase in the prevalence of hypertension (95% CI, 0.6–5.3; \( P < .05 \)), an increase in systolic BP by 0.78 mm Hg (95% CI, 0.12–1.45; \( P < .05 \)) and an increase in diastolic BP by 0.80 mm Hg (95% CI, 0.28–1.32; \( P < .05 \)). In addition, delaying the midpoint of sleep by 1 h was associated with an increase in systolic BP by 0.73 mm Hg (95% CI, 0.30–1.16; \( P < .01 \)) and diastolic BP by 0.53 mm Hg (95% CI, 0.17–0.90; \( P < .01 \)). These associations were not significant after adjusting for shift work status. No association was found between interdaily stability or sleep timing and diabetes, BMI, or insulin resistance. CONCLUSIONS: These results suggest that beyond sleep duration, the timing and regularity of sleep-wake schedules are related to hypertension prevalence and BP.

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Sleep-wake and melatonin pattern in craniopharyngioma patients.

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OBJECTIVE: To assess the influence of craniopharyngioma or consequent surgery on melatonin secretion, and the association with fatigue, sleepiness, sleep pattern and sleep quality.

DESIGN: Cross-sectional study.

METHODS: A total of 15 craniopharyngioma patients were individually matched to healthy controls. In this study, 24-h salivary melatonin and cortisol were measured. Sleep-wake patterns were characterised by actigraphy and
sleep diaries recorded for 2 weeks. Sleepiness, fatigue, sleep quality and general health were assessed by Multidimensional Fatigue Inventory, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale and Short-Form 36.

RESULTS: Patients had increased mental fatigue, daytime dysfunction, sleep latency and lower general health (all, P≤0.05), and they tended to have increased daytime sleepiness, general fatigue and impaired sleep quality compared with controls. The degree of hypothalamic injury was associated with an increased BMI and lower mental health (P=0.01). High BMI was associated with increased daytime sleepiness, daytime dysfunction, mental fatigue and lower mental health (all, P≤0.01). Low midnight melatonin was associated with reduced sleep time and efficiency (P≤0.03) and a tendency for increased sleepiness, impaired sleep quality and physical health. Midnight melatonin remained independently related to sleep time after adjustment for cortisol. Three different patterns of melatonin profiles were observed; normal (n=6), absent midnight peak (n=6) and phase-shifted peak (n=2). Only patients with absent midnight peak had impaired sleep quality, increased daytime sleepiness and general and mental fatigue.

CONCLUSION: Craniopharyngioma patients present with changes in circadian pattern and daytime symptoms, which may be due to the influence of the craniopharyngioma or its treatment on the hypothalamic circadian and sleep regulatory nuclei.

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Sleep–wake behavior in chronic fatigue syndrome.

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STUDY OBJECTIVES: Disturbances of the internal biological clock manifest as fatigue, poor concentration, and sleep disturbances—symptoms reminiscent of chronic fatigue syndrome (CFS) and suggestive of a role for circadian rhythm disturbance in CFS. We examined circadian patterns of activity, sleep, and cortisol secretion in patients with CFS.

DESIGN: Case-control study, 5-day behavioral observation.

SETTING: Natural setting/home environment

PARTICIPANTS: 15 patients with CFS and 15 healthy subjects of similar age, sex, body mass index (BMI), and activity levels.

INTERVENTIONS: N/A.

MEASUREMENTS: Self-report questionnaires were used to obtain medical history and demographic information and to assess health behaviors, somatic and psychological symptoms, and sleep quality. An actiwatch accelerometer recorded activity and sleep patterns over 5 days with concurrent activity and symptom logs. Diurnal salivary cortisol secretion was measured. Additionally, overnight heart rate monitoring and pain sensitivity assessment was undertaken.

RESULTS: Ratings of symptoms, disability, sleep disturbance, and pain sensitivity were greater in patients with CFS. No between-group differences were found in the pattern or amount of sleep, activity, or cortisol secretion. Afternoon activity levels significantly increased evening fatigue in patients but not control subjects. Low nocturnal heart rate variability was identified as a biological correlate of unrefreshing sleep.

CONCLUSIONS: We found no evidence of circadian rhythm disturbance in CFS. However, the role of autonomic activity in the experience of unrefreshing sleep warrants further assessment. The activity symptom-relationship modelled here is of clinical significance in the approach to activity and symptom management in the treatment of CFS.

Sleep-wake circadian activity rhythm parameters and fatigue in oncology patients before the initiation of radiation therapy.

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BACKGROUND: Little is known about the relationships between sleep parameters and fatigue in patients at the initiation of radiation therapy (RT).

OBJECTIVES: The objectives of this study were to describe values for nocturnal sleep/rest, daytime wake/activity, and circadian activity rhythm parameters measured using actigraphy and to evaluate the relationships between these objective parameters and subjective ratings of sleep disturbance and fatigue severity, in a sample of patients at the initiation of RT.

METHODS: Patients (n = 185) with breast, prostate, lung, or brain cancer completed self-report measures for sleep disturbance (ie, Pittsburgh Sleep Quality Index, General Sleep Disturbance Scale) and fatigue (Lee Fatigue Scale) and wore wrist actigraphs for a total of 48 hours prior to beginning RT. Actigraphy data were analyzed using the Cole-Kripke algorithm. Spearman rank correlations were calculated between variables.

RESULTS: Approximately 30% to 50% of patients experienced sleep disturbance, depending on whether clinically significant cutoffs for the subjective or objective measures were used to calculate occurrence rates. In addition, these
patients reported moderate levels of fatigue. Only a limited number of significant correlations were found between the subjective and objective measures of sleep disturbance. Significant positive correlations were found between the subjective, but not the objective measures of sleep disturbance and fatigue.

CONCLUSIONS: A significant percentage of oncology patients experience significant disturbances in sleep–wake circadian activity rhythms at the initiation of RT. The disturbances occur in both sleep initiation and sleep maintenance.

IMPLICATIONS FOR PRACTICE: Patients need to be assessed at the initiation of RT for sleep disturbance, so appropriate treatment is initiated.

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Sleep–wake circadian activity rhythms and fatigue in family caregivers of oncology patients.

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BACKGROUND: Little is known about the relationships between sleep/wake circadian activity rhythms and fatigue in family caregivers (FCs) of oncology patients.

OBJECTIVES: The objectives of this study were to describe values for nocturnal sleep/rest, daytime wake/activity, and circadian activity rhythm parameters measured using actigraphy and to evaluate the relationships between these subjective and objective measures of sleep disturbance and self-reported fatigue.
severity, in a sample of FCs of oncology patients.

METHODS: Family caregivers (n = 103) completed self-report measures for sleep disturbance (ie, Pittsburgh Sleep Quality Index, General Sleep Disturbance Scale) and fatigue (Lee Fatigue Scale) and wore wrist actigraphs for 48 hours prior to beginning radiation therapy. Spearman rank correlations were calculated between variables.

RESULTS: Approximately 40% to 60% of FCs experienced sleep disturbance depending on whether clinically significant cutoffs for the subjective or objective measures were used to calculate occurrence rates. In addition, these FCs reported moderate levels of fatigue. Only a limited number of significant correlations were found between the subjective and objective measures of sleep disturbance. Significant positive correlations were found between fatigue and subjective, but not objective measures of sleep disturbance. The amplitude of circadian activity rhythm was not related to any objective sleep measure but was correlated with self-report of longer sleep-onset latency.

CONCLUSIONS: A significant percentage of FCs experience clinically meaningful disturbances in sleep-wake circadian activity rhythms. These disturbances occur primarily in sleep maintenance.

IMPLICATIONS FOR PRACTICE: Family caregivers need to be assessed, along with patients, for sleep disturbance, and appropriate interventions initiated for them and for the patient.

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PMID: 21760489 [Indexed for MEDLINE]


Sleep–Wake Concordance in Couples Is Inversely Associated With Cardiovascular Disease Risk Markers.

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Aim: To determine whether interdependence in couples' sleep (sleep-wake concordance i.e., whether couples are awake or asleep at the same time throughout the night) is associated with two markers of cardiovascular disease (CVD) risk, ambulatory blood pressure (BP) and systemic inflammation.

Methods: This community-based study is a cross-sectional analysis of 46 adult couples, aged 18-45 years, without known sleep disorders. Percent sleep-wake concordance, the independent variable, was calculated for each individual using actigraphy. Ambulatory BP monitors measured BP across 48 h. Dependent variables included mean sleep systolic BP (SBP) and diastolic BP (DBP), mean wake SBP and DBP, sleep-wake SBP and DBP ratios, and C-reactive protein (CRP). Mixed models were used and were adjusted for age, sex, education, race, and body mass index.

Results: Higher sleep-wake concordance was associated with lower sleep SBP (b = -.35, SE = .01) and DBP (b = -.22, SE = .10) and lower wake SBP (b = -.26, SE = .12; all p values < .05). Results were moderated by sex; for women, high concordance was associated with lower BP. Men and women with higher sleep-wake concordance also had lower CRP values (b = -.15, SE = .03, p < .05). Sleep-wake concordance was not associated with wake DBP or sleep/wake BP ratios. Significant findings remained after controlling for individual sleep quality, duration, and wake after sleep onset.

Conclusions: Sleep-wake concordance was associated with sleep BP, and this
association was stronger for women. Higher sleep-wake concordance was associated with lower systemic inflammation for men and women. Sleep-wake concordance may be a novel mechanism by which marital relationships are associated with long-term CVD outcomes.

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Sleep–wake cycle and melatonin rhythms in adolescents and young adults with mood disorders: comparison of unipolar and bipolar phenotypes.

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This study evaluated the potential of circadian measures as early markers of mood disorders subtypes. Patients with bipolar disorders had significantly lower levels and later onset of melatonin secretion than those with unipolar depression. Furthermore, abnormal phase angles between sleep, melatonin and temperature were found in several patients.

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Sleep/wake cycle disturbance in Alzheimer's disease: how much is due to an inherent trait?

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Major advances in understanding the physiology and genetics of circadian rhythm in the past decade challenge the researcher of sleep/wake disorders in Alzheimer's disease (AD) to distinguish patient characteristics stable across the course of illness ("traits") from characteristics that vary with stage of illness ("states"). A components-of-variance approach with a repeated measures model was used to examine the between-subjects variance over time ("trait") vs. within-subjects ("state") variance in 42 patients with probable AD followed, on average, over 2 years on actigraphic sleep/wake measures. Mental status scores indexed stage of illness. Actigraphic measures of sleep efficiency and circadian rhythmicity appeared predominantly "trait," with between-individual differences accounting for over 55% of variance compared to the less than 5% of variance related to stage of cognitive impairment. We discuss how "state-trait" analyses can be helpful in identifying areas of assessment most likely to be fruitful objectives of physiologic and genetic research on sleep/wake disturbance in AD.

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mood disorders.

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Considering the marked changes in sleep and circadian rhythms across the lifespan, age may contribute to the heterogeneity in sleep-wake profiles linked to mood disorders. This study aimed to investigate the contributions of age and depression severity to sleep-wake disturbances. The Hamilton Depression Rating Scale (HDRS) was administered to assess current symptoms severity in 238 persons with a history of a mood disorder between 12 and 90 years of age (y.o.).

Actigraphy was recorded over five to 22 days. Regression analyses and analyses of variance [age (12–19 y.o., 20–39 y.o., 40–59 y.o., and ≥ 60 y.o.) by depression severity (HDRS < and ≥ 8)] were conducted. The 12–19 y.o. and 20–39 y.o. groups had a delayed sleep schedule and acrophase compared to all other groups. The ≥ 60 y.o. group had a lower rhythmicity and amplitude (p ≤ .006) than the 12–19 y.o. group (p ≤ .046). Participants with a HDRS ≥ 8 spent longer time in bed, had later sleep offset times and had lower circadian rhythmicity than those with a HDRS<8 (p ≤ .036). Younger age and higher HDRS score correlated with
later sleep onset and offset times, longer time in bed, higher WASO, lower sleep efficiency and later acrophase (p ≤ .023). Age was a significant predictor of delayed sleep and activity schedules (p ≤ .001). The profile of sleep-wake cycle disturbances associated with mood disorders changes with age, with prominent sleep phase delay during youth and reduced circadian strength in older persons. Conversely, disruptions in sleep consolidation seem more stable across age.

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Sleep-wake cycle phenotypes in young people with familial and non-familial mood disorders.


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OBJECTIVES: Converging evidence identifies that the offspring of parents with bipolar disorder (BD), individuals at clinical high risk of BD, and young people with recent onset BD may differ from other clinical cases or healthy controls in terms of sleep-wake profiles. However, it is possible that these differences may reflect current mental state, subtype of mood disorder, or familial traits. This study aimed to determine objective and subjective sleep-wake profiles
in individuals aged 15–25 years with a current major depressive episode, in relation to familial traits.

METHODS: Frequency matching was employed to ensure that each individual with a confirmed family history of BD (FH+) could be compared to four controls who did not have a familial mood disorder (FH−). Pre-selected objective actigraphy and subjective Pittsburgh Sleep Quality Index (PSQI) ratings were compared using one-way analysis of variance (ANOVA) and applying the Benjamini-Hochberg (BH) correction for false discoveries.

RESULTS: The sample comprised 60 individuals with a mean age of 19 years. The FH+(n=12) and FH− groups (n=48) differed on three key sleep parameters: mean sleep duration on week nights (P=.049), variability in waking after sleep onset (P=.038), and daily disturbances (PSQI dimension of sleep disturbance and daytime dysfunction; P=.01).

CONCLUSIONS: The sleep profiles we identified in this study, especially the daily disturbances phenotype, provide support for research into endophenotypes for BD. Also, the findings may offer the opportunity for more tailored, personalized interventions that target specific components of the sleep–wake cycle in individuals with a family history of BD.

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Sleep–wake cycles and cognitive functioning in schizophrenia.

BACKGROUND: Irregular sleep-wake cycles and cognitive impairment are frequently observed in schizophrenia, however, how they interact remains unclear.

AIMS: To investigate the repercussions of circadian rhythm characteristics on cognitive performance and psychopathology in individuals with schizophrenia.

METHOD: Fourteen middle-aged individuals diagnosed with schizophrenia underwent continuous wrist actimetry monitoring in real-life settings for 3 weeks, and collected saliva samples to determine the onset of endogenous melatonin secretion as a circadian phase marker. Moreover, participants underwent multiple neuropsychological testing and clinical assessments throughout the study period.

RESULTS: Sleep-wake cycles in individuals with schizophrenia ranged from well entrained to highly disturbed rhythms with fragmented sleep epochs, together with delayed melatonin onsets and higher levels of daytime sleepiness. Participants with a normal rest-activity cycle (objectively determined by high relative amplitude of day/night activity) performed significantly better in frontal lobe function tasks. Stepwise regression analysis revealed that relative amplitude and age represented the best predictors for cognitive performance (Stroop colour-word interference task, Trail Making Test A and B, semantic verbal fluency task), whereas psychopathology (Positive and Negative Syndrome Scale) did not significantly correlate with either cognitive performance levels or the quality of sleep-wake cycles.

CONCLUSIONS: Consolidated circadian rhythms and sleep may be a prerequisite for adequate cognitive functioning in individuals with schizophrenia.

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Sleep-wake detection using recurrence quantification analysis.

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Actigraphy is a method for monitoring the movements of the nondominant arm, and the technology has found applications ranging from clinical devices to smart wristbands. Time series obtained from actigraphy data is used in chronobiology to define the sleep-wake cycle, as well as in sleep medicine to evaluate an individual's sleep quality. In the study described in this paper, an algorithm based on recurrence quantification analysis (RQA) was applied to a time series obtained from a commercial actigraph, which was used to collect raw data alongside polysomnography (PSG), generally considered as the gold standard for assessing sleep quality. The central hypothesis is that transitions between sleep and wakefulness are not purely random events, but are strongly influenced by two internal processes: the homeostatic pressure and the circadian cycle. On the basis of this premise, application of RQA to time series as an estimator of this system should lead to improved results and allow more reliable investigations than a purely empirical approach. To compare the results from the RQA algorithm and those from PSG, we present a detailed statistical analysis involving a bias evaluation of the two methods following an approach suggested by Bland and Altman, a comparison of data processed using the kappa coefficient, and a comparison of consolidated sleep quality data using the p-value.

DOI: 10.1063/1.5024692
Sleep-wake difficulties in community-dwelling cancer patients receiving palliative care: subjective and objective assessment.

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OBJECTIVE: Prevalence rates of sleep difficulties in advanced cancer patients have varied widely across studies (12 to 96%), and none of these employed a diagnostic interview to distinguish different types of sleep-wake disorders. Moreover, very limited information is available on subjective and objective sleep parameters in this population. Our study was conducted in palliative cancer patients and aimed to assess rates of sleep-wake disorders and subsyndromal symptoms and to document subjective and objective sleep-wake parameters across various types of sleep-wake difficulties.

METHOD: The sample was composed of 51 community-dwelling cancer patients receiving palliative care and having an Eastern Cooperative Oncology Group score of 2 or 3. Relevant sections of the Duke Interview for Sleep Disorders were administered over the phone. An actigraphic recording and a daily sleep diary were completed for 7 consecutive days.

RESULTS: Overall, 68.6% of the sample had at least one type of sleep-wake difficulty (disorder or symptoms): 31.4% had insomnia and 29.4% had hypersomnolence as their main sleep-wake problem. Participants with insomnia as their main sleep difficulty had greater disruptions of subjective
sleep parameters, while objectively-assessed sleep was more disrupted in patients with hypersomnia comorbid with another sleep–wake difficulty. Significance of the Results: The high rates of sleep–wake difficulties found in this study indicate a need to screen more systematically for sleep–wake disorders, including insomnia and hypersomnia, in both palliative care research and clinical practice, and to develop effective nonpharmacological interventions specifically adapted to this population.

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Sleep–wake disorders in Alzheimer's disease: further genetic analyses in relation to objective sleep measures.


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This paper presents updated analyses on the genetic associations of sleep disruption in individuals with Alzheimer's disease (AD). We published previously
a study of the association between single nucleotide polymorphisms (SNPs) found in eight genes related to circadian rhythms and objective measures of sleep-wake disturbances in 124 individuals with AD. Here, we present new relevant analyses using polygenic risk scores (PRS) and variable number tandem repeats (VNTRs) enumerations. PRS were calculated using the genetic data from the original participants and relevant genome wide association studies (GWAS). VNTRs for the same circadian rhythm genes studied with SNPs were obtained from a separate cohort of participants using whole genome sequencing (WGS). Objectively (wrist actigraphy) determined wake after sleep onset (WASO) was used as a measure of sleep disruption. None of the PRS were associated with sleep disturbance. Computer analyses using VNTRseek software generated a total of 30 VNTRs for the circadian-related genes but none appear relevant to our objective sleep measure. In addition, of 71 neurotransmitter function-related genes, 29 genes had VNTRs that differed from the reference VNTR, but it was not clear if any of these might affect circadian function in AD patients. Although we have not found in either the current analyses or in our previous published analyses of SNPs any direct linkages between identified genetic factors and WASO, research in this area remains in its infancy.

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PMID: 31739820


Sleep-wake disturbances in hospitalized patients with traumatic brain injury: association with brain trauma but not with an abnormal melatonin circadian rhythm.

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STUDY OBJECTIVES: To test whether the sleep-wake cycle disruption in patients hospitalized with traumatic brain injury (TBI) (1) is also found in patients with traumatic injuries other than TBI (non-TBI) and (2) is associated with a weaker or abnormal circadian clock signal.

METHODS: Forty-two non-mechanically ventilated and non-sedated patients hospitalized for moderate-to-severe TBI were compared to 34 non-TBI patients. They wore wrist actigraphs for 9.4 ± 4.2 days, starting 19.3 ± 12.6 days post-injury. Of these, 17 TBI and 14 non-TBI patients had their urine collected every hour for 25 hours, starting 18.3 ± 12.3 days post-injury. We calculated urinary 6-sulfatoxymelatonin concentration to obtain total 24-hour excretion, excretion onset, offset, duration, amplitude, and acrophase. Using Student's t-tests, we compared groups on actigraphy (daytime activity ratio, nighttime total sleep time, and fragmentation index) and melatonin variables. We investigated associations between melatonin and actigraphy variables using Pearson's correlations.

RESULTS: TBI patients had poorer daytime activity ratio (TBI: 77.5 ± 9.4%; non-TBI: 84.6 ± 6.9%), shorter nighttime total sleep time (TBI: 353.5 ± 96.6 min; non-TBI: 421.2 ± 72.2 min), and higher fragmentation index (TBI: 72.2...
non-TBI: 53.5 ± 23.6) (all p-values < 0.01). A melatonin rhythm was present in both groups, and no group differences were found on melatonin variables. No associations were found between melatonin and actigraphy variables in TBI patients.

CONCLUSION: Moderate-to-severe TBI patients have more serious sleep-wake disturbances than non-TBI patients hospitalized in the same environment, suggesting that the brain injury itself alters the sleep-wake cycle. Despite their deregulated 24-hour sleep-wake cycle, TBI patients have a normal circadian clock signal.

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Sleep–wake pattern following gunshot suprachiasmatic damage.

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BACKGROUND: The suprachiasmatic nucleus (SCN) plays a critical role in maintaining melatonin and sleep-wake cycles.
METHODS/PATIENT: We report a case of 38-year-old woman who, after gunshot wound to the right temple, developed a sleep complaint of multiple nocturnal awakenings and several naps throughout the day.
RESULTS: Computerized tomography and magnetic resonance imaging revealed bilateral optic nerve and optic chiasm damage. Diagnostic polysomnography and actigraphy revealed an irregular sleep wake rhythm.
CONCLUSIONS: We speculate concurrent damage of the SCN and optic nerves bilaterally resulted in the posttraumatic irregular sleep-wake rhythm.

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Sleep/Wake Patterns and Parental Perceptions of Sleep in Children Born Preterm.

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STUDY OBJECTIVES: To compare sleep/wake patterns in children born preterm in Australia vs Canada and determine cultural differences in the relationship between parental perception of sleep and actual sleep behaviors. 

METHODS: Australian and Canadian children born preterm were recruited from the Caffeine for Apnea of Prematurity trial (n = 188, 5-12 y) and underwent 14 days actigraphy monitoring. Parents completed the National Sleep Foundation 2004 Sleep in America questionnaire. Cross-cultural differences in sleep characteristics assessed by actigraphy and parent-reported questionnaire were examined. Correlational analyses determined the associations between parental perceptions of child sleep need and sleep behavior.

RESULTS: Actigraphy showed preterm children obtained, on average, 8 h sleep/night, one hour less than population recommendations for their age. There was no difference in total sleep time (TST) between Australian and Canadian cohorts; however, bed and wake times were earlier in Australian children. Bedtimes and TST varied by 60 minutes from night to night in both cohorts. Parent-reported child TST on the National Sleep Foundation questionnaire was 90 minutes longer than recorded by actigraphy. Both bedtime and TST on weekdays and weekends were related to parental perception of child sleep need in the Australian cohort. Only TST on weekdays was related to parental perception of child sleep need in the Canadian cohort.

CONCLUSIONS: This study suggests that short sleep duration and irregular sleep schedules are common in children born preterm. Cultural differences in the association between parental perception of child sleep need and actual sleep
behaviors provide important targets for future sleep health education.

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Sleep/wake patterns derived from activity monitoring and maternal report for healthy 1- to 5-year-old children.

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STUDY OBJECTIVES: To describe behavioral sleep/wake patterns of young children from actigraphy and mothers' reports, assess age-group and sex differences, describe daytime napping, and investigate the impact of family demographic variables on sleep-wake measures.

DESIGN: Cross-sectional sample of children wore actigraphs for 1 week; mothers kept concurrent diaries.

SETTING: Children studied in their homes.

PARTICIPANTS: 169 normal healthy children in 7 age groups (12, 18, 24, 30, 36, 48, and 60 months old); 84 boys and 85 girls.

INTERVENTIONS: N/A.

MEASUREMENTS AND RESULTS: Nocturnal sleep/wake measures estimated from activity recordings using a validated algorithm; mothers' reports of nocturnal sleep/wake patterns and daytime naps obtained from concurrent diaries. Bedtimes and sleep start times were earliest and time in bed and sleep period times were longest for 12-month-old children. Rise time, sleep end time, and nocturnal sleep minutes did not differ across age groups. Actigraphic estimates indicated that children aged 1 to 5 years slept an average of 8.7 hours at night. Actigraph-based
nocturnal wake minutes and wake bouts were higher than maternal diary reports for all age groups. Daytime naps decreased monotonically across age groups and accounted for most of the difference in 24-hour total sleep over age groups. Children in families with lower socioeconomic status had later rise times, longer time in bed, more nocturnal wake minutes and bouts, and more night-to-night variability in bedtime and sleep period time. Children with longer naps slept less at night.

CONCLUSIONS: Individual differences in sleep/wake measures reflect characteristics of children, parents, or parent–child interactions.

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Sleep–Wake Patterns of Adolescents with Borderline Personality Disorder and Bipolar Disorder.


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Sleep-wake patterns are rarely examined in adolescents with borderline personality disorder (BPD) or bipolar disorder (BD). Within a developmental perspective, this study explores the sleep-wake cycle of adolescents aged 12-17 years with BPD or BD and healthy controls (HC) during periods with and without entrainment by school/work schedules. Eighteen euthymic BPD, six euthymic BD, and 20 HC adolescents wore wrist actigraphy during nine consecutive days to assess sleep-wake patterns. During school/work days, BPD adolescents spent more time awake when they were in bed compared to HC and BD adolescents ($p = 0.039$). On schedule-free days, BPD and BD youths spent more time in bed compared to HC adolescents ($p = 0.015$). BPD adolescents woke up over 1 h later compared to HC ($p = 0.003$). Total sleep time was more variable between nights in BPD adolescents compared to the HC group ($p = 0.031$). Future research should explore if sleep-wake pattern disruptions are a cause or a consequence of BPD symptomatology in adolescents. Addressing sleep-wake pattern during clinical assessment and treatment of BPD adolescents may potentially reduce their symptoms; this therapeutic effect still needs to be evaluated.

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Sleep-wake profiles and circadian rhythms of core temperature and melatonin in young people with affective disorders.

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While disturbances of the sleep-wake cycle are common in people with affective disorders, the characteristics of these disturbances differ greatly between individuals. This heterogeneity is likely to reflect multiple underlying pathophysiology, with different perturbations in circadian systems contributing to the variation in sleep-wake cycle disturbances. Such disturbances may be particularly relevant in adolescents and young adults with affective disorders as circadian rhythms undergo considerable change during this key developmental period. This study aimed to identify profiles of sleep-wake disturbance in young people with affective disorders and investigate associations with biological circadian rhythms. Fifty young people with affective disorders and 19 control participants (aged 16-31 years) underwent actigraphy monitoring for approximately two weeks to derive sleep-wake cycle parameters, and completed an in-laboratory assessment including evening dim-light saliva collection for melatonin assay and overnight continuous core body temperature measurement. Cluster analysis based on sleep-wake cycle parameters identified three distinct patient groups, characterised by 'delayed sleep-wake', 'disrupted sleep', and 'long sleep' respectively. The 'delayed sleep-wake' group had both delayed melatonin onset and core temperature nadir; whereas the other two cluster groups did not differ from
controls on these circadian markers. The three groups did not differ on clinical characteristics. These results provide evidence that only some types of sleep-wake disturbance in young people with affective disorders are associated with fundamental circadian perturbations. Consequently, interventions targeting endogenous circadian rhythms to promote a phase shift may be particularly relevant in youth with affective disorders presenting with delayed sleep-wake cycles.

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Sleep-wake profiles predict longitudinal changes in manic symptoms and memory in young people with mood disorders.

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Mood disorders are characterized by disabling symptoms and cognitive difficulties which may vary in intensity throughout the course of the illness. Sleep-wake cycles and circadian rhythms influence emotional regulation and cognitive functions. However, the relationships between the sleep-wake disturbances experienced commonly by people with mood disorders and the longitudinal changes
in their clinical and cognitive profile are not well characterized. This study investigated associations between initial sleep-wake patterns and longitudinal changes in mood symptoms and cognitive functions in 50 young people (aged 13–33 years) with depression or bipolar disorder. Data were based on actigraphy monitoring conducted over approximately 2 weeks and clinical and neuropsychological assessment. As part of a longitudinal cohort study, these assessments were repeated after a mean follow-up interval of 18.9 months. No significant differences in longitudinal clinical changes were found between the participants with depression and those with bipolar disorder. Lower sleep efficiency was predictive of longitudinal worsening in manic symptoms ($P = 0.007$). Shorter total sleep time ($P = 0.043$) and poorer circadian rhythmicity ($P = 0.045$) were predictive of worsening in verbal memory. These findings suggest that some sleep-wake and circadian disturbances in young people with mood disorders may be associated with less favourable longitudinal outcomes, notably for subsequent manic symptoms and memory difficulties.

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Sleep waves and recovery from drug and alcohol dependence: Towards a rhythm analysis of sleep in residential treatment.

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This paper reports on a study of sleep amongst men and women who are living in residential rehabilitation centres in the UK and who are receiving support for their recovery from addiction to alcohol and other forms of substance use. Conceptually and methodologically, the paper draws on the work of the French sociologist Lefebvre and, in particular, his rhythm-analysed. We argue that this approach offers a useful way of exploring sleep in terms of biological, experiential, temporal, spatial and social rhythms. It also has the potential to facilitate interdisciplinary dialogue. Empirical data comprising qualitative interviews with 28 individuals, sleep diaries, and actigraphy reports (which measure movement as a proxy for sleep) are examined in combination to generate insights into the challenges associated with sleep in recovery from substance misuse. We examine how sleep in recovery involves an alignment of the spatiotemporal rhythms of rehabilitation and the multiple embodied rhythms of individuals. Institutionalised routines reproduce and impose ideas of day/night sleep cycles which are presumed to accord with 'natural' circadian rhythms. Although study participants very much want to achieve these 'natural hegemonies' of sleep, alignment of individual and institutional rhythms is difficult to achieve. We develop the notion of 'sleep waves' as an analytic to capture the multifaceted elements of sleep and to argue that sleep waves recur but are also shaped by complex networks of rhythms, rituals and routines. Sleep waves can become relatively stabilised in rehabilitation settings, but the anticipation of moving on disturbs rhythms and generates anxieties which can affect recovery.
Sleepiness and driving events in shift workers: the impact of circadian and homeostatic factors.


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We aimed to characterize objective and subjective sleepiness and driving events during short work commutes and examine the impact of circadian and homeostatic factors across different shift types in a shift worker population. Thirty-three nurses were monitored for 2 weeks over day (07:00-15:30), evening (13:00-21:30), and night shifts (21:00-07:30). Sleep was measured via daily sleep logs and wrist actigraphy. Driving logs were completed for each work commute, reporting driving events and a pre-drive Karolinska Sleepiness Scale (KSS). Ocular data
from a subset of participants (n = 11) assessed objective sleepiness using infrared oculography during commutes. Circadian phase was assessed at three time points via urinary 6-sulphatoxymelatonin (aMT6s) collected over 24–48 hours. Subjective and objective sleepiness and sleep-related and hazardous driving events significantly increased following night shift compared with preshift. There were significant shift differences with KSS, sleep-related and inattention-related events highest during the postnight shift commute, compared with day and evening shifts. Sleep-related events were highest following the first night shift, while inattention-related events were most frequent after consecutive night shifts. KSS, sleep-related and hazardous events were increased during drives following ≥16 hours of wakefulness. KSS and sleep-related events increased during drives within ±3 hours of aMT6s acrophase. An interaction between homeostatic and circadian processes was observed, with KSS and sleep-related events highest within ±3 hours of acrophase, when wakefulness was ≥16 hours. In naturalistic conditions, subjective and objective sleepiness and driving events are increased following night shifts, even during short (~30 minutes) commutes and exacerbated by an interaction between circadian phase and duration of wakefulness.

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Sleepiness in medical ICU residents.
BACKGROUND AND METHODS: Sleepiness in medical residents has crucial implications for the safety of both patients and residents. Measures to improve this have primarily included an Accreditation Council for Graduate Medical Education-mandated reduction in work hours in residency programs. The impact of these work-hour limitations has not been consistent. The purpose of this study was to provide an objective assessment of daytime sleepiness in medical residents working in the medical ICU. Sleep times for 2 days/night prior to on call and on the day/night of being on call were assessed by actigraphy and sleep diaries. On-call and post-call measurements of residents' sleepiness were measured both objectively, by means of a modified multiple sleep latency test (MSLT) [two nap sessions], as well as subjectively, by the Stanford Sleepiness Scale. RESULTS: Our data showed that despite an average sleep time of 7.15 h on nights leading to being on call, the mean sleep latency (MSL) on the on-call day was (± SD) 9 ± 4.4 min, and 4.8 ± 4.1 min (p < 0.001) on the post-call day. On the post-call day, 14 residents (70%) had an MSL of < 5 min, suggesting severe sleepiness, compared to 6 residents (30%) on the on-call day. CONCLUSION: Our results demonstrate that residents working in the ICU despite reductions in work hours demonstrate severe degree of sleepiness post-call.

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Sleepiness, sleep, and use of sleepiness countermeasures in shift-working long-haul truck drivers.

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Driver sleepiness is a prevalent phenomenon among professional drivers working unconventional and irregular hours. For compromising occupational and traffic safety, sleepiness has become one of the major conundrums of road transportation. To further elucidate the phenomenon, an on-road study canvassing the under-explored relationship between working hours and sleepiness, sleep, and use of sleepiness countermeasures during and outside statutory rest breaks was conducted. Testing the association between the outcomes and working hours, generalized estimating equations models were fitted on a data collected from 54 long-haul truck drivers (mean 38.1 ± 10.5 years, one female).
volunteering in the 2-week study. Unobtrusive data-collection methods applied under naturalistic working and shift conditions included the Karolinska Sleepiness Scale (KSS) measuring sleepiness, a combination of actigraphy and sleep-log measuring sleep, and self-report questionnaire items incorporated into the sleep-log measuring the use of sleepiness countermeasures during and outside statutory rest breaks. Drivers' working hours were categorized into first and consecutive night, morning and day/evening shifts based on shift timing. The results reveal severe sleepiness (KSS ≥ 7) was most prevalent on the first night (37.8%) and least on the morning (10.0%) shifts. Drivers slept reasonably well prior to duty hours, with main sleep being longest prior to the first night (total sleep time 7:21) and shortest prior to the morning (total sleep time 5:43) shifts. The proportion of shifts whereby drivers reported using at least one sleepiness countermeasure outside statutory rest breaks was approximately 22% units greater for the night than the non-night shifts. Compared to the day/evening shifts, the odds of severe sleepiness were greater only on the first night shifts (OR 6.4–9.1 with 95% confidence intervals, depending on the statistical model), the odds of insufficient daily sleep were higher especially prior to the consecutive night shifts (OR 3.5 with 95% confidence intervals), and the odds of using efficient sleepiness countermeasures outside statutory rest breaks were greater on the first as well as consecutive night shifts (OR 4.0–4.6 with 95% confidence intervals). No statistically significant association was found between shift type and use of efficient sleepiness countermeasures during statutory rest breaks. In all, the findings demonstrate marked differences in the occurrence of severe sleepiness at the wheel, sleep preceding duty hours, and the use of sleepiness countermeasures between different shift types. In addition, although drivers
slept reasonably well in connection with different shift types, the findings imply there is still room for improvement in alertness management among this group of employees.

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Sleeping under the threat of the Scud: war-related environmental insomnia.

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The influence of the Scud missile attacks during the Persian Gulf war on the sleep of the Israeli population is described. Our study group comprised a random sample of 200 people (mean age 41.13 +/- 15.32) who were contacted by telephone during the third week of the war and interviewed about their sleep. Overall, 28% of the entire sample complained about sleep: 10% complained about mid-sleep awakenings, 4.5% on difficulties falling asleep, and 13.5% about the combination of the two. People living in the Tel Aviv and Haifa areas complained significantly more than those in the rest of the country. Women complained significantly more than men, and people with lower education complained significantly more than people with higher education. Only 3% of the sample reported using sleeping pills. During the war actigraphic sleep recordings in 19 adults living in the Tel Aviv and Haifa areas did not reveal any measurable decrease in sleep quality in comparison with pre-war recordings. Possible explanations for the discrepancy between the subjective and objective assessments
are discussed.

PMID: 1757247  [Indexed for MEDLINE]


Sleeping well.

Sen M(1), Young GB.

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Comment on

In a study by Cruse et al. published in BMC Medicine, patients with severe brain damage who were in the Vegetative or Minimally Conscious States (VS or MCS, respectively) from traumatic and nontraumatic etiologies had assessments of circadian rhythms using an actigraph, a device worn on a limb to evaluate circadian rhythmicity, in this population. This is a novel approach and is being used as a surrogate for polysomnography and other reference standards. Cruse et al. showed more disruption in circadian rhythms in the VS when compared to the MCS. This suggests that more brain injury occurs in the areas that control circadian rhythmicity in VS than in MCS patients. The study provides opportunities for improved prognostication and rehabilitation strategies in this patient population.

DOI: 10.1186/1741-7015-11-19
PMCID: PMC3751661
PMID: 23347511  [Indexed for MEDLINE]


Sleeping with one eye open: the sleep experience of family members providing palliative care at home.
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PURPOSE: To empirically describe the sleep experience of family caregivers (n=13) of advanced cancer patients.

METHOD: Mixed methodology using: family interviews; Epworth Sleepiness Scale (ESS); Pittsburgh Sleep Quality Index (PSQI); and actigraphy measurement.

Qualitative data analysis utilized constant comparative content techniques. Actiware for the actigraphy data and the Statistical Package for the Social Sciences-15 (SPSS-15) generated descriptive and correlation statistics.

FINDINGS: The overarching theme "sleeping with one eye open" captures the vigilant nature of caregivers' sleep experiences. Caregiver narratives were validated by quantitative findings: 5 of the family caregivers (38.5 percent) had an ESS score > or =11 indicative of excessive daytime sleepiness, all caregivers had a PSQI global score >5 indicative of moderate to severe sleep problems, and actigraphy scores--including total sleep time, sleep efficiency, and time awake after sleep onset--fell beyond normal values documented in the literature.

CONCLUSION: Impeccable assessment of the patient's and family's sleep status, sleep education, intervention strategies, and high-quality respite services are critical in community-based palliative care.

PMID: 21805941 [Indexed for MEDLINE]

Social Jetlag, Chronotype, and Cardiometabolic Risk.

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Comment in

CONTEXT: Shift work, which imposes a habitual disruption in the circadian system, has been linked to increased incidence of cardiometabolic diseases, and acute circadian misalignment alters various metabolic processes. However, it remains unclear whether day-to-day circadian dysregulation contributes to these risks beyond poor sleep and other behavioral characteristics.

OBJECTIVE: Individuals differ in circadian phase preference, known as chronotype, but may be constrained by modern work obligations to specific sleep schedules. Individuals experience social jetlag (SJL) due to a habitual discrepancy between their endogenous circadian rhythm and actual sleep times imposed by social obligations. Here, we examined whether chronotype and/or SJL associate with components of cardiovascular disease risk beyond the known effects of sleep disturbances, poor health behaviors, and depressive symptomatology.

DESIGN: Participants were healthy, midlife adults who worked part- or full-time day shifts (n = 447; mean age, 42.7 [range, 30–54] y; 53% female; 83% white). Chronotype was assessed with the Composite Scale of Morningness. SJL was quantified as the difference (in minutes) between the midpoints of actigraphy-derived sleep intervals before work vs non-workdays.

RESULTS: Multiple regression analyses showed that SJL related to a lower high-density lipoprotein-cholesterol level, higher triglycerides, higher fasting
plasma insulin, insulin resistance, and adiposity (P < .05), even after adjustment for subjective sleep quality, actigraphy-derived sleep characteristics, depressive symptomatology, and health behaviors. Evening chronotype associated with lower high-density lipoprotein-cholesterol after adjustment for covariates.

CONCLUSION: Our findings suggest that a misalignment of sleep timing is associated with metabolic risk factors that predispose to diabetes and atherosclerotic cardiovascular disease.

DOI: 10.1210/jc.2015-2923
PMCID: PMC4667156
PMID: 26580236  [Indexed for MEDLINE]


Social stressors at work, sleep quality and psychosomatic health complaints--a longitudinal ambulatory field study.

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There is increasing evidence that occupational stress increases psychosomatic health complaints in the long run. However, the underlying mechanisms are still unclear. The present longitudinal actigraphy field study investigated the role of sleep quality--objectively assessed sleep-onset latency, sleep efficiency and sleep fragmentation, and subjectively assessed sleep quality--as a mediator in the relationship between stressful work conditions at time 1 and psychosomatic health complaints at time 2. A longitudinal hierarchical regression analysis revealed that social stressors at work were positively related to objectively assessed sleep fragmentation and to psychosomatic health complaints. Moreover, objectively assessed sleep fragmentation mediated the effect of social stressors.
at work on psychosomatic health complaints. Contrary to our expectations, social stressors at work were not related to other sleep quality parameters (i.e. sleep-onset latency, sleep efficiency and subjectively assessed sleep quality) during follow-up. Sleep fragmentation is discussed as an important consequence of social stressors at work that increase the risk of psychosomatic health complaints in the long run.

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PMID: 23824588 [Indexed for MEDLINE]


Socioeconomic Adversity and Women's Sleep: Stress and Chaos as Mediators.

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We examined income-to-needs ratio, perceived economic well-being, and education and their relations with European and African American women's sleep (n = 219). Sleep was examined through actigraphy and self-reports. Income-to-needs ratio was related to sleep minutes. Perceived economic well-being and education were associated with subjective sleep problems. Perceived stress mediated relations between both income-to-needs ratio and economic well-being and subjective sleep problems. Chaos emerged as a mediator linking income-to-needs ratio and subjective sleep problems. African American women had fewer sleep minutes and lower sleep efficiency than European Americans, and more robust relations between
economic well-being and stress was observed for European Americans. Findings highlight the importance of economic adversity for women's sleep and explicate some pathways of risk.

DOI: 10.1080/15402002.2014.940110
PMCID: PMC4871111
PMID: 25115947 [Indexed for MEDLINE]


Socioeconomic Status and Sleep among Couples.
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Objective/Background: Lower socioeconomic status (SES) is generally associated with poor sleep but little is known about how different SES indices are associated with sleep duration and quality, or about these relations longitudinally or in cohabiting couples. The main objective was to examine longitudinal associations between multiple SES and sleep parameters in cohabiting adults. Participants: Participants were cohabiting couples (N = 135) of women (M age = 37.2 years, SD = 5.93; 76% White/European American, 18% Black/African American) and men (M = 39.9 years, SD = 7.33; 78% White, 18% Black). Methods: Men and women participated twice with a 1-year lag. At Time (T1), participants reported on multiple SES indices including their income, perceived economic well-being, education, employment status, and occupation. Sleep at T1 and T2 was assessed with self-reports and actigraphs (sleep duration from onset to wake time, %sleep from onset to wake, long wake episodes). Results: Actor effects on actigraphy-assessed sleep parameters were evident for both men and
women; low SES was associated with shorter duration and poor quality (%sleep, long wake episodes) sleep. These associations were most pronounced for income-to-needs ratio (men and women) and perceived economic well-being (women only). Partner effects were also evident such that men's employment status was associated with women's longer sleep duration and greater sleep quality (%sleep) whereas women's employment predicted increased subjective sleep problems for men. Conclusion: Findings illustrate the need to consider multiple SES and sleep indices, as well as the family context in studies addressing linkages between SES and sleep.

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PMID: 32008377


Socioeconomic status in childhood predicts sleep continuity in adult Black and White men.

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OBJECTIVES: Low socioeconomic status (SES) in childhood may be associated with sleep in adulthood. We evaluated the relationships between SES in childhood through adolescence and into adulthood and sleep in midlife men. DESIGN: Prospective assessment of SES in childhood and adulthood. SETTING: Population-based study of 139 Black and 105 White men enrolled since age 7 and evaluated for sleep characteristics at age 32.
MEASUREMENTS: Actigraphy and diary measures of sleep duration, continuity, and quality for 1 week. Their parents reported their SES (a combination of educational attainment and occupational status) annually when the boys were ages 7 to 16. We estimated SES intercept (age 7) and slope (age 7 to 16) using M-Plus and conducted linear regression analyses using those values to predict adult sleep measures, adjusting for covariates.

RESULTS: Men who had lower SES families at age 7, smaller increases in SES from ages 7 to 16, and lower SES in adulthood had more minutes awake after sleep onset. White men with greater increases in SES from ages 7 to 16 had shorter sleep.

CONCLUSIONS: SES in childhood and improvement in SES through adolescence are related to sleep continuity in midlife men. To our knowledge, this is the first report using prospectively measured SES in childhood in relation to adult sleep.

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Socioeconomic status, occupational characteristics, and sleep duration in African/Caribbean immigrants and US White health care workers.

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STUDY OBJECTIVES: o advance our understanding of the interplay of socioeconomic factors, occupational exposures, and race/ethnicity as they relate to sleep
duration. We hypothesize that non Hispanic African/Caribbean immigrant employees in long term health care have shorter sleep duration than non Hispanic white employees, and that low education, low income, and occupational exposures including night work and job strain account for some of the African/Caribbean immigrant–white difference in sleep duration.

DESIGN: Cross sectional

SETTING: Four extended care facilities in Massachusetts, United States

PARTICIPANTS: 340 employees in extended care facilities

MEASUREMENTS AND RESULTS: Sleep duration was assessed with wrist actigraphy for a mean of 6.3 days. In multivariable regression modeling controlling for gender and age, African/Caribbean immigrants slept 64.4 fewer minutes (95% CI: -81.0, -47.9) per night than white participants; additional control for education and income reduced the racial gap to 50.9 minutes (-69.2, -32.5); additional control for the occupational factors of hours worked per week and working the night shift reduced the racial gap to 37.7 minutes (-57.8, -17.6).

CONCLUSIONS: This study provides support for the hypothesis that socioeconomic and occupational characteristics explain some of the African/Caribbean immigrant–white difference in sleep duration in the United States, especially among health care workers.

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PMID: 21461330 [Indexed for MEDLINE]


Software thresholds alter the bias of actigraphy for monitoring sleep in team-sport athletes.

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OBJECTIVES: Actical® actigraphy is commonly used to monitor athlete sleep. The proprietary software, called Actiware®, processes data with three different sleep-wake thresholds (Low, Medium or High), but there is no standardisation regarding their use. The purpose of this study was to examine validity and bias of the sleep-wake thresholds for processing Actical® sleep data in team sport athletes.

DESIGN: Validation study comparing actigraph against accepted gold standard polysomnography (PSG).

METHODS: Sixty seven nights of sleep were recorded simultaneously with polysomnography and Actical® devices. Individual night data was compared across five sleep measures for each sleep-wake threshold using Actiware® software. Accuracy of each sleep-wake threshold compared with PSG was evaluated from mean bias with 95% confidence limits, Pearson moment-product correlation and associated standard error of estimate.

RESULTS: The Medium threshold generated the smallest mean bias compared with polysomnography for total sleep time (8.5min), sleep efficiency (1.8%) and wake after sleep onset (-4.1min); whereas the Low threshold had the smallest bias (7.5min) for wake bouts. Bias in sleep onset latency was the same across thresholds (-9.5min). The standard error of the estimate was similar across all thresholds; total sleep time ~25min, sleep efficiency ~4.5%, wake after sleep onset ~21min, and wake bouts ~8 counts.

CONCLUSIONS: Sleep parameters measured by the Actical® device are greatly influenced by the sleep–wake threshold applied. In the present study the Medium threshold produced the smallest bias for most parameters compared with PSG. Given the magnitude of measurement variability, confidence limits should be employed.
Solving insomnia electronically: Sleep treatment for asthma (SIESTA): A study protocol for a randomized controlled trial.

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BACKGROUND: Chronic insomnia is associated with poor asthma control. Cognitive-behavioral treatment for insomnia (CBT-I) is an efficacious and durable treatment for comorbid insomnia in medical and psychiatric disorders.
However, the efficacy and potential accompanying mechanisms of CBT-I have not been examined in asthma. The purpose of this study is to test the efficacy of a CBT-I intervention on sleep and asthma control in adults with insomnia and asthma. We will also explore airway inflammation (i.e., exhaled nitric oxide, blood eosinophils) as a potential biological mechanism linking improvements in sleep with improvements in asthma control.

METHODS: The study is a single center, parallel group, randomized controlled trial. Two hundred and ten adults with insomnia and asthma that is not well-controlled will be randomized to either a 9-week Internet-based CBT-I program (Sleep Healthy Using the Internet (SHUTi)) or an enhanced usual care condition which utilizes an online educational video about insomnia. The primary sleep outcome is insomnia severity measured by the Insomnia Severity Index. Secondary sleep outcomes are sleep quality and wrist actigraph-recorded sleep parameters. Asthma control will be assessed by the Asthma Control Test, Asthma Quality of Life Questionnaire, pulmonary function testing, and self-report of asthma exacerbations and asthma-related healthcare utilization. Treatment outcomes will be measured at baseline, 9 weeks, and 6 months.

DISCUSSION: This trial has the potential to identify a novel strategy for improving asthma control. Findings may advocate for the inclusion of treatment of comorbid insomnia into current asthma management practice guidelines.

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PMID: 30825525


The sportsman readjustment after transcontinental flight: a study on marathon runners.
AIM: The aim of the study was to evaluate the synchronizing effect of physical activity on the rest-activity cycle after a flight across different time zones, investigating the parameters linked to sleep. The purpose of this study is to evaluate the synchronizing effect of physical activity on the sleep-activity parameters after a flight across different time zones.

METHODS: Eighteen volunteers flew from Milan to New York for the 2007 New York City Marathon. A training program, that consisted of running sessions three times a week for one month, was planned for the twelve athletes that participated in the marathon. The athletes were divided in two groups: Morning Training Group (MTG), trained from 7:00 to 9:00; Evening Training Group (ETG) from 19:00 to 21:00. The Control Group (CG), of 6 non-athletes, did not train before the flight and did not participate in the marathon. In New York, both groups of athletes trained in the morning. Two Actigraph monitoring sessions were performed in all three groups, before the Milan–New York flight and during the stay in New York.

The actigraphy made it possible to calculate sleep and activity-specific parameters; sleep and activity patterns were continuously monitored using an actometer on the wrist of the non-dominant hand.

RESULTS: Sleep analysis done on the first night in New York showed a significant difference (P<0.05) in the Movement and Fragmentation Index (MFI) between MTG and ETG. In CG and MTG, the MFI increased after the flight, while in ETG, the MFI decreased. Activity analysis demonstrated that, in ETG, evening physical activity in Milan associated with morning activity in New York produced a shift in the
Cosine Peak of the rhythm of activity.

CONCLUSIONS: Physical activity can have a positive effect both on sleep, by improving quality, as well as on the circadian rhythm of activity, by encouraging re-synchronization after the flight.

PMID: 20087296 [Indexed for MEDLINE]


Stability and fragmentation of the activity rhythm across the sleep-wake cycle: the importance of age, lifestyle, and mental health.

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The rhythms of activity across the 24-h sleep-wake cycle, determined in part by the circadian clock, change with aging. Few large-scale studies measured the activity rhythm objectively in the general population. The present population-based study in middle-aged and elderly persons evaluated how activity rhythms change with age, and additionally investigated sociodemographics, mental health, lifestyle, and sleep characteristics as determinants of rhythms of activity. Activity rhythms were measured objectively with actigraphy. Recordings of at least 96 h (138 ± 14 h, mean ± SD) were collected from 1734 people (age: 62 ± 9.4 yrs) participating in the Rotterdam Study. Activity rhythms were quantified by calculating interdaily stability, i.e., the stability of the rhythm over days, and intradaily variability, i.e., the fragmentation of the rhythm relative to its 24-h amplitude. We assessed age, gender, presence of a partner, employment, cognitive functioning, depressive symptoms, body mass index (BMI),
coffee use, alcohol use, and smoking as determinants. The results indicate that older age is associated with a more stable 24-h activity profile ($\beta = 0.07, p = 0.02$), but also with a more fragmented distribution of periods of activity and inactivity ($\beta = 0.20, p < 0.001$). Having more depressive symptoms was related to less stable ($\beta = -0.07, p = 0.005$) and more fragmented ($\beta = 0.10, p < 0.001$) rhythms. A high BMI and smoking were also associated with less stable rhythms (BMI: $\beta = -0.11, p < 0.001$; smoking: $\beta = -0.11, p < 0.001$) and more fragmented rhythms (BMI: $\beta = 0.09, p < 0.001$; smoking: $\beta = 0.11, p < 0.001$). We conclude that with older age the 24-h activity rhythm becomes more rigid, whereas the ability to maintain either an active or inactive state for a longer period of time is compromised. Both characteristics appear to be important for major health issues in old age.

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PMID: 23971909 [Indexed for MEDLINE]


Stability of melatonin and temperature as circadian phase markers and their relation to sleep times in humans.

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Circadian rhythms of core body temperature and melatonin are commonly used as phase markers of the circadian clock. Melatonin is a more stable marker of circadian phase when measured under constant routine conditions. However, little is known about the variability of these phase markers under less
controlled conditions. Moreover, there is little consensus about the preferred method of analysis. The objective of this study was to assess various methods of calculating melatonin and temperature phase in subjects with regular sleep schedules living in their natural environment. Baseline data were analyzed from 42 healthy young subjects who were studied on at least two occasions. Each hospital admission was separated by at least 3 weeks. Subjects were instructed to maintain a regular sleep schedule, which was monitored for 1 week before admission by sleep logs and actigraphy. Subjects spent one habituation night under controlled conditions prior to collecting baseline temperature and melatonin measurements. The phase of the melatonin rhythm was assessed by 9 different methods. The temperature nadir (Tmin) was estimated using both Cleveland and Cosine curve fitting procedures, with and without demasking. Variability between admissions was assessed by correlation analysis and by the mean absolute difference in timing of the phase estimates. The relationship to sleep times was assessed by correlation of sleep onset or sleep offset with the various phase markers. Melatonin phase markers were more stable and more highly correlated with the timing of sleep than estimates of Tmin. Of the methods for estimating Tmin, simple cosine analysis was the least variable. In addition, sleep offset was more strongly correlated with the various phase markers than sleep onset. The relative measures of melatonin offset had the highest correlation coefficients, the lowest study-to-study variability, and were more strongly associated with sleep timing than melatonin onsets. Concordance of the methods of analysis suggests a tendency for the declining phase of the melatonin profile to be more stable and reliable than either markers of melatonin onset or measures of the termination of melatonin synthesis.

DOI: 10.1177/0748730404273983
Stability of sleep timing against the melatonin secretion rhythm with advancing age: clinical implications.

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Aging is often associated with decreased ability of sleep maintenance. It has been hypothesized that the elderly experience a delayed timing of sleep period relative to the circadian phase of various sleep-promoting physiological functions, possibly causing decreased sleep propensity in the latter part of their nocturnal sleep. We evaluated the relationship between the sleep timing and circadian phase of melatonin secretion, which is known as a possible human sleep modulator as well as a stable marker of biological clock phase (BCP). Actigraph sleep recordings were performed, followed by the evaluation of melatonin phase under dim light in 42 healthy elderly volunteers (mean age, 68.8 yr; male/female ratio, 16/26) and 27 healthy young male volunteers (22.5 yr). Elderly subjects showed remarkable clock time advances in both the midpoint of BCP and sleep timing, with a significant decrease in sleep maintenance ability. However, they showed no significant age-related changes in the sleep timing against the midpoint of BCP, suggesting that early morning awakening in the elderly appeared in a BCP for which sleep propensity remained sufficient to sustain sleep. The present findings do not support the hitherto known hypothesis that age-related delay in the sleep timing against the BCP induces the deterioration in sleep.
Statistical characterization of actigraphy data during sleep and wakefulness states.

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Human activity can be measured with actimetry sensors used by the subjects in several locations such as the wrists or legs. Actigraphy data is used in different contexts such as sports training or tele-medicine monitoring. In the diagnosis of sleep disorders, the actimetry sensor, which is basically a 3D axis accelerometer, is used by the patient in the non dominant wrist typically during an entire week. In this paper the actigraphy data is described by a weighted mixture of two distributions where the weight evolves along the day according to the patient circadian cycle. Thus, one of the distributions is mainly associated with the wakefulness state while the other is associated with the sleep state. Actigraphy data, acquired from 20 healthy patients and manually segmented by trained technicians, is used to characterize the acceleration magnitude during sleep and wakefulness states. Several mixture combinations are tested and statistically validated with conformity measures. It is shown that both distributions can co-exist at a certain time with varying importance along the
We compared two "3 x 8" shift rota with backward rotation and quick return (morning and night shift in the same day) in a 5- or 6-day shift cycle, and a "2 x 12" shift rota with forward rotation in a 5-d shift cycle. A total of 294 nurses (72.6% women, mean age 33.8) were examined in a survey on work-related stress, including the Standard Shiftwork Index. Ten nurses per shift roster recorded their activity and rest periods by actigraphy, rated sleepiness and sleep quality, and collected salivary cortisol throughout the whole shift cycle. Nurses engaged in the "2 x 12" rota showed lower levels of sleep disturbances and, according to actigraphy, sleep duration was more balanced and less fragmented than in the "3 x 8" rosters. The counter-clockwise shift rotation and quick return of "3 x 8" schedules reduce possibility of sleep and recovery. The insertion of a morning shift before the day with quick return increases night sleep by about 1 h. Nurses who take a nap during the night shift require 40% less sleep in the morning after. The "2 x 12" clockwise roster, in spite of 50% increased length of shift, allows a better recovery and more
satisfying leisure
times, thanks to longer intervals between work periods. Sleepiness
increased more
during the night than day shifts in all rosters, but without
significant
difference between 8-h and 12-h rosters. However, the significantly
higher level
at the start of the night shift in the "3 × 8" rotas points out that
the fast
backward rotation with quick return puts the subjects in less
efficient
operational conditions. Some personal characteristics, such as
morningness,
lability to overcome drowsiness, flexibility of sleeping habits and
age were
significantly associated to sleep disturbances in nurses engaged in
the "3 × 8"
rotas, but not in the "2 × 12" schedule.

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PMID: 25216205 [Indexed for MEDLINE]

s12160-012-9352-y.

Stress, coping, and circadian disruption among women awaiting breast
cancer surgery.

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Comment in

BACKGROUND: Psychological distress and coping related to a breast
cancer
diagnosis can profoundly affect psychological adjustment, possibly
resulting in
the disruption of circadian rest/activity and cortisol rhythms, which
are
prognostic for early mortality in metastatic colorectal and breast
cancers,
respectively.
PURPOSE: This study aims to explore the relationships of cancer-
specific distress and avoidant coping with rest/activity and cortisol rhythm disruption in the period between diagnosis and breast cancer surgery.

METHODS: Fifty-seven presurgical breast cancer patients provided daily self-reports of cancer-specific distress and avoidant coping as well as actigraphic and salivary cortisol data.

RESULTS: Distress and avoidant coping were related to rest/activity rhythm disruption (daytime sedentariness, inconsistent rhythms). Patients with disrupted rest/activity cycles had flattened diurnal cortisol rhythms.

CONCLUSIONS: Maladaptive psychological responses to breast cancer diagnosis were associated with disruption of circadian rest/activity rhythms. Given that circadian cycles regulate tumor growth, we need greater understanding of possible psychosocial effects in cancer-related circadian disruption.

DOI: 10.1007/s12160-012-9352-y
PMID: 22450856  [Indexed for MEDLINE]


Stress-Induced Behavioral Quiescence and Abnormal Rest-Activity Rhythms During Critical Illness.


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OBJECTIVES: To characterize acute alterations of circadian and ultradian rest–activity rhythms in critically ill patients and their association with brain dysfunction, systemic multiple organ dysfunction, and melatonin rhythms.

DESIGN: Prospective study observing a cohort for 48 hours beginning
within the first day of ICU admission.

SETTING: ICUs within an academic medical center.

PATIENTS: Patients presenting from the community with acute onset of either intracerebral hemorrhage or sepsis as representative neurologic and systemic critical illnesses. Healthy control patients were studied in the community, during hospital bedrest, and during sleep deprivation.

INTERVENTIONS: None.

MEASUREMENTS AND MAIN RESULTS: Circadian and ultradian characteristics of rest-activity patterns were measured by wrist actigraphy, severity of neurologic and systemic illness by Glasgow Coma Scale and Sequential Organ Failure Assessment, and central circadian rhythm by melatonin profile. We studied 112 critically ill patients, including 53 with sepsis and 59 with intracerebral hemorrhage, along with 53 control participants. Total daily activity was markedly reduced and rest-activity rhythmicity was undetectable, neither of which was replicated by hospital bedrest in healthy controls. Circadian rest-activity rhythm fragmentation and attenuation and ultradian disorganization was associated with Glasgow Coma Scale and Sequential Organ Failure Assessment in adjusted models. Rest-activity rhythms showed no detectable phase coherence with melatonin rhythms.

CONCLUSIONS: Critically ill patients rapidly enter a state of behavioral quiescence proportionate to their illness severity with concomitant disturbance of circadian and ultradian rest-activity rhythms and loss of phase coherence with the melatonin rhythm. Quiescence characteristics in rest-activity rhythms were not different in patients with and without delirium, suggesting them to be distinct phenomena. Animal models of severe physiologic stress have shown that specific neural pathway separate from the sleep-wake regulatory pathway induce behavioral quiescence and rest-activity arrhythmia, and facilitate recovery of
cellular homeostasis. Whether quiescence is a conserved protective response pathway in humans is not yet understood.

DOI: 10.1097/CCM.0000000000004334
PMID: 32317592


[A study comparing circadian rhythm and sleep quality of athletes and sedentary subjects engaged in night work].

[Article in French]

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The aim of this study was to show the resistance and persistence of the circadian rhythm of temperature (T degree) and the sleep quality of athletic subjects and sedentary subjects engaged in night work, and attempt to explain the mechanisms that influence these differences. The effects of night work on biological rhythms have been studied extensively in the past few years. The contradictory situations for the night workers irrefutably affect their biological systems. Individuals with high amplitudes in their circadian rhythms have been found to be more tolerant to shift work and this results in a greater stability of circadian rhythms. This seems beneficial in coping with frequent rhythm disturbances. The physical training program seems to improve several mechanisms of the human biological system: amplitudes of circadian rhythms were increased and the circadian rhythm period was more resistant to an environment extreme (night work, shift work, sleep deprivation, or jet lag). To test this hypothesis, athletes and
sedentary subjects who were engaged in regular night work were selected in the PSA Peugeot Citroën Automobiles Group in French Normandy country. The circadian rhythm of the T degree for both groups was studied with a specific methodology and with extensive spectral analysis, especially the spectral elliptic inverse method. Study models of the rhythm of the T degree were determined and the characteristic parameters were exposed. A complementary actigraphic study showed the physical training program's effects on the sleep quality. The results revealed a large stability in the rhythm of circadian variation of T degree for the athletes: the amplitude was still large but for the sedentary subjects the amplitude of the T degree decreased and it was difficult to adjust a period on the rhythm of T degree. The stability and persistent quality of the athletes' circadian rhythm was confirmed. We observed that the actigraphic sleep was greater for athletes than for sedentary subjects, and the acrophase time for the athletes was later than for the sedentary subjects during the night shift.

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[Study of circadian rhythms of activity by actometry: preliminary results in 30 patients with metastatic colorectal cancer].

[Article in French]

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Activity circadian rhythms were measured non-invasively in 30 patients with
metastatic colorectal cancer by wrist actigraphy, and compared with control data. Patients and control subjects were requested to wear the actigraph at home for 2 to 5 days. Control time-series exhibit high activity levels (150 to 350 counts/min) during daytime, followed by low activity levels (0 to 50 counts/min) during the night. In patients, the contrast between daytime activity and nocturnal sleep is noticeably less marked, and a wide inter-patient variability can be observed. This alteration of the rest-activity rhythm in the cancer group was statistically validated by autocorrelation test. Results from the cosinor and maximal entropy spectral analysis must be interpreted more cautiously, since the prerequisites for these tests may not be fulfilled by actometric time-series. These results indicate that cancer patients may have altered rest-activity circadian rhythms. The significance and prognostic value of such alterations deserve further testing in a larger population. Actigraphy may provide a simple and innovative tool to study the circadian system in cancer patients.

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Study protocol for a randomised controlled trial examining the association between physical activity and sleep quality in children with autism spectrum disorder based on the melatonin-mediated mechanism model.

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INTRODUCTION: Sleep disturbance is commonly observed in children with autism spectrum disorders (ASD). Disturbed sleep may exacerbate the core symptoms of ASD. Behavioural interventions and supplemental melatonin medication are traditionally used to improve sleep quality, but poor sustainability of behavioural intervention effects and use of other medications that metabolise melatonin may degrade the effectiveness of these interventions. However, several studies have suggested that physical activity may provide an effective intervention for treating sleep disturbance in typically developing children. Thus, we designed a study to examine whether such an intervention is also effective in children with ASD. We present a protocol (4 December 2017) for a jogging intervention with a parallel and two-group randomised controlled trial design using objective actigraphic assessment and 6-sulfatoxymelatonin measurement to determine whether a 12-week physical activity intervention elicits changes in sleep quality or melatonin levels.

METHODS AND ANALYSIS: All eligible participants will be randomly allocated to either a jogging intervention group or a control group receiving standard care. Changes in sleep quality will be monitored through actigraphic assessment and parental sleep logs. All participants will also be instructed to collect a 24-hour urine sample. 6-sulfatoxymelatonin, a creatinine-adjusted morning urinary melatonin representative of the participant's melatonin levels, will be measured from the sample. All assessments will be carried out before the intervention (T1), immediately after the 12-week intervention or regular treatment (T2), 6 weeks after the intervention (T3) and 12 weeks after the intervention (T4) to examine the sustainability of the intervention effects. The first
enrolment began in February 2018.

ETHICS AND DISSEMINATION: Ethical approval was obtained through the Human Research Ethics Committee, Education University of Hong Kong. The results of this trial will be submitted for publication in peer-reviewed journals.

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Conflict of interest statement: Competing interests: None declared.


Subjective but Not Actigraphy-Defined Sleep Predicts Next-Day Fatigue in Chronic Fatigue Syndrome: A Prospective Daily Diary Study.


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STUDY OBJECTIVES: This study aimed to (1) examine the relationship between subjective and actigraphy-defined sleep, and next-day fatigue in chronic fatigue.
syndrome (CFS); and (2) investigate the potential mediating role of negative mood on this relationship. We also sought to examine the effect of presleep arousal on perceptions of sleep.

METHODS: Twenty-seven adults meeting the Oxford criteria for CFS and self-identifying as experiencing sleep difficulties were recruited to take part in a prospective daily diary study, enabling symptom capture in real time over a 6-day period. A paper diary was used to record nightly subjective sleep and presleep arousal. Mood and fatigue symptoms were rated four times each day. Actigraphy was employed to provide objective estimations of sleep duration and continuity.

RESULTS: Multilevel modelling revealed that subjective sleep variables, namely sleep quality, efficiency, and perceiving sleep to be unrefreshing, predicted following-day fatigue levels, with poorer subjective sleep related to increased fatigue. Lower subjective sleep efficiency and perceiving sleep as unrefreshing predicted reduced variance in fatigue across the following day. Negative mood on waking partially mediated these relationships. Increased presleep cognitive and somatic arousal predicted self-reported poor sleep. Actigraphy-defined sleep, however, was not found to predict following-day fatigue.

CONCLUSIONS: For the first time we show that nightly subjective sleep predicts next-day fatigue in CFS and identify important factors driving this relationship. Our data suggest that sleep specific interventions, targeting presleep arousal, perceptions of sleep and negative mood on waking, may improve fatigue in CFS.

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Subjective Measurements of In-Flight Sleep, Circadian Variation, and Their Relationship with Fatigue.

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BACKGROUND: This study examined whether subjective measurements of in-flight sleep could be a reliable alternative to actigraphic measurements for monitoring pilot fatigue in a large-scale survey.

METHODS: Pilots (3-pilot crews) completed a 1-page survey on outbound and inbound long-haul flights crossing 1-7 time zones (N = 586 surveys) between 53 city pairs with 1-d layovers. Across each flight, pilots documented flight start and end times, break times, and in-flight sleep duration and quality if they attempted sleep. They also rated their fatigue (Samn-Perelli Crew Status Check) and sleepiness (Karolinska Sleepiness Scale) at top of descent (TOD).

Mixed model ANCOVA was used to identify independent factors associated with sleep duration, quality, and TOD measures. Domicile time was used as a surrogate measure of circadian phase.

RESULTS: Sleep duration increased by 10.2 min for every 1-h increase in flight duration. Sleep duration and quality varied by break start time, with significantly more sleep obtained during breaks starting between (domicile) 22:00-01:59 and 02:00-05:59 compared to earlier breaks. Pilots were more fatigued and sleepy at TOD on flights arriving between 02:00-05:59 and 06:00-09:59 domicile time compared to other flights. With every 1-h increase in sleep duration, sleepiness ratings at TOD decreased by 0.6 points and fatigue ratings decreased by 0.4 points.

DISCUSSION: The present findings are consistent with previous actigraphic studies, suggesting that self-reported sleep duration is a reliable alternative to actigraphic sleep in this type of study, with use of validated
measures, sufficiently large sample sizes, and where fatigue risk is expected to be low.


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Subjective-Objective Sleep Discrepancy in Schizophrenia.

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Objective/Background: Subjective methods are often employed for sleep assessment due to their ease of use, but the results may not concur with objective findings. This discrepancy may be present in schizophrenia; however, limited data are available. We performed a secondary analysis to evaluate the agreement between 1-week actigraphy and sleep diary-derived parameters and factors that contribute to subjective-objective sleep discrepancy. Participants: 66 outpatients with schizophrenia (mean age = 44.08 years; 45.45% males). Methods: Agreement between subjective-objective parameters was assessed using two-way repeated measures ANOVA, Pearson's correlation, and Bland-Altman plot. The magnitude of discrepancy
was quantified using Cohen's d. Pearson's correlation was used to determine the significant factors of subjective-objective sleep discrepancy. Benjamini-Hochberg adjustment was performed to account for multiple testing. Results: On average, sleep diaries overestimated sleep onset latency by 20.45 min, total sleep time by 37.63 min, and sleep efficiency by 4.29%, but underestimated wake after sleep onset by 33.28 min. Cohen's d ranged between 0.61 and 1.41. Subjective-objective discrepancies were significantly associated with marital and employment status, self-reported sleep disturbance, delayed sleep–wake phase disorder, chronotype, and psychosocial functioning ($r = 0.32–0.44$; Benjamini-Hochberg corrected $p < .05$). Conclusions: Our findings show that differences between subjective and objective measurements of sleep are present in schizophrenia. Although actigraphy is not a standard procedure for sleep disturbance in schizophrenia, clinical judgment should be used if patients are suspected to have overestimated their sleep difficulties. Further studies should examine whether feedback based on actigraphy can benefit patients with schizophrenia and comorbid sleep disturbances.

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The suitability of actigraphy, diary data, and urinary melatonin profiles for quantitative assessment of sleep disturbances in schizophrenia: a case report.

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Sleep disruption is a commonly encountered clinical feature in schizophrenic patients, and one important concern is to determine the extent of this disruption under "real" life situations. Simultaneous wrist actigraphy, diary records, and repeated urine collection for urinary 6-sulphatoxymelatonin (aMT6s) profiles are appropriate tools to assess circadian rhythms and sleep patterns in field studies. Their suitability for long-term recordings of schizophrenic patients living in the community has not been evaluated. In this case report, we document long-term simultaneous wrist actigraphy, light detection, repeated urine collection, and diary records as a suitable combination of non-invasive techniques to quantify and assess changes in sleep-wake cycles, light exposure, and melatonin profiles in a schizophrenic patient. The actigraph was well-tolerated by the patient, and compliance to diary records and 48 h urine collection was particularly good with assistance from family members. The data obtained by these techniques are illustrated, and the results reveal remarkable abnormal patterns of rest-activity patterns, light exposure, and melatonin production. We observed various rest-activity patterns, including phase-shifts, highly delayed sleep on- and offsets, and irregular rest-activity phases. The period of the rest-activity rhythm, light-dark cycle, and melatonin rhythm was longer than 24 h. These circadian abnormalities may reinforce the altered sleep patterns and the problems of cognitive function and social engagement associated with schizophrenic.

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Sunlight Exposure, Work Hours, Caffeine Consumption, and Sleep
Duration in the Naval Environment.

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BACKGROUND: Sailors in the U.S. Navy are habitual shiftworkers, often experiencing circadian misalignment due to their irregular work/rest schedules. This study assessed the effect of sunlight exposure, work hours, and caffeinated beverage consumption on the daily sleep duration of crewmembers of a U.S. Navy ship during a 2-wk underway period.

METHODS: Working in an artificially lit area with no access to sunlight during work hours, U.S. Navy crew members (N = 91) used daily logs to report their daily activity, caffeinated beverage consumption, and exposure to sunlight while off-duty; sleep was assessed by wrist-worn actigraphy.

RESULTS: Hours of sunlight exposure, work duration, and the amount of coffee/tea/soft drinks were statistically significant predictors of sleep duration. On average, crewmembers who reported more than one half-hour of sunlight each day slept on average ~40 min (10%) less than their peers working the same shifts who received less than one half-hour of sunlight (on average 6.05 ± 0.90 h vs. 6.71 ± 0.91 h, respectively).

DISCUSSION: Exposure to sunlight, work hours, and consumption of caffeinated beverages are important factors when planning watchstanding schedules at sea. Even though further research is needed, our results suggest that even brief exposure to sunlight may contribute to circadian misalignment that negatively affects sleep in the operational environment. Educating crewmembers about sleep hygiene, especially the important roles played by sunlight and caffeine, could potentially improve the sleep and fatigue levels of this population of maritime shiftworkers.

Night work is non-optimal for performance and recuperation because of a lack of circadian influence that fully promote a night orientation. Our study assessed, in an industrial setting, the effects of bright light exposure (BL) on sleepiness, sleep and melatonin, during night work and during the following readaptation to day work. In a crossover design, 18 workers at a truck production plant were exposed to either BL (2500 lx) during breaks or normal light during four consecutive weeks. Twenty minute breaks were initiated by 67% of the workers between 03:00 and 04:00 hours. Sleep/wake patterns were assessed through actigraphs and ratings were given in a sleep/wake diary. Saliva melatonin was measured at 2-h intervals before, during and after night shift weeks. A significant interaction demonstrated a reduction of sleepiness in the BL condition particularly on the first two nights at 04:00 and 06:00 hours. Day sleep in the BL condition was significantly lengthened. Bright light administration significantly suppressed melatonin levels during night work and most strongly at 02:00 hours. Daytime melatonin during the readaptation after night work remained unaffected. The present findings demonstrate the feasibility and benefits of photic stimulation in industrial settings to increase adaptation to night work.
Sustaining sleep: Results from the randomized controlled work, family, and health study.

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Although calls for intervention designs are numerous within the organizational literature and increasing efforts are being made to conduct rigorous randomized controlled trials, existing studies have rarely evaluated the long-term sustainability of workplace health intervention outcomes, or mechanisms of this process. This is especially the case with regard to objective and subjective sleep outcomes. We hypothesized that a work–family intervention would increase both self-reported and objective actigraphic measures of sleep quantity and sleep quality at 6 and 18 months post-baseline in a sample of information technology workers from a U.S. Fortune 500 company. Significant intervention effects were found on objective actigraphic total sleep time and self-reported sleep insufficiency at the 6- and 18-month follow-up, with no significant decay.
occurring over time. However, no significant intervention effects were found for objective actigraphic wake after sleep onset or self-reported insomnia symptoms. A significant indirect effect was found for the effect of the intervention on objective actigraphic total sleep time through the proximal intervention target of 6-month control over work schedule and subsequent more distal 12-month family time adequacy. These results highlight the value of long-term occupational health intervention research, while also highlighting the utility of this work–family intervention with respect to some aspects of sleep. (PsycINFO Database Record (c) 2019 APA, all rights reserved).

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Systematic evaluation of Axis-I DSM diagnoses in delayed sleep phase disorder and evening-type circadian preference.


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BACKGROUND: Alterations in circadian rhythms can have profound effects on mental health. High co-morbidity for psychiatric disorders has been observed in patients with circadian rhythm disorders, such as delayed sleep phase disorder (DSPD), and in those with an evening-type circadian preference. The aim of this study was to systematically determine the prevalence and type of Diagnostic and Statistical Manual of Mental Disorders fourth edition (DSM IV) Axis-I disorders in
those with DSPD compared to evening-type controls.

METHODS: Forty-eight DSPD and 25 evening-type participants took part in this study. Sleep and wake parameters were assessed with actigraphy, diary and questionnaires (Pittsburgh Sleep Quality Index (PSQI) and Functional Outcomes of Sleep Questionnaire (FOSQ). Evening-type preference was defined by the Horne-Ostberg questionnaire. DSPD was determined by an interview according to International Classification of Sleep Disorders criteria. Current and past diagnoses of psychiatric disorders were assessed with a Structured Clinical Interview for DSM-IV disorders.

RESULTS: DSPD was associated with a later wake time, longer sleep time, higher PSQI score and lower Horne-Ostberg and FOSQ scores compared to evening-types. There were no significant differences in the prevalence or type of Axis-I disorders between those with DSPD or evening-type preference. Over 70% of participants met criteria for at least one past Axis-I disorder. Approximately 40% of both the DSPD and evening-types met criteria for a past diagnosis of mood, anxiety (most frequently phobia) or substance-use disorders. Evening types were more likely to have a past diagnosis of more than one Axis-I disorder.

CONCLUSIONS: These results highlight the important link between circadian rhythms and mental disorders. Specifically, an evening circadian chronotype regardless of DSPD status is associated with a risk for anxiety, depressive or substance-use disorders.

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Tailored Lighting Intervention for Persons with Dementia and Caregivers Living at
OBJECTIVES: Light therapy has shown promise as a nonpharmacological treatment to help regulate abnormal sleep–wake patterns and associated behavioral issues prevalent among individuals diagnosed with Alzheimer's disease and related dementia (ADRD). The present study investigated the effectiveness of a lighting intervention designed to increase circadian stimulation during the day using light sources that have high short-wavelength content and high light output.

METHODS: Thirty-five persons with ADRD and 34 caregivers completed the 11-week study. During week 1, subjective questionnaires were administered to the study participants. During week 2, baseline data were collected using Daysimeters and actigraphs. Researchers installed the lighting during week 3, followed by 4 weeks of the tailored lighting intervention. During the last week of the lighting intervention, Daysimeter, actigraph and questionnaire data were again collected. Three weeks after the lighting intervention was removed, a third data collection (post-intervention assessment) was performed.

RESULTS: The lighting intervention significantly increased circadian entrainment, as measured by phasor magnitude and sleep efficiency, as measured by actigraphy data, and significantly reduced symptoms of depression in the
participants with ADRD. The caregivers also exhibited an increase in circadian entrainment during the lighting intervention; a seasonal effect of greater sleep efficiency and longer sleep duration was also found for caregivers. CONCLUSIONS: An ambient lighting intervention designed to increase daytime circadian stimulation can be used to increase sleep efficiency in persons with ADRD and their caregivers, and may also be effective for other populations such as healthy older adults with sleep problems, adolescents, and veterans with traumatic brain injury.

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Targeted versus chrono-targeted chemotherapy for inhaled chemotherapy in non-small cell lung cancer.


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Lung cancer long term survival still remains poor and early detection is still the best methodology to treatment. Therefore several novel approaches have been investigated for anticancer drug administration. Inhaled therapies for lung diseases are used since the ancient times. Inhaled anticancer treatment administration was firstly investigated almost 30 years ago. Since then the inclusion and exclusion criteria have been investigated in correlation with the safety and efficacy of cisplatin, 5-fluoracil, carboplatin, paclitaxel, docetaxel, 9-nitro camptothecine, gemcitabine, cetuximab, granulocyte-colony stimulating factor, interleukins and recently with bevasizumab. Along with the anticancer drug formulations administered, other aspects of this local treatment have been also investigated to improve the efficiency and safety, such as; proper nebulization system, drug formulation delivery system, setting of administration, aerosol protection measures, inhalation techniques and safety issues follow up. During the last years with the use of actigraphy wrist watches, an extended investigation of the circadian rhythm of animals and humans has been performed and new insights are included in lung cancer chemotherapy administration. The "personalized" therapy administration should not be considered only as a molecular pathway inhibition, but also as a chrono-targeted anticancer treatment.

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Task switching following 24 h of total sleep deprivation: a functional MRI study.

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Task switching is a ubiquitous feature of many human activities that involve multitasking. In addition, owing to occupational demands, many individuals are required to engage in task switching under various levels of sleep deprivation, such as those who work in military and medical contexts. Nevertheless, little is known about the effects that sleep loss has on the neural bases of task switching. To address this shortcoming, we administered a cued switching task to participants following a night of normal sleep and also following a night of total sleep deprivation – in counterbalanced order. The behavioral results demonstrated a cost (i.e. longer reaction time) both as a function of sleep deprivation and task switching. Sleep deprivation resulted in greater activation in the frontoparietal network, whereas task switching was correlated with greater activation in the thalamus and superior temporal gyrus. However, despite increases in fatigue and sleepiness and a reduction in cognitive effectiveness (computed from actigraphic data), the reaction time cost associated with switching (i.e. switch cost) was not exacerbated by sleep deprivation. The results are discussed in terms of the involvement of executive functions in mitigating the effects of sleep deprivation on task switching.

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Teen at work: the burden of a double shift on daily activities.

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The purpose of this study was to evaluate time spent by working and nonworking adolescents on daily activities (work, home duties, school, transportation, other activities, leisure, sleep, and naps). Twenty-seven students, 8 male workers, 8 female workers, 5 male nonworkers, and 6 female nonworkers, ages 14-18 yrs participated in the study. They attended evening classes Monday-Friday (19:00-22:30h) in a public school in the city of São Paulo, Brazil. The students answered a comprehensive questionnaire on the characterization of their life, work, and health conditions. Simultaneously, they wore actigraphs (Ambulatory Monitoring, Inc.) and completed a diary of their daily activities (time spent at work, on home duties, commuting, leisure, other activities) for a minimum of 10 to a maximum of 17 consecutive days. The means of the variables were tested for differences by a two-factor (work and sex) ANOVA and Student-t test applied to pair-wise samples (weekdays and weekends). The average duration during weekdays of working time was 7 h 09 min and home duties 0 h 48 min. As for commuting time, there was a work effect \[ F(1,23) = 4.9; p = 0.04 \]; mean commuting time was 2 h 22 min for workers (males and females) and 1 h 25 min for nonworkers. There was a significant difference between workers and nonworkers \[ F(1,23) = 4.6; p = 0.04 \] regarding extra-curricular class activities; workers spent a mean of 3 min/day on them as opposed to 1 h 14 min by nonworkers. The average daily time spent on leisure activities by workers was 6h 31 min; whereas, for nonworkers it was 7h 38 min. Time spent in school amounted to 2h 47 min for workers in comparison to 3h 22 min by nonworkers. There was a
significant work effect upon sleep \[F(1,23)= 10.0; \ p<0.01\]. The work
effect upon
nighttime sleep duration was significant \[F(1,23)= 16.7; \ p<0.01\]. Male workers
showed a mean night sleep of 6 h 57 min and female workers 07h 15min. The average
nighttime sleep duration for nonworkers was 9 h 06 min. There was a significant
interactive effect between work and sex \[F(1,23)= 5.6; \ p=0.03\] for
naps. Female workers showed took shortest nap on average (36 min; \ SD = 26 min), and
female nonworkers the longest naps (1 h 45min; \ SD= 35min). Study and
employment exert significant impact on the life and activities of high school students.
Work affects sleep and nap duration plus the amount of time spent in school and other
extra-curricular activities.

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Telomere length is associated with sleep duration but not sleep quality in adults
with human immunodeficiency virus.

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BACKGROUND AND STUDY OBJECTIVE: Telomere length provides an estimate of cellular aging and is influenced by oxidative stress and health behaviors such as diet and exercise. This article describes relationships between telomere length and sleep parameters that included total sleep time (TST), wake after sleep onset (WASO), and self-reported sleep quality in a sample of adults with chronic illness.

DESIGN AND PARTICIPANTS: Cross-sectional study of 283 adults (74% male, 42% Caucasian) infected with human immunodeficiency virus (HIV) while living in the San Francisco Bay area, CA, USA. Ages ranged from 22-77 y.

MEASUREMENTS AND RESULTS: TST and WASO were estimated with wrist actigraphy across 72 h; self-reported sleep quality was assessed with the Pittsburgh Sleep Quality Index. Relative telomere length (RTL) in leukocytes was estimated by quantitative polymerase chain reaction assays. Shorter RTL was associated with older age, and RTL was shorter in males than females. RTL was unrelated to HIV disease characteristics. RTL was not associated with WASO or self-reported sleep quality. Participants with at least 7 h sleep had longer RTL than those with less than 7 h, even after controlling for the effects of age, sex, race, education, body mass index, metabolic hormones (i.e., leptin, ghrelin, adiponectin, and resistin), depression and anxiety, and sleep quality.

CONCLUSION: Results suggest that sleep duration is associated with preserving telomere length in a population of human immunodeficiency virus-infected adults. Getting at least 7 hours of sleep at night may either protect telomeres from damage or restore them on a nightly basis.

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Temporal interrelationships among fatigue, circadian rhythm and depression in breast cancer patients undergoing chemotherapy treatment.

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Seventy-eight female breast cancer patients were assessed for fatigue, depression, overall mood, and circadian rhythm at their second and fourth on-study chemotherapy cycles as part of a larger study examining the efficacy of paroxetine in reducing chemotherapy-induced fatigue. The Multidimensional Assessment of Fatigue (MAF), the Fatigue Symptom Checklist (FSCL), the Center for Epidemiologic Studies-Depression [CES-D] questionnaire, the Hamilton Depression Inventory (HDI), and the Profile of Mood States (POMS) were completed by patients at home 7 days after each treatment to assess symptom severity. Circadian rhythm was assessed over a 72-h period with the Mini-Motionlogger Actigraph (Ambulatory Monitoring, Ardsley, NY), starting 6 days after treatment. Daily patterns of sleep and activity were compared across the 3-day period by autocorrelation analyses to calculate a circadian rhythm score for each patient, with higher scores associated with lower disruption. Comparisons of fatigue, depression, and mood with patient circadian rhythm measures taken after the second cycle indicate that all five paper and pencil measures correlated well with the measure of circadian rhythm (all r(partial) <−0.30, all P<0.05). Changes in the fatigue,
depression and mood measures from the second on-study treatment to the fourth were significantly correlated with concurrent changes in circadian rhythm (MAF $r=-0.31; P=0.04$; FSCL $r=-0.30; P=0.04$; CES-D $r=-0.39; P=0.008$; HDI $r=-0.34; P=0.03$; POMS $r=-0.40; P=.007$). These findings provide evidence that circadian rhythm disruption is involved in the experience of fatigue and depression in cancer patients.

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Temporal relationships between physical activity and sleep in older women.

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PURPOSE: The objective of this study is to examine the temporal and bidirectional relationships between accelerometer-derived physical activity estimates and actigraphy-assessed sleep characteristics among older women.
METHODS: A subgroup of participants ($N = 143$, mean age = 73 yr) enrolled in the Healthy Women Study wore an ActiGraph accelerometer on their waist and an Actiwatch sleep monitor on their wrist concurrently for seven consecutive days. Multilevel models examined whether ActiGraph-assessed daily activity counts ($\text{ct} \cdot \text{min}^{-1} \cdot \text{d}^{-1}$) and moderate- to vigorous-intensity physical activity (MVPA; $\text{min} \cdot \text{d}^{-1}$) predicted Actiwatch-assessed sleep onset latency, total sleep time,
sleep efficiency, and sleep fragmentation. Similar models were used to determine whether nighttime sleep characteristics predicted physical activity the following day.

RESULTS: In unadjusted models, greater daily activity counts (B = -0.05, P = 0.005) and more minutes of MVPA (B = -0.03, P = 0.01) were temporally associated with less total sleep time across the week. Greater sleep efficiency was associated with greater daily activity counts (B = 0.37, P = 0.01) and more minutes of MVPA (B = 0.64, P = 0.009) the following day. Less sleep fragmentation was also associated with greater daily activity counts and more MVPA the following day. Findings were similar after adjustment for age, education, body mass index, depressive symptoms, arthritis, and accelerometer wear time.

CONCLUSIONS: Few studies have used objective measures to examine the temporal relationships between physical activity and sleep. Notably, these findings suggest that nightly variations in sleep efficiency influence physical activity the following day. Thus, improving overall sleep quality in addition to reducing nightly fluctuations in sleep may be important for encouraging a physically active lifestyle in older women.

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Temporal sleep patterns in adults using actigraph.

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The aim of the present study was to characterize the temporal patterns of sleep and wakefulness in a sample of the adult subjects from São Paulo city. All subjects filled the Morningness/Eveningness Questionnaire (MEQ) and wore an actigraph for at least three consecutive days. A total of 359 subjects were considered for the analyses. The mean age was 43±14 years, the mean body mass index was 26.7±5.7 kg/m², and 60% were female. The mean MEQ score was 58.0±10.7. The sleep pattern evaluated by the actigraphic analyses showed that 92% had a monophasic sleep pattern, 7% biphasic, and 1% polyphasic sleep pattern. Cluster analysis, based on time to sleep onset, sleep efficiency, sleep latency, and total sleep time, was able to identify three different groups denominated: morning type, evening type, and undefined type. Morning type subjects were more frequent, older, and had higher MEQ scores than evening type subjects. Our results showed that the actigraph objectively assessed the sleep-wake cycle and was able to discriminate between morning and evening type individuals. These findings suggest that the actigraph could be a valuable tool for assessing temporal sleep patterns, including the circadian preferences.

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Thoracic surface temperature rhythms as circadian biomarkers for cancer chronotherapy.
The disruption of the temperature circadian rhythm has been associated with cancer progression, while its amplification resulted in cancer inhibition in experimental tumor models. The current study investigated the relevance of skin surface temperature rhythms as biomarkers of the Circadian Timing System (CTS) in order to optimize chronotherapy timing in individual cancer patients. Baseline skin surface temperature at four sites and wrist accelerations were measured every minute for 4 days in 16 patients with metastatic gastrointestinal cancer before chronotherapy administration. Temperature and rest-activity were recorded, respectively, with wireless skin surface temperature patches (Respironics, Phillips) and an actigraph (Ambulatory Monitoring). Both variables were further monitored in 10 of these patients during and after a 4-day course of a fixed chronotherapy protocol. Collected at baseline, during and after therapy longitudinal data sets were processed using Fast Fourier Transform Cosinor and Linear Discriminant Analyses methods. A circadian rhythm was statistically validated with a period of 24 h (p < 0.05) for 49/61 temperature time series (80.3%), and 15/16 rest-activity patterns (93.7%) at baseline. However, individual circadian amplitudes varied from 0.04 °C to 2.86 °C for skin surface temperature (median, 0.72 °C), and from 16.6 to 146.1 acc/min for rest-activity (median, 88.9 acc/min). Thirty-nine pairs of baseline temperature and rest-activity time series (75%) were correlated (r > |0.7|; p < 0.05). Individual circadian acrophases at baseline were scattered from 15:18 to 6:05 for skin surface temperature, and from 12:19 to 15:18 for rest-activity, with respective
median values of 01:10 (25-75% quartiles, 22:35–3:07) and 14:12 (13:14–14:31).
The circadian patterns in skin surface temperature and rest-activity persisted or were amplified during and after fixed chronotherapy delivery for 5/10 patients. In contrast, transient or sustained disruption of these biomarkers was found for the five other patients, as indicated by the lack of any statistically significant dominant period in the circadian range. No consistent correlation ($r < |0.7|$, $p \geq 0.05$) was found between paired rest-activity and temperature time series during fixed chronotherapy delivery. In conclusion, large inter-patient differences in circadian amplitudes and acrophases of skin surface temperature were demonstrated for the first time in cancer patients, despite rather similar rest-activity acrophases. The patient-dependent coupling between both CTS biomarkers, and its possible alteration on a fixed chronotherapy protocol, support the concept of personalized cancer chronotherapy.

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Time-of-day and days-on-shift predict increased fatigue over two-week offshore day-shifts.

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OBJECTIVES: The purpose of this study was to investigate the accumulation of fatigue over a two-week offshore period. In particular, the effects of (1) time-of-day and days-on-shift as well as (2) acute and chronic sleep loss on the rate at which fatigue accumulates were investigated.

METHODS: 42 day-shift offshore workers were examined. Fatigue was measured using pre- and post-shift scores on the Karolinska Sleepiness Scale (KSS). Total sleep time was measured using actigraphy (Motionwatch8, Camntech). Data was analyzed using a linear mixed model analyses.

RESULTS: Average sleep loss per night was 92 min (95%CI: 89.6–94.0; \( p < .001 \)). Mean cumulative sleep loss across the study was 21:20hrs (SD = 08:10hrs) over the
14 days. Chronic sleep loss was significantly related to a modest increase in sleepiness (KSS) across the shift (95%CI: 0.01-0.17; p = .020) and in post-shift scores (95%CI: 0.07-0.19; p < .001). Time-of-day (95%CI: 0.63 to -0.01; p = .042) and days-on-shift (95%CI: 0.03-0.08; p < .001) as well as their interaction (95%CI: 0.08 to -0.00; p = .027) influenced the rate at which fatigue accumulated over a two-week offshore period.

CONCLUSIONS: Pre- and post-shift fatigue accumulate in different ways over the two-week offshore period. The accumulation of post-shift fatigue scores was positively related to successive days-on-shift and chronic sleep loss. Our results suggest that prolonging offshore periods will likely result in elevated fatigue risk. Accumulating fatigue and sleep loss over two-week offshore periods should be considered in fatigue risk management plans and systems.

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Time of day effects in, and the relationship between, sleep quality and movement.

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The study aimed to measure the effects of a 27-h 'day' sleep-wake regime on actigraphic and subjective sleep variables, and to examine the relationships between these variables. Nine subjects spent 30 days and nights in the laboratory. After sleeping 8 h for each of 8 nights, the subjects had an imposed 27-h 'day', for 18 'days', remaining in bed for 9 h on each sleep period. Sleep periods therefore started 3 h later each day, although subjects'
circadian rhythms stayed entrained to 24 h, because subjects were not isolated from the natural light–dark cycle. Time asleep, subjective sleep efficiency and subjective sleep quality, but not movement during sleep, were found to be significantly affected by time of going to bed. There were significant decreases in movement during recovery sleeps following each of two episodes of 26 h sleep deprivation. Over the study there were significant within-subject correlations between subjective sleep quality and subjective sleep efficiency (rav = 0.65), movement during sleep and subjective sleep efficiency (rav = −0.48), and movement during sleep and subjective sleep quality (rav = −0.26). We conclude that sleep movement, despite its low within- and between-subjects variability, is nevertheless a statistically reliable, but weak, indicator of subjective sleep efficiency and quality.

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Time to wake up: No impact of COMT Val158Met gene variation on circadian preferences, arousal regulation and sleep.


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Dopamine has been implicated in the regulation of sleep-wake states and the circadian rhythm. However, there is no consensus on the impact of two established dopaminergic gene variants: the catechol-O-methyltransferase Val158Met (COMT Val158Met; rs4680) and the dopamine D4 receptor Exon III variable-number-of-tandem-repeat polymorphism (DRD4 VNTR). Pursuing a multi-method approach, we examined their potential effects on circadian preferences, arousal regulation and sleep. Subjects underwent a 7-day actigraphy assessment (SenseWear Pro3), a 20-minute resting EEG (analyzed using VIGALL 2.0) and a body mass index (BMI) assessment. Further, they completed the Morningness-Eveningness Questionnaire (MEQ), the Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Quality Index (PSQI). The sample comprised 4625 subjects (19–82 years) genotyped for COMT Val158Met, and 689 elderly subjects (64–82 years) genotyped for DRD4 VNTR. The number of subjects varied across phenotypes. Power calculations revealed a minimum required phenotypic variance explained by genotype ranging between 0.5% and 1.5% for COMT Val158Met and between 3.3% and 6.0% for DRD4 VNTR. Analyses did not reveal significant genotype effects on MEQ, ESS, PSQI, BMI, actigraphy and EEG variables. Additionally, we found no compelling evidence in sex- and age-stratified subsamples. Few associations surpassed the threshold of nominal significance (p < .05), providing some indication for a link between DRD4 VNTR and daytime sleepiness. Taken together, in light of the statistical power obtained in the present study, our data
particularly suggest no impact of the COMT Val158Met polymorphism on circadian preferences, arousal regulation and sleep. The suggestive link between DRD4 VNTR and daytime sleepiness, on the other hand, might be worth investigation in a sample enriched with younger adults.

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Light exposure can influence sleep and circadian timing, both of which have been shown to influence weight regulation. The goal of this study was to evaluate the relationship between ambient light, sleep and body mass index. Participants included 54 individuals (26 males, mean age 30.6, SD = 11.7 years). Light levels, sleep midpoint and duration were measured with wrist actigraphy (Actiwatch-L) for 7 days. BMI was derived from self-reported height and weight. Caloric intake was determined from 7 days of food logs. For each participant, light and activity data were output in 2 minute epochs, smoothed using a 5 point (10 minute) moving average and then aggregated over 24 hours. The mean light timing above 500 lux (MLiT500) was defined as the average clock time of all aggregated data points above 500 lux. MLiT500 was positively correlated with BMI (r = 0.51,
p<0.001), and midpoint of sleep (r = 0.47, p<0.01). In a multivariable linear regression model including MLiT500 and midpoint of sleep, MLiT500 was a significant predictor of BMI (B = 1.26 SE = 0.34, β = 0.53 p = 0.001, r²Δ = 0.22). Adjusting for covariates, MLiT500 remained an independent predictor of BMI (B = 1.28 SE = 0.36, β = 0.54, p = 0.002, r²Δ = 0.20). The full model accounted for 34.7% of the variance in BMI (p = 0.01). Exposure to moderate levels of light at biologically appropriate times can influence weight, independent of sleep timing and duration.

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The timing of activity rhythms in patients with dementia is related to survival.

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BACKGROUND: Older adults with dementia often have disruptions in circadian rhythms, including disruptions of the rest-activity rhythm. These disruptions are a product of internal neuronal activity and external environmental influences, both of which are deficient in dementia. However, the consequences of disturbed rhythms are unknown. This study examined the relationship between rest-activity rhythms and death in patients with dementia.

METHODS: The authors recruited 149 older adults with dementia (104 women; mean age, 84.1 years) from nursing homes. Activity was recorded with wrist actigraphs.
from each participant for 3 days. Survival was determined by examining public
death records. Cox proportional hazards models were used to determine which
aspects of rest-activity rhythms were related to survival.
RESULTS: The timing of each participant's rest-activity rhythm compared with a
sample of persons without dementia was related to survival, such that those who
more closely resembled the persons without dementia lived longer.
CONCLUSIONS: Although rest-activity rhythms as a whole were not related to
survival, the timing of the rhythm was. Patients with dementia appear to develop
an abnormal timing of their rhythms, which is predictive of shorter survival. It
may be possible to intervene with these patients to correct the timing
of their rhythms and possibly prolong their lives.

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Timing of light exposure and activity in adults with delayed sleep-wake phase disorder.

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OBJECTIVE: To characterize the patterns of light exposure and physical activity level and assess their relationship with sleep quality and depressive symptoms in adults with delayed sleep-wake phase disorder (DSWPD).

METHODS: 42 DSWPD (22 female, mean age 34.5 y) and 26 (±4 years) age-and-sex-matched controls (12 female, mean age 33.4 y) underwent seven days of light and activity monitoring.

RESULTS: Individuals with DSWPD had significantly delayed bed times and wake times, but similar sleep duration compared to controls. Subjective sleep quality (Pittsburgh Sleep Quality Index (PSQI)) was poorer in DSWPDs compared to controls. Those with DSWPD had significantly more activity and light exposure late at night (2:00-4:00) and significantly less activity and light exposure in the morning (8:00-11:00). Total 24 h levels of light and activity were not significantly different between DSWPD and controls. However, the DSWPD group had significantly more light exposure than controls 22 h after waking, during their sleep period. Later light exposure correlated with higher depression scores [Beck Depression Index (BDI)] and poorer sleep quality (PSQI).

CONCLUSIONS: The light exposure patterns observed in DSWPD likely contribute to and perpetuate the chronically delayed sleep and wake phase in these patients. In addition, increased light exposure during the sleep period may also contribute to the poor sleep quality and mood disorders that are common in these individuals.
The Timing of the Circadian Clock and Sleep Differ between Napping and Non-Napping Toddlers.

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The timing of the internal circadian clock shows large inter-individual variability across the lifespan. Although the sleep-wakefulness pattern of most toddlers includes an afternoon nap, the association between napping and circadian phase in early childhood remains unexplored. This study examined differences in circadian phase and sleep between napping and non-napping toddlers. Data were
collected on 20 toddlers (34.2±2.0 months; 12 females; 15 nappers). Children followed their habitual napping and non-napping sleep schedules (monitored with actigraphy) for 5 days before an in-home salivary dim light melatonin onset (DLMO) assessment. On average, napping children fell asleep during their nap opportunities on 3.6±1.2 of the 5 days before the DLMO assessment. For these napping children, melatonin onset time was 38 min later (p = 0.044; d = 0.93), actigraphically-estimated bedtime was 43 min later (p = 0.014; d = 1.24), sleep onset time was 59 min later (p = 0.006; d = 1.46), and sleep onset latency was 16 min longer (p = 0.030; d = 1.03) than those not napping. Midsleep and wake time did not differ by napping status. No difference was observed in the bedtime, sleep onset, or midsleep phase relationships with DLMO; however, the wake time phase difference was 47 min smaller for napping toddlers (p = 0.029; d = 1.23).

On average, nappers had 69 min shorter nighttime sleep durations (p = 0.006; d = 1.47) and spent 49 min less time in bed (p = 0.019; d = 1.16) than non-nappers. Number of days napping was correlated with melatonin onset time (r = 0.49; p = 0.014). Our findings indicate that napping influences individual variability in melatonin onset time in early childhood. The delayed bedtimes of napping toddlers likely permits light exposure later in the evening, thereby delaying the timing of the clock and sleep. Whether the early developmental trajectory of circadian phase involves an advance associated with the decline in napping is a question necessitating longitudinal data as children transition from a biphasic to monophasic sleep-wakefulness pattern.

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Too Late and Not Enough: School Year Sleep Duration, Timing, and Circadian Misalignment Are Associated with Reduced Insulin Sensitivity in Adolescents with Overweight/Obesity.


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OBJECTIVES: To examine the relationship between insulin resistance (IR) and sleep/circadian health in overweight/obese adolescents. We hypothesized that insufficient and delayed sleep would be associated with IR in this population.

STUDY DESIGN: Thirty-one adolescents (mean age, 16.0 ± 1.4 years; 77% female) with body mass index ≥90th percentile for age/sex were recruited from outpatient clinics at a children's hospital. Participants underwent 1 week of objective home sleep monitoring with wrist actigraphy during the academic year. A 3-hour oral glucose tolerance test was conducted, followed by in-laboratory salivary dim-light melatonin sampling every 30–60 minutes from 5 p.m. to noon the next day. Regression analyses between sleep and circadian variables with IR were examined.

RESULTS: Longer sleep time and time in bed on weekends and weekdays and earlier weekday bedtime were significantly associated with better insulin sensitivity. Participants who obtained less than the median duration of sleep per night (6.6 hours) had evidence of IR with compensatory insulin secretion compared with those obtaining ≥6.6 hours of sleep. A wider phase angle between bedtime and melatonin onset, indicating a later circadian timing of sleep onset, was significantly associated with IR.

CONCLUSIONS: Short sleep duration, later weekday bedtime, and later circadian timing of sleep were associated with IR in a cohort of adolescents with overweight/obesity during the school year. Further research is needed to better understand the physiology underlying these observations and to evaluate the impact of improved sleep and circadian health on metabolic health in this at-risk population.

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Toward a complex system understanding of bipolar disorder: A chaotic model of abnormal circadian activity rhythms in euthymic bipolar disorder.

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IMPORTANCE: In the absence of a comprehensive neural model to explain the underlying mechanisms of disturbed circadian function in bipolar disorder, mathematical modeling is a helpful tool. Here, circadian activity as a response to exogenous daily cycles is proposed to be the product of interactions between neuronal networks in cortical (cognitive processing) and subcortical (pacemaker) areas of the brain.

OBJECTIVE: To investigate the dynamical aspects of the link between disturbed circadian activity rhythms and abnormalities of neurotransmitter functioning in frontal areas of the brain, we developed a novel mathematical model of a chaotic system which represents fluctuations in circadian activity in bipolar disorder as changes in the model's parameters.

DESIGN, SETTING AND PARTICIPANTS: A novel map-based chaotic system was developed to capture disturbances in circadian activity across the two extreme mood states of bipolar disorder. The model uses chaos theory to characterize
interplay between neurotransmitter functions and rhythm generation; it aims to illuminate key activity phenomenology in bipolar disorder, including prolonged sleep intervals, decreased total activity and attenuated amplitude of the diurnal activity rhythm. To test our new cortical-circadian mathematical model of bipolar disorder, we utilized previously collected locomotor activity data recorded from normal subjects and bipolar patients by wrist-worn actigraphs.

RESULTS: All control parameters in the proposed model have an important role in replicating the different aspects of circadian activity rhythm generation in the brain. The model can successfully replicate deviations in sleep/wake time intervals corresponding to manic and depressive episodes of bipolar disorder, in which one of the excitatory or inhibitory pathways is abnormally dominant.

CONCLUSIONS AND RELEVANCE: Although neuroimaging research has strongly implicated a reciprocal interaction between cortical and subcortical regions as pathogenic in bipolar disorder, this is the first model to mathematically represent this multilevel explanation of the phenomena of bipolar disorder.

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Trajectories of sleep and cardiac sympathetic activity indexed by pre-ejection period in childhood.

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Fragmented and insufficient sleep has been implicated in disrupted autonomic nervous system activity during resting state conditions in typically developing children. Towards explication of these relations over development, the current study tested reciprocal relations between the development of sleep parameters (efficiency, duration, latency) and cardiac sympathetic nervous system (SNS) activity indexed by pre-ejection period (PEP) during waking-resting state conditions throughout middle and late childhood. Whether sleep derives changes in PEP or vice versa was examined. A longitudinal design was employed and latent growth modelling was used to examine the research questions. During the first assessment, 282 children aged 9.44 years (65% European American, 35% African American) participated. Two more assessments followed, with a 1-year lag between consecutive study waves. Sleep was examined with 7 nights of actigraphy in the child's home. Controlling for many potential confounds (sex, race/ethnicity, body mass index and family socioeconomic status), higher sleep efficiency and more sleep minutes predicted increases in PEP (less SNS activity) over 3 years. PEP did not predict changes in sleep efficiency or duration over time and there were no significant effects for sleep latency. Findings highlight the probable direction of effects between these two key bioregulatory systems. High levels of cardiac SNS activity are associated with many negative health outcomes, and thus these findings may have important implications.

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Trajectory of insomnia symptoms in older adults with lung cancer: using mixed methods.

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CONTEXT: A knowledge gap exists in our understanding of the illness and insomnia symptom treatment trajectory in adults with inoperable non-small cell lung cancer (NSCLC).

OBJECTIVES: Compare valid and reliable sleep-wake measures for insomnia to interpretations of narrative descriptions of sleep to improve our comprehension of sleep-wake disturbances in adults with NSCLC.

METHODS: This study employed mixed methods (quantitative and qualitative) in a longitudinal design to study adults (n = 26) from ambulatory thoracic clinics. Valid and reliable surveys (Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale), 7-day sleep diary, and actigraphy were obtained with interview narrative interpretations of sleep experiences in the context of lung cancer. Data collection occurred at four-time points: baseline (before chemotherapy), pre-second chemotherapy, pre-third chemotherapy, and 6 months from baseline. Sleep measures were compared to interpretations from interview narratives to understand context of survey measures.
RESULTS: Objective quantitative results were congruent with interview narrative interpretations that reflected participants' sleep-wake experiences. Objective sleep-wake measures for insomnia over-time described increasing sleep latency and decreasing sleep duration. The interview narratives provided context and insight into participants' subjective insomnia experiences. While participants' insomnia symptoms were present, they were resigned to endure insomnia, and the subjective measures reflected a more positive perception of sleep outcomes. CONCLUSION: A mixed methods approach provides a deeper understanding of sleep-wake disturbances and the differing quantitative objective and subjective results of sleep measures in the context of the participants' experience of the trajectory of insomnia symptoms before, during, and after lung cancer treatment.

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Transcutaneous electrical nerve stimulation (TENS) improves circadian rhythm disturbances in Alzheimer disease.

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In patients with Alzheimer disease (AD), an irregular day-night rhythm with behavioral restlessness during the night makes a strong demand on caregivers and is among the most important reasons for institutionalization. A dysfunctioning circadian timing system is supposed to underlie the disturbance or at least to contribute to it. The disturbance improves with increased environmental light, which, through the retinohypothalamic tract, activates the
suprachiasmatic nucleus (SCN), the biological clock of the brain. Because recent studies have indicated both direct and indirect spinal projections to the SCN, we investigated whether excitation of spinal neurons by means of transcutaneous electrical nerve stimulation (TENS) could also improve circadian rhythm disturbances in AD patients. The actigraphically obtained rest-activity rhythm of 14 AD patients showed an improvement in its coupling to Zeitgeber after TENS treatment but not after placebo treatment.

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Transcutaneous electrical nerve stimulation (TENS) improves the rest-activity rhythm in midstage Alzheimer's disease.

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Nightly restlessness in patients with Alzheimer's disease (AD) is probably due to a disorder of circadian rhythms. Transcutaneous electrical nerve stimulation (TENS) was previously reported to increase the strength of coupling of the circadian rest activity rhythm to Zeitgebers in early stage Alzheimer's disease (AD) patients. It was investigated in the present study whether TENS could also improve the rest activity rhythm of patients in a midstage. Sixteen patients who met the NINCDS ADRDA criteria for probable AD, and the stage 6 criteria of the Global Deterioration Scale were treated with TENS or placebo. Rest activity rhythm was assessed using actigraphy. Compared to the control group, stimulated patients showed an improvement in the rest activity rhythm of similar
magnitude
as observed previously in patients in an early stage. It is concluded that TENS
increased the coupling between the rest activity rhythm and supposedly stable
Zeitgebers in an advanced stage of AD.

DOI: 10.1016/s0166-4328(98)00150-8
PMID: 10342404  [Indexed for MEDLINE]


Transdermal lisuride: short-term efficacy and tolerability study in patients with severe restless legs syndrome.

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BACKGROUND AND PURPOSE: Restless legs syndrome (RLS) patients suffer from symptoms not only at bedtime but also with variable circadian patterns. Transdermal application forms of dopamine agonists are expected to lead to a stable plasma concentration of the active drug which could ease treatment for RLS patients with daytime symptoms and avoid side effects of oral dopaminergic therapies.

PATIENTS AND METHODS: In this controlled pilot study, 10 patients (six females, four males, mean age 58 years) with severe and long-lasting idiopathic RLS were treated during an initial open-label phase for 2 weeks either with one (n=3 patients) or, if required, two patches of lisuride every other day (dose per patch: 3mg lisuride, nominal effective release rate 7.0 microg lisuride/h).

Patients were then randomized to double-blind treatment with lisuride (n=5) or placebo (n=4) for 1 week.

RESULTS: Severity of RLS clearly improved during open-label and double-blind
treatment with lisuride but became worse under placebo according to
the
International Restless Legs Syndrome Study Group Rating Scale (IRLS),
RLS-6, and
Clinical Global Impressions (CGIs) scales, and actigraphy assessments
(periodic
leg movement index) in the 1-week double-blind period.
CONCLUSION: The explorative findings of this small controlled study
suggest that
lisuride patches might be an efficacious treatment for RLS patients
without
clinically relevant tolerability problems.

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PMID: 16194624 [Indexed for MEDLINE]

Transient short free running circadian rhythm in a case of aneurysm
near the
suprachiasmatic nuclei.
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Comment in
A free running circadian rest-activity cycle is rare in sighted
individuals
living in a normal environment. Even more rare is a periodicity
shorter than 24
hours, as observed in actigraphic recordings in a female patient
during
convalescence after a whiplash injury in a car accident. The
documented free
running period was 22.5 hours for 19 days. During the subsequent weeks
re-entrainment occurred following re-establishment by a social
zeitgeber, with a
slightly early circadian phase of nocturnal melatonin onset relative
to a late
sleep period. Magnetic resonance imaging and cerebral angiography
showed an
aneurysm at the bifurcation of the right internal carotid artery,
close to the
circadian pacemaker structure (the suprachiasmatic nuclei), which was later occluded.

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PMCID: PMC1739733
PMID: 16024905 [Indexed for MEDLINE]


Treating Disorders of Consciousness With Apomorphine: Protocol for a Double-Blind Randomized Controlled Trial Using Multimodal Assessments.


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Background: There are few available therapeutic options to promote recovery among patients with chronic disorders of consciousness (DOC). Among pharmacological treatments, apomorphine, a dopamine agonist, has exhibited promising behavioral effects and safety of use in small-sample pilot studies. The true
efficacy of the
drug and its neural mechanism are still unclear. Apomorphine may act
through a
modulation of the anterior forebrain mesocircuit, but neuroimaging and
neuropysiological investigations to test this hypothesis are scarce.
This
clinical trial aims to (1) assess the treatment effect of subcutaneous
apomorphine infusions in patients with DOC, (2) better identify the
phenotype of
responders to treatment, (3) evaluate tolerance and side effects in
this
population, and (4) examine the neural networks underlying its
modulating action
on consciousness. Methods/Design: This study is a prospective double-
blind
randomized parallel placebo-controlled trial. Forty-eight patients
diagnosed with
DOC will be randomized to receive a 30-day regimen of either
apomorphine
hydrochloride or placebo subcutaneous infusions. Patients will be
monitored at
baseline 30 days before initiation of therapy, during treatment and
for 30 days
after treatment washout, using standardized behavioral scales (Coma
Recovery
Scale-Revised, Nociception Coma Scale-Revised), neuropysiological
measures
(electroencephalography, body temperature, actigraphy) and brain
imaging
(magnetic resonance imaging, positron emission tomography). Behavioral
follow-up
will be performed up to 2 years using structured phone interviews.
Analyses will
look for changes in behavioral status, circadian rhythmicity, brain
metabolism,
and functional connectivity at the individual level (comparing before
and after
treatment) and at the group level (comparing apomorphine and placebo
arms, and
comparing responder and non-responder groups). Discussion: This study
investigates the use of apomorphine for the recovery of consciousness
in the
first randomized placebo-controlled double-blind trial using
multimodal
assessments. The results will contribute to define the role of
dopamine agonists
for the treatment of these challenging conditions and identify the
neural
correlates to their action. Results will bring objective evidence to
further
assess the modulation of the anterior forebrain mesocircuit by pharmacological agents, which may open new therapeutic perspectives. Clinical Trial Registration: EudraCT n°2018-003144-23; Clinicaltrials.gov n°NCT03623828 (https://clinicaltrials.gov/ct2/show/NCT03623828).

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PMID: 30941094


Treatment of behavioural, cognitive and circadian rest-activity cycle disturbances in Alzheimer's disease: haloperidol vs. quetiapine.


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This 5-wk, open-label, comparative study investigated the effects of quetiapine and haloperidol on behavioural, cognitive and circadian rest-activity cycle disturbances in patients with Alzheimer's disease (AD). Out of a total of 30 patients enrolled in the study, there were 22 completers, 11 in the quetiapine group (mean age 81.9+-1.8 yr, mean baseline MMSE 19.9+-1.3, mean dose 125 mg) and 11 in the haloperidol group (mean age 82.3+-2.5 yr, mean baseline MMSE 18.1+-1.3, mean dose 1.9 mg). As shown in the Neuropsychiatric Inventory, both medications reduced delusion and agitation, whereas quetiapine additionally improved depression and anxiety. Haloperidol worsened aberrant motor behaviour and caused extrapyramidal symptoms. In the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) neuropsychological test battery which assessed cognitive parameters, quetiapine improved word recall; significant
interaction terms revealed differences between quetiapine and haloperidol in word-list memory and constructional praxis. According to the Nurses' Observation Scale for Geriatric Patients (NOSGER) quetiapine improved instrumental activities of daily living. Actimetry documented the circadian rest-activity cycle before and after treatment. Sleep analysis revealed that patients receiving quetiapine had shorter wake bouts during the night, whereas patients receiving haloperidol had fewer though longer immobile phases. The study provides evidence that quetiapine at a moderate dose may be efficacious in treating behavioural disturbances in AD, with better tolerability than haloperidol.

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The treatment of early-morning awakening insomnia with 2 evenings of bright light.

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Comment in

STUDY OBJECTIVE: To assess the effectiveness of brief bright-light therapy for the treatment of early-morning awakening insomnia.

PARTICIPANTS: Twenty-four healthy adults with early-morning awakening insomnia were assigned to either the bright-light condition (2,500-lux white light) or the control (dim red light) condition.

MEASUREMENTS AND RESULTS: The circadian phase of rectal temperature and urinary
melatonin rhythms were assessed with 26-hour constant routines before and after 2 evenings of light therapy. Sleep and daytime functioning were monitored using sleep diaries, activity monitors, and mood scales before light therapy and for 4 weeks during the follow-up period. While there were no significant circadian phase changes in the dim-light control group, the bright-light group had significant 2-hour phase delays of circadian temperature and melatonin rhythm.

Compared to pretreatment measures, over the 4-week follow-up period, the bright-light group had a greater reduction of time awake after sleep onset, showed a trend toward waking later, and had a greater increase of total sleep time. Participants in the bright-light condition also tended to report greater reductions of negative daytime symptoms, including significantly fewer days of feeling depressed at the 4-week follow-up, as compared with the control group.

**CONCLUSION:** Two evenings of bright-light exposure phase delayed the circadian rhythms of early-morning awakening insomniacs. It also improved diary and actigraphy sleep measures and improved some indexes of daytime functioning for up to 1 month after light exposure. The study suggests that a brief course of evening bright-light therapy can be an effective treatment for early-morning awakening insomniacs who have relatively phase advanced circadian rhythms.

DOI: 10.1093/sleep/28.5.616
PMID: 16171276  [Indexed for MEDLINE]
BACKGROUND AND PURPOSES: Sleep and nighttime behavioral disturbances are widespread in community-dwelling dementia patients, but little is known about the usefulness of behavioral interventions for treating them. This article presents data from three cases enrolled in an ongoing study of sleep problems in community-dwelling Alzheimer's disease (AD) patients: nighttime insomnia treatment and education for Alzheimer's disease.

PATIENTS AND METHODS: All subjects received written materials describing age- and dementia-related changes in sleep, and standard principles of good sleep hygiene. Caregivers also received education about dementia, listings of relevant community resources, and general support. Subjects' sleep-wake activity was measured at baseline, post-test (2 months), and 6-month follow-up using an Actilume wrist-movement recorder, which was worn continuously for 1 week.

RESULTS: Post-test actigraphic improvements in sleep quantity and sleep efficiency, number of nighttime awakenings, and amount of daytime sleep, as well as subjective sleep ratings were observed. One subject maintained improvements at 6-month follow-up. Subjects varied widely in the type of sleep problems reported and behavioral strategies implemented by family caregivers, illustrating the complexity that characterizes nighttime behavioral disturbances in AD.

CONCLUSIONS: This paper provides clinical and empirical evidences that behavioral strategies including standard sleep hygiene recommendations can be helpful in treating sleep and nighttime behavioral disturbances in dementia patients.

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PMID: 15222994  [Indexed for MEDLINE]
Twenty four-hour activity cycle in older adults using wrist-worn accelerometers: The seniors-ENRICA-2 study.


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OBJECTIVES: This study aimed: (a) to provide a detailed description of sleep, sedentary behavior (SED), light physical activity (LPA), and moderate-to-vigorous physical activity (MVPA) over the complete 24-hours period using raw acceleration data in older adults; and (b) to examine the differences in the 24-hours activity cycle by sex, age, education, and body mass index (BMI).

METHODS: Population-based cohort comprising 3273 community-dwelling individuals (1739 women), aged 71.8 ± 4.5 years, participating in the Seniors-ENRICA-2 study. Participants wore a wrist-worn ActiGraph GT9X accelerometer for 7 consecutive days, and the raw signal was processed using the R-package GGIR.

RESULTS: Participants reached 21.5 mg as mean acceleration over the whole day; 32.3% (7.7 h/d) of time was classified as sleep, 53.2% (12.7 h/d) as
SED, 10.4% (148.6 min/d) as LPA, and 4.1% (59.0 min/d) as MVPA. No marked differences were found in sleep-related variables between socio-demographic and BMI groups. However, women showed higher LPA but lower SED and MVPA than men. Moreover, SED increased whereas LPA and MVPA decreased with age. Participants with obesity (BMI ≥ 30 kg/m²) accumulated more SED and less LPA and MVPA than those without obesity. As expected, adherence to physical activity recommendations varied widely (9.2%-76.6%) depending on the criterion of MVPA accumulation.

CONCLUSION: Objective assessment of the 24-hour activity cycle provides extensive characterization of daily activities distribution in older adults and may inform health-promotion interventions in this population. Women, the oldest old, and those with obesity offer relevant targets of strategies to improve lifestyle patterns.

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Twenty-four-hour motor activity and body temperature patterns suggest altered central circadian timekeeping in Smith-Magenis syndrome, a neurodevelopmental disorder.

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Smith–Magenis syndrome (SMS) is a contiguous gene syndrome linked to interstitial microdeletion, or mutation of RAI1, within chromosome 17p11.2. Key behavioral features of SMS include intellectual disability, sleep-disturbances, maladaptive, aggressive and self-injurious behaviors, hyperactivity, and sudden changes in mood. A distinguishing feature of this syndrome is an inverted pattern of melatonin characterized by elevated daytime and low nighttime melatonin levels.

As the central circadian clock controls the 24-hr rhythm of melatonin, we hypothesized that the clock itself may contribute to the disrupted pattern of melatonin and sleep. In this report, 24-hr patterns of body temperature, a surrogate marker of clock-timing, and continuous wrist activity were collected to examine the links between body temperature, sleep behavior, and the circadian clock. In addition, age-dependent changes in sleep behavior were explored.

Actigraphy-estimated sleep time for SMS was 1 hr less than expected across all ages studied. The timing of the 24-hr body temperature (Tb-24) rhythm was phase advanced, but not inverted. Compared to sibling (SIB) controls, the SMS group had less total night sleep, lower sleep efficiency, earlier sleep onset, earlier final awake times, increased waking after sleep onset (WASO), and increased daytime nap duration. The timing of wake onset varied with age, providing evidence of ongoing developmental sleep changes from childhood through adolescence. Clarification of the circadian and developmental factors that contribute to the disrupted and variable sleep patterns in this syndrome will be helpful in identifying more effective individualized treatments.

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Twin-based heritability of actimetry traits.


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There is a critical need for phenotypes with substantial heritability that can be used as endophenotypes in behavioral genetic studies. Activity monitoring, called actimetry, has potential as a means of assessing sleep and circadian rhythm traits that could serve as endophenotypes relevant to a range of psychopathologies. This study examined a range of actimetry traits for heritability using a classic twin design. The sample consisted of 195 subjects from 45 monozygotic (MZ) and 50 dizygotic (DZ) twin pairs aged 16-40 years. Subjects wore both a research-grade actimeter (GENEActiv) and a consumer-oriented device (FitBit) for 2 weeks. Sleep and circadian traits were extracted from GENEActiv data using PennZzz and ChronoSapiens software programs. Sleep statistics for a limited number of FitBit-collected traits were generated by its accompanying mobile app. Broad sense heritability was computed on a set of 33 MZ
and 38 DZ twin pairs with complete data using both OpenMX and SOLAR software. These analyses yielded a large number of actimetry-derived traits, 20 of which showed high heritability \( h^2 > 0.6 \), seven of which remain significant after Bonferroni correction. These results indicate that actimetry enables assessing a range of phenotypes with substantial heritability that may be useful as endophenotypes for genetic studies.

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Two- and 4-hour bright-light exposures differentially effect sleepiness and performance the subsequent night.

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The effect of two durations of bright light upon sleepiness and performance during typical night shift hours was assessed. Thirty normal, healthy young adults participated in a 2-night protocol. On the 1st night subjects were exposed to bright or dim light beginning at 2400 hours, under one of the following three conditions: bright light for 4 hours, dim light for 2 hours followed by bright light for 2 hours or dim light for 4 hours. Following light exposure, subjects remained awake until 0800 hours in a dimly lit room and slept in the laboratory between 0800 and 1600 hours, during which time sleep was estimated with
actigraphy. Throughout the 2nd night, the multiple sleep latency test (MSLT),
simulated assembly line task (SALT) performance, and subjective sleepiness were
recorded. The single, 4-hour exposure to bright light was found to significantly
increase MSLT scores and improve SALT performance during the early morning hours
on the night following bright-light exposure. No significant effects were noted
with a 2-hour exposure. The most likely explanation for these findings is a phase
delay in the circadian rhythm of sleepiness-alertness.

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eCollection 2015.

Ubiquitin carboxy-terminal hydrolase-l1 as a serum neurotrauma biomarker for
exposure to occupational low-level blast.

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Repeated exposure to low-level blast is a characteristic of a few select
occupations and there is concern that such occupational exposures present risk
for traumatic brain injury. These occupations include specialized military and
law enforcement units that employ controlled detonation of explosive charges for
the purpose of tactical entry into secured structures. The concern for negative
effects from blast exposure is based on rates of operator self-
reported headache, sleep disturbance, working memory impairment, and other concussion-like symptoms. A challenge in research on this topic has been the need for improved assessment tools to empirically evaluate the risk associated with repeated exposure to blast overpressure levels commonly considered to be too low in magnitude to cause acute injury. Evaluation of serum-based neurotrauma biomarkers provides an objective measure that is logistically feasible for use in field training environments. Among candidate biomarkers, ubiquitin carboxy-terminal hydrolase-L1 (UCH-L1) has some empirical support and was evaluated in this study. We used daily blood draws to examine acute change in UCH-L1 among 108 healthy military personnel who were exposed to repeated low-level blast across a 2-week period. These research volunteers also wore pressure sensors to record blast exposures, wrist actigraphs to monitor sleep patterns, and completed daily behavioral assessments of symptomology, postural stability, and neurocognitive function. UCH-L1 levels were elevated as a function of participating in the 2-week training with explosives, but the correlation of UCH-L1 elevation and blast magnitude was weak and inconsistent. Also, UCH-L1 elevations did not correlate with deficits in behavioral measures. These results provide some support for including UCH-L1 as a measure of central nervous system effects from exposure to low-level blast. However, the weak relation observed suggests that additional indicators of blast effect are needed.

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PMID: 25852633


Ultradian and circadian activity-rest rhythms of preterm neonates compared to
During the first weeks of life, preterm neonates show fewer circadian rhythms in their physiological parameters than full-term neonates. To determine whether preterm neonates differ in their temporal adaptation to the day-night cycle from full-term neonates at the early age of 1 week, we compared activity-rest behavior of both groups. Activity-rest behavior of 10 neurologically healthy preterm neonates (born in 34th to 36th week of gestation) and 10 neurologically healthy full-term neonates (born in 37th to 42nd week of gestation) was monitored longitudinally for 8 successive days in the first 2 weeks of life. Actigraphy was used to register and display time patterns of activity and rest in neonates by using small actometers, which resemble a wristwatch. Nursing/feeding was recorded using the actometer's integrated event marker button. Recordings for preterm neonates were conducted in the hospital, recordings for full-term neonates were carried out in the hospital and in their homes. In addition to the actigraphic recordings, a standardized diary was kept regularly. To assess periodic characteristics, frequency components of activity-rest behavior were analyzed using fast Fourier transformation (FFT). Amounts of daily sleep time, nightly sleep time, and sleep time during 24h were compared. Nursing/feeding epochs were also analyzed for 5 preterm and 5 full-term neonates to compare their food intake behavior. The majority of preterm neonates showed a multitude of ultradian frequencies in their spectra. In contrast, several full-term neonates showed a
distinct circadian frequency. In preterm neonates, average nightly sleep and average daily sleep of all recorded days were very similar, but after the fourth day of life, only average nightly sleep increased. In full-term neonates, average nightly and daily sleep time of all recorded days differed by about 1h. Average sleep time during 24h for preterm and full-term neonates was similar. Preterm neonates showed longer intervals between events of food intake than full-term neonates. The circadian peaks in the frequency spectra of full-term neonates may indicate the initial adaptation in the first week of life to a 24h day. This is in agreement with our results concerning the different durations of nightly and daily sleep. The increase in nightly sleep time of preterm neonates may be attributed to the progressing adaptation to a circadian activity-rest pattern.

DOI: 10.1081/cbi-100106082
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A unique, fast-forwards rotating schedule with 12-h long shifts prevents chronic sleep debt.


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Sleep debt—together with circadian misalignment—is considered a central factor for adverse health outcomes associated with shift work. Here, we describe in detail sleep-wake behavior in a fast-forward rotating 12-h shift schedule, which involves at least 24 hours off after each shift and thus allows examining the role of immediate recovery after shift-specific sleep debt. Thirty-five participants at two chemical plants in Germany were chronotyped using the Munich ChronoType Questionnaire for Shift-Workers (MCTQ(Shift)) and wore actimeters throughout the two-week study period. From these actimetry recordings, we computed sleep and nap duration, social jetlag (a measure of circadian misalignment), and the daily timing of activity and sleep (center of gravity and mid-sleep, respectively). We observed that the long off-work periods between each shift create a fast alternation between shortened (mean ± standard deviation, 5h 17min ± 56min) and extended (8h 25min ± 72min) sleep episodes resulting in immanent reductions of sleep debt. Additionally, extensive napping of early chronotypes (up to 3 hours before the night shift) statistically compensated short sleep durations after the night shift. Partial rank correlations showed chronotype-dependent patterns of sleep and activity that were similar to those previously described in 8-h schedules; however, sleep before the day shift did not differ between chronotypes. Our findings indicate that schedules preventing a build-up of chronic sleep debt may reduce detrimental effects of shift work irrespective of shift duration. Prospective studies are needed to further elucidate the relationship between sleep, the circadian system, and health and safety hazards.

Unpaid Caregiving Roles and Sleep Among Women Working in Nursing Homes: A Longitudinal Study.

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BACKGROUND AND OBJECTIVES: Although sleep is a critical health outcome providing insight into overall health, well-being, and role functioning, little is known about the sleep consequences of simultaneously occupying paid and unpaid caregiving roles. This study investigated the frequency with which women employed in U.S.-based nursing homes entered and exited unpaid caregiving roles for children (double-duty-child caregivers), adults (double-duty-elder caregivers), or both (triple-duty caregivers), as well as examined how combinations of and changes in these caregiving roles related to cross-sectional and longitudinal sleep patterns.

RESEARCH DESIGN AND METHODS: The sample comprised 1,135 women long-term care employees who participated in the baseline wave of the Work, Family, and Health Study and were assessed at three follow-up time points (6-, 12-, and 18-months). Sleep was assessed with items primarily adapted from the Pittsburgh
Sleep Quality
Index and wrist actigraphic recordings. Multilevel models with data nested within persons were applied.
RESULTS: Women long-term care employees entered and exited the unpaid elder caregiving role most frequently. At baseline, double-duty-child and triple-duty caregivers reported shorter sleep quantity and poorer sleep quality than their counterparts without unpaid caregiving roles, or workplace-only caregivers. Double-duty-elder caregivers also reported shorter sleep duration compared to workplace-only caregivers. Over time, double-duty-elder caregiving role entry was associated with negative changes in subjective sleep quantity and quality.

DISCUSSION AND IMPLICATIONS: Simultaneously occupying paid and unpaid caregiving roles has negative implications for subjective sleep characteristics. These results call for further research to advance understanding of double-and-triple-duty caregivers' sleep health and facilitate targeted intervention development.

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Urinary 6-sulfatoxymelatonin cycle-to-cycle variability.

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For either clinical or research purposes, the timing of the nocturnal onset in
production of the urinary melatonin metabolite 6-sulfatoxymelatonin (UaMT6s-onset), has been proposed as a reliable and robust marker of circadian phase. However, given that most circadian rhythms show cycle-to-cycle variability, the statistical reliability of phase estimates obtained from a single study using UaMT6s-onset remains to be determined. Following 2 weeks of sleep diary and wrist actigraphy, 15 young, healthy good sleepers participated in four UaMT6s sampling sessions spaced 1 day apart. During the sampling sessions subjects remained indoors under low light conditions and hourly urine samples were collected from 19:00 to 02:00 h. Samples were subsequently assayed for UaMT6s using standard radioimmunographic techniques. UaMT6s-onset was determined by the time at which melatonin production exceeded the average of three proceeding trials by 100%. Sleep onset times were derived from sleep diary and actigraphic measures taken before the melatonin collection nights. We found that there was no significant variation between nights in group mean UaMT6s-onset times, and intraindividual variability was small. In addition, UaMT6s-onset times were highly and significantly correlated between nights (grand mean $r = 0.804$).

Our results suggest that within 95% confidence interval limits, individual UaMT6s-onset estimates obtained from a single night UaMT6s-onset study can be used to predict subsequent UaMT6s-onset times within +/- 97 min. A close temporal relationship was also found between the timing of UaMT6s-onset and sleep onset. Overall, our results suggest that under entrained conditions single-session UaMT6s-onset studies can provide reliable individual UaMT6s-onset phase estimates and that the protocol described in this study is a practical and noninvasive methodology.

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Use of Actigraphy for the Evaluation of Sleep Disorders and Circadian Rhythm
Sleep-Wake Disorders: An American Academy of Sleep Medicine Clinical Practice Guideline.

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INTRODUCTION: The purpose of this guideline is to establish clinical practice recommendations for the use of actigraphy in adult and pediatric patients with suspected or diagnosed sleep disorders or circadian rhythm sleep-wake disorders.

METHODS: The American Academy of Sleep Medicine (AASM) commissioned a task force of experts in sleep medicine to develop recommendations and assigned strengths based on a systematic review of the literature and an assessment of the evidence using the GRADE process. The task force provided a summary of the relevant literature and the quality of evidence, the balance of benefits and harms, patient values and preferences, and resource use considerations that support the recommendations. The AASM Board of Directors approved the final recommendations.

RECOMMENDATIONS: The following recommendations are intended as a guide
for clinicians using actigraphy in evaluating patients with sleep disorders and circadian rhythm sleep-wake disorders, and only apply to the use of FDA-approved devices. Each recommendation statement is assigned a strength ("Strong" or "Conditional"). A "Strong" recommendation (ie, "We recommend...") is one that clinicians should follow under most circumstances. A "Conditional" recommendation (ie, "We suggest...") reflects a lower degree of certainty regarding the outcome and appropriateness of the patient-care strategy for all patients. The ultimate judgment regarding any specific care must be made by the treating clinician and the patient, taking into consideration the individual circumstances of the patient, available treatment options, and resources. We suggest that clinicians use actigraphy to estimate sleep parameters in adult patients with insomnia disorder. (Conditional). We suggest that clinicians use actigraphy in the assessment of pediatric patients with insomnia disorder. (Conditional). We suggest that clinicians use actigraphy to estimate total sleep time in adult patients with suspected central disorders of hypsomnolence. (Conditional). We suggest that clinicians use actigraphy to estimate total sleep time in adult patients with suspected insufficient sleep syndrome. (Conditional). We recommend
that clinicians not use actigraphy in place of electromyography for the diagnosis of periodic limb movement disorder in adult and pediatric patients. (Strong).

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INTRODUCTION: The purpose of this systematic review is to provide supporting evidence for a clinical practice guideline on the use of actigraphy. METHODS: The American Academy of Sleep Medicine commissioned a task force of experts in sleep medicine. A systematic review was conducted to identify studies that compared the use of actigraphy, sleep logs, and/or
polysomnography. Statistical analyses were performed to determine the clinical significance of using actigraphy as an objective measure of sleep and circadian parameters. Finally, the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process was used to assess the evidence for making recommendations.

RESULTS: The literature search resulted in 81 studies that met inclusion criteria; all 81 studies provided data suitable for statistical analyses. These data demonstrate that actigraphy provides consistent objective data that is often unique from patient-reported sleep logs for some sleep parameters in adult and pediatric patients with suspected or diagnosed insomnia, circadian rhythm sleep-wake disorders, sleep-disordered breathing, central disorders of hypersomnolence, and adults with insufficient sleep syndrome. These data also demonstrate that actigraphy is not a reliable measure of periodic limb movements in adult and pediatric patients. The task force provided a detailed summary of the evidence along with the quality of evidence, the balance of benefits and harms, patient values and preferences, and resource use considerations.

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The use of actimetry to assess changes to the rest-activity cycle.

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The endogenous circadian oscillator (the body clock) is slow to adjust
to altered
rest-activity patterns. As a result, several negative consequences
arise during
night work and after time-zone transitions. The process of adjustment
can be
assessed by measurements of the sleep electroencephalogram (EEG), core
temperature or melatonin secretion, for example, but these techniques
are very
difficult to apply in field studies, and make very great demands upon
both
experimenters and subjects. We have sought to establish if the
activity record,
measured conveniently and unobtrusively by a monitor attached to the
wrist, can
be treated in ways that enable estimates to be made of the disruption
caused by
changes to the rest-activity cycle, and the process of adjustment to
them. In
Part A, we describe the calculation and assessment of a series of
"activity
indices" that measure the overall activity pattern, activity when out
of bed or
in bed, or the activity in the hours adjacent to going to bed or
getting up. The
value of the indices was assessed by measuring changes to them in
subjects
undergoing night work or undergoing time-zone transitions. In both
cases, there
is a large body of literature describing the changes that would be
expected.
First, night workers (working 2 to 4 successive night shifts) were
investigated
during rest days and night shifts. The indices indicated that night
work was
associated with lower activity when the subjects were out of bed and
higher
activity when in bed. Some indices also measured when subjects took an
afternoon
nap before starting a series of night shifts and gave information
about the
process of adjustment to night work and recovery from it. Second, in
studies from
travelers crossing six or more time zones to the east or west, the
indices
indicated that there were changes to the rest-activity cycle
immediately after
the flights, both in its overall profile and when activity of the
subjects in bed
or out of bed was considered, and that adjustment took place on
subsequent days.
By focusing on those indices describing the activity records during the last hour in bed (LHIB) and the first hour out of bed (FHOB), some evidence was found for incomplete adjustment of the body clock, and for differences between westward and eastward flights. In Part B, the battery of indices are applied to the activity records of long-haul pilots, whose activity patterns showed a mixture of effects due to night work and time-zone transitions. Actimetry was performed during the flights themselves and during the layover days (which were either rest or work days). The indices indicated that all pilots had disrupted rest-activity cycles caused by night flights, and that there were added problems for those who had also undergone time-zone transitions. Rest days were valuable for normalizing the activity profile. For those pilots who flew to the west, adjustment was by delay, though not all aspects of the rest-activity cycle adjusted immediately; for those who flew to the east, some attempted to advance their rest-activity cycle while others maintained home-based activity profiles. The indices indicated that the activity profile was disrupted more in those pilots who attempted to advance their rest-activity cycle. We conclude that objective estimates of the disruption caused to the rest-activity cycle and the circadian system can be obtained by suitable analysis of the activity record.

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The use of melatonin to treat sleep disorder in adults with intellectual disabilities in community settings – the evaluation of three cases using actigraphy.

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BACKGROUND: Sleep disorders are known to be very prevalent in adults with intellectual disabilities (ID) but to date there has been limited objective assessment of either sleep disorders or of interventions such as the use of melatonin. METHODOLOGY: A protocol-driven assessment and intervention procedure was followed with three people with moderate to severe ID identified as having a possible sleep disorder. Actigraphic assessment was used to determine the nature of the sleep disorder, after which sleep hygiene advice and then individual treatment with melatonin were provided, following which further actigraphic assessment was carried out. Behavioural disturbance was formally assessed before and after the intervention phase. RESULTS: Following treatment with melatonin, changes in circadian rhythm were noted, together with improvements in challenging behaviour, but no significant effects were noted with regard to either quantity or quality of sleep. CONCLUSIONS: A standardised procedure for assessment and treatment of sleep disorders in people with ID was established. Although no apparent effects on sleep quantity or quality were noted, this may reflect factors inherent in the sample, rather than the relative efficacy of melatonin treatment per se.

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PMID: 18444986  [Indexed for MEDLINE]
OBJECTIVES: The objective of this study was to assess the impact of wearing an actigraph and receiving personalized feedback on the sleep of a high-risk occupational group: United States soldiers recently returned from a combat deployment.

DESIGN: Following a baseline survey with a full sample, a subsample of soldiers wore an actigraph, received feedback, and completed a brief survey. Two months later, the full sample completed a follow-up survey. The actigraph intervention involved wearing an actigraph for 3 weeks and then receiving a personalized report about sleep patterns and an algorithm-based estimate of cognitive functioning derived from individual sleep patterns.

RESULTS: Propensity score matching with a genetic search algorithm revealed that subjects in the actigraph condition (n=43) reported fewer sleep problems (t value = -2.55, P<.01) and getting more sleep hours (t value =1.97, P<.05) at follow-up than those in a matched comparison condition (n=43, weighted). There were no significant differences in functioning, somatic symptoms, and mental health outcomes (posttraumatic stress disorder symptoms and depression). A significant interaction indicated that the actigraph had a more beneficial effect...
on those with more somatic symptoms at baseline but not those with more sleep problems. Most participants rated the personalized report as helpful.

CONCLUSION: Actigraphs combined with personalized reports may offer a useful, simple intervention to improve the sleep patterns of large, high-risk occupational groups.

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Using actigraphy to measure sleep patterns in rheumatoid arthritis: a pilot study in patients taking night-time prednisone.

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OBJECTIVE: Poor sleep quality is a commonly reported but under-investigated consequence of rheumatoid arthritis (RA). Actigraphy is a non-invasive way of measuring sleep, estimated from the frequency and intensity of physical movement at the wrist. We used actigraphy to measure sleep parameters compared with sleep questionnaire data, and assessed the practicality of actigraph use in patients with RA.

METHODS: In a pilot study of actigraphy conducted within an investigation of night-time prednisone treatment and circadian interleukin-6 concentrations in ten patients with active RA, we compared actigraphy with the St Mary's Hospital Sleep Questionnaire and assessed whether night-time administration of prednisone resulted in increased sleep disturbance.
RESULTS: The actigraph watch was well tolerated by our patients, producing adequate data for analysis for 128 out of 133 test days (96.2%). The results indicated reasonable concordance between actigraph and sleep questionnaire data in the present sample. Patient satisfaction with sleep (question 11) strongly correlated with sleep efficiency measured by the actigraph ($r = 0.71$, $p = 0.22$) and showed a trend for inverse correlation with the fragmentation index ($r = -0.60$, $p = 0.067$). Quality of sleep (question 9) correlated non-significantly with the fragmentation index ($r = -0.59$, $p = 0.072$). We were unable to identify any significant correlations between clinical measures of disease and sleep parameters in this sample. There were no apparent detrimental consequences of the night-time dose of prednisone on the measures of sleep quality and quantity.

CONCLUSION: In spite of the physical disability imposed by RA, the actigraph was well tolerated and gave a useful measure of sleep in patients with active disease. It has the potential for use in larger controlled trials.

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Using Actiwatch to monitor circadian rhythm disturbance in Huntington's disease: A cautionary note.

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Huntington's disease (HD) is an inherited neurodegenerative disorder that is well recognised as producing progressive deterioration of motor function, including dyskinetic movements, as well as deterioration of cognition and ability to carry out activities of daily living. However, individuals with HD commonly suffer from a wide range of additional symptoms, including weight loss and sleep disturbance, possibly due to disruption of circadian rhythmicity. Disrupted circadian rhythms have been reported in mice models of HD and in humans with HD. One way of assessing an individual's circadian rhythmicity in a community setting is to monitor their sleep/wake cycles, and a convenient method for recording periods of wakefulness and sleep is to use accelerometers to discriminate between varied activity levels (including sleep) during daily life. Here we used Actiwatch® Activity monitors alongside ambulatory EEG and sleep diaries to record wake/sleep patterns in people with HD and normal volunteers. We report that periods of wakefulness during the night, as detected by activity monitors, agreed poorly
with EEG recordings in HD subjects, and unsurprisingly sleep diary findings showed poor agreement with both EEG recordings and activity monitor derived sleep periods. One explanation for this is the occurrence of 'break through' involuntary movements during sleep in the HD patients, which are incorrectly assessed as wakeful periods by the activity monitor algorithms. Thus, care needs to be taken when using activity monitors to assess circadian activity in individuals with movement disorders.

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Using blue-green light at night and blue-blockers during the day to improves adaptation to night work: a pilot study.

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BACKGROUND: Bright light at night paired with darkness during the day seem to facilitate adaptation to night work. Considering the biological clock sensitive to short wavelengths, we investigated the possibility of adaptation in shift workers exposed to blue-green light at night, combined with using blue-blockers during the day.

METHODS: Four sawmill shift workers were evaluated during two weeks of night shifts (control and experimental) and one week of day shifts.
Throughout the experimental week, ambient light (approximately 130 lx) was supplemented with blue-green light (200 lx) from 00:00 h to 05:00 h on Monday and Tuesday, 06:00 h on Wednesday and 07:00 h on Thursday. Blue-blockers had to be worn outside from the end of the night shift until 16:00 h. For circadian assessment, salivary melatonin profiles were obtained between 00:00 h and 08:00 h, before and after 4 experimental night shifts. Sleep was continuously monitored with actigraphy and subjective vigilance was measured at the beginning, the middle and the end of each night and day shifts. The error percentage in wood board classification was used as an index of performance.

RESULTS: Through experimental week, melatonin profiles of 3 participants have shifted by at least 2 hours. Improvements were observed in sleep parameters and subjective vigilance from the third night (Wednesday) as performance increased on the fourth night (Thursday) from 5.14% to 1.36% of errors (p=0.04).

CONCLUSIONS: Strategic exposure to short wavelengths at night, and/or daytime use of blue-blocker glasses, seemed to improve sleep, vigilance and performance.

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Validation of a Device for the Ambulatory Monitoring of Sleep Patterns: A Pilot Study on Parkinson's Disease.


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The development of wearable devices has increased interest in the use of ambulatory methods to detect sleep disorders more objectively than those permitted by subjective scales evaluating sleep quality, while subjects maintain their usual lifestyle. This study aims to validate an ambulatory circadian monitoring (ACM) device for the detection of sleep and wake states and apply it to the evaluation of sleep quality in patients with Parkinson disease (PD). A polysomnographic validation study was conducted on a group of patients with different sleep disorders in a preliminary phase, followed by a pilot study to apply this methodology to PD patients. The ACM device makes it possible to estimate the main sleep parameters very accurately, as demonstrated by: (a) the lack of significant differences between the mean values detected by PSG and ACM in time in bed (TIB), total sleep time (TST), sleep efficiency (SE), and time awake after sleep onset (WASO); (b) the slope of the correlation lines between the parameters estimated by the two procedures, very close to 1, which demonstrates the linearity of the predictions; (c) the low bias value in the estimates obtained through ACM. Sleep in PD is associated with lower distal skin temperature, efficiency and overall sleep time; greater WASO, activity during sleep and duration of naps and a worse circadian function index. In summary, the ACM device has proven to be clinically useful to evaluate sleep in an
objective manner, thanks to the integrated management of different complementary variables, having advantages over conventional actigraphy.

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PMID: 31031690


Validation of actigraphy to assess circadian organization and sleep quality in patients with advanced lung cancer.

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BACKGROUND: Many cancer patients report poor sleep quality, despite having adequate time and opportunity for sleep. Satisfying sleep is dependent on a healthy circadian time structure and the circadian patterns among cancer patients are quite abnormal. Wrist actigraphy has been validated with concurrent polysomnography as a reliable tool to objectively measure many standard sleep parameters, as well as daily activity. Actigraphic and subjective sleep data are in agreement when determining activity-sleep patterns and sleep quality/quantity, each of which are severely affected in cancer patients. We investigated the relationship between actigraphic measurement of circadian organization and self-reported subjective sleep quality among patients with advanced lung cancer.

METHODS: This cross-sectional and case control study was conducted in 84 patients with advanced non-small cell lung cancer in a hospital setting for the patients...
at Midwestern Regional Medical Center (MRMC), Zion, IL, USA and home setting for
the patients at WJB Dorn Veterans Affairs Medical Center (VAMC), Columbia, SC,
USA. Prior to chemotherapy treatment, each patient's sleep–activity cycle was
measured by actigraphy over a 4–7 day period and sleep quality was assessed using
the Pittsburgh Sleep Quality Index (PSQI) questionnaire.
RESULTS: The mean age of our patients was 62 years. 65 patients were males while
19 were females. 31 patients had failed prior treatment while 52 were newly
diagnosed. Actigraphy and PSQI scores showed significantly disturbed daily
sleep–activity cycles and poorer sleep quality in lung cancer patients compared
to healthy controls. Nearly all actigraphic parameters strongly correlated with
PSQI self-reported sleep quality of inpatients and outpatients.
CONCLUSIONS: The correlation of daily activity/sleep time with PSQI–documented
sleep indicates that actigraphy can be used as an objective tool and/or to
complement subjective assessments of sleep quality in patients with advanced lung
cancer. These results suggest that improvements to circadian function may also
improve sleep quality.

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PMID: 21592392

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Validation of an innovative method, based on tilt sensing, for the
assessment of activity and body position.

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Since there is less movement during sleep than during wake, the recording of body movements by actigraphy has been used to indirectly evaluate the sleep-wake cycle. In general, most actigraphic devices are placed on the wrist and their measures are based on acceleration detection. Here, we propose an alternative way of measuring actigraphy at the level of the arm for joint evaluation of activity and body position. This method analyzes the tilt of three axes, scoring activity as the cumulative change of degrees per minute with respect to the previous sampling, and measuring arm tilt for the body position inference. In this study, subjects (N = 13) went about their daily routine for 7 days, kept daily sleep logs, wore three ambulatory monitoring devices and collected sequential saliva samples during evenings for the measurement of dim light melatonin onset (DLMO). These devices measured motor activity (arm activity, AA) and body position (P) using the tilt sensing of the arm, with acceleration (wrist acceleration, WA) and skin temperature at wrist level (WT). Cosinor, Fourier and non-parametric rhythmic analyses were performed for the different variables, and the results were compared by the ANOVA test. Linear correlations were also performed between actimetry methods (AA and WA) and WT. The AA and WA suitability for circadian phase prediction and for evaluating the sleep-wake cycle was assessed by comparison with the DLMO and sleep logs, respectively. All correlations between rhythmic parameters obtained from AA and WA were highly significant. Only parameters related to activity levels, such as mesor, RA (relative amplitude), VL5 and VM10 (value for the 5 and 10 consecutive hours of minimum and maximum activity, respectively) showed significant differences between AA and WA records. However, when a correlation analysis was performed on the phase markers acrophase, mid-time for the 10 consecutive hours of highest (M10) and
mid-time
for the five consecutive hours of lowest activity (L5) with DLMO, all of them showed a significant correlation for AA (R = 0.607, p = 0.028; R = 0.582, p = 0.037; R = 0.620, p = 0.031, respectively), while for WA, only acrophase did (R = 0.621, p = 0.031). Regarding sleep detection, WA showed higher specificity than AA (0.95 ± 0.01 versus 0.86 ± 0.02), while the agreement rate and sensitivity were higher for AA (0.76 ± 0.02 versus 0.66 ± 0.02 and 0.71 ± 0.03 versus 0.53 ± 0.03, respectively). Cohen's kappa coefficient also presented the highest values for AA (0.49 ± 0.04) and AP (0.64 ± 0.04), followed by WT (0.45 ± 0.06) and WA (0.37 ± 0.04). The findings demonstrate that this alternative actigraphy method (AA), based on tilt sensing of the arm, can be used to reliably evaluate the activity and sleep–wake rhythm, since it presents a higher agreement rate and sensitivity for detecting sleep, at the same time allows the detection of body position and improves circadian phase assessment compared to the classical actigraphic method based on wrist acceleration.

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The Children's ChronoType Questionnaire (CCTQ) is a valid and reliable measure for assessing prepubertal children aged 4–11 years. The CCTQ is a parent-reported, 27-item questionnaire consisting of sleep-wake parameters for scheduled and free days (16 items), a morningness/eveningness scale (M/E, 10 items), and a five-point, single-item, chronotype score. The CCTQ has been translated into different languages, but a Chinese version is not available. In the present study, we aimed to produce a Chinese version of the CCTQ and test its validity and reliability on school-aged children. A total of 555 children aged 7–11 years were recruited from five primary schools. The parents were told to complete the CCTQ and record their child's sleep pattern in a 7-day sleep diary. Sixty-six children and their parents were invited to participate in determining the test-retest reliability of the CCTQ over a 2-week interval, and their sleep patterns were assessed using a sleep diary. The internal consistency of the Chinese CCTQ M/E score as measured by Cronbach's alpha was acceptable (0.74). Regarding the test-retest reliability of the instrument, moderate to strong Spearman's correlation coefficients were found for most of the CCTQ–sleep-wake items (ρ = 0.52–0.86) and for the CCTQ-M/E total score (ρ = 0.78). For the concurrent validity, Spearman's correlations between the sleep-wake parameters of the CCTQ and the sleep diary were moderate to high on both the scheduled days (ρ = 0.54 to 0.87) and free days (ρ = 0.36 to 0.60). For the correlations measured with actigraphs, significant correlations were found in the CCTQ sleep-wake parameters, including bedtime, get-up time, sleep latency, sleep
period, time in bed, and mid-sleep point on both the scheduled 
(ρ = 0.31 to 0.76)
and free days (ρ = 0.27 to 0.52), but not in sleep latency and sleep period on 
free days. The results of the present study suggest that the Chinese version of 
the CCTQ is a reliable and valid tool for assessing chronotypes in Chinese 
school-aged children in Hong Kong.

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Validation of the Munich ChronoType Questionnaire in Korean Older 
Adults.

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Objective: This study aimed to evaluate psychometric properties of the Munich ChronoType Questionnaire (MCTQ) in a sample of Korean older adults.

Methods: One-hundred ninety two participants aged 65 and over completed interview-based questionnaires about chronotype, insomnia, depression, and anxiety. Additionally, a small subset of subjects completed a 7-day sleep diary and actigraphy measurements.

Results: Morningness-Eveningness Questionnaire (MEQ) scores were significantly negatively correlated with Midpoint of sleep on free days corrected
for sleep
debt accumulated through weekdays (MSFsc) (r=-0.45, p<0.01)
assessed by the
MCTQ. MSFsc using the MCTQ was significantly positively correlated
with MSFsc
assessed by both the sleep diary (r=0.74, p<0.05) and actigraphy
(r=0.76,
p<0.05). Additionally, MSFsc assessed by the MCTQ was significantly
positively
correlated with insomnia (r=0.26, p<0.01), depression (r=0.25,

p<0.01), and
anxiety (r=0.18, p<0.05). Finally, based on MEQ scores, we derived a cut-off
score for the MCTQ that distinguishes morning type and other types
(intermediate/evening types) in older adults.

Conclusion: The results of these studies supported the validity of the
MCTQ in
Korean older adults. Additionally, while sleep rhythms in elder adults
may be
more advanced, eveningness tendency may be still important and
indicative of
sleep and psychological disturbance.

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Values of sleep/wake, activity/rest, circadian rhythms, and fatigue
prior to
adjuvant breast cancer chemotherapy.

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Fatigue is the most prevalent and distressing symptom experienced by
patients
receiving adjuvant chemotherapy for early stage breast cancer. Higher
fatigue
levels have been related to sleep maintenance problems and low daytime
activity
in patients who have received chemotherapy, but knowledge describing
these
relationships prior to chemotherapy is sparse. The Piper Integrated
Fatigue Model
guided this study, which describes sleep/wake, activity/rest, circadian rhythms, and fatigue and how they interrelate in women with Stage I, II, or IIIA breast cancer during the 48 hours prior to the first adjuvant chemotherapy treatment. The present report describes these variables in 130 females, mean age=51.4 years; the majority were married and employed. Subjective sleep was measured by the Pittsburgh Sleep Quality Index and fatigue was measured by the Piper Fatigue Scale. Wrist actigraphy was used to objectively measure sleep/wake, activity/rest, and circadian rhythms. Mean Pittsburgh Sleep Quality Index score was 6.73+/-3.4, indicating poor sleep. Objective sleep/wake results were within normal limits established for healthy individuals, except for the number and length of night awakenings. Objective activity/rest results were within normal limits except for low mean daytime activity. Circadian rhythm mesor was 132.3 (24.6) and amplitude was 97.2 (22.8). Mean Piper Fatigue Scale score was 2.56+/-2, with 72% reporting mild fatigue. There were significant relationships between subjective and objective sleep, but no consistent patterns. Higher total and subscale fatigue scores were correlated with most components of poorer subjective sleep quality (r=0.25–0.42, P< or =0.005).

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Variability of sleep duration is related to subjective sleep quality and subjective well-being: an actigraphy study.

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While there is a large body of evidence that poor subjective sleep quality is related to lower subjective well-being, studies on the relation of objective sleep measures and subjective well-being are fewer in number and less consistent in their findings. Using data of the Survey of Mid-Life in the United States (MIDUS), we investigated whether duration and quality of sleep, assessed by actigraphy, were related to subjective well-being and whether this relationship was mediated by subjective sleep quality. Three hundred and thirteen mainly white American individuals from the general population and 128 urban-dwelling African American individuals between 35 and 85 years of age were studied cross-sectionally. Sleep duration, variability of sleep duration, sleep onset latency, and time awake after sleep onset were assessed by actigraphy over a period of 7 days. Subjective sleep quality was assessed with the Pittsburgh Sleep Quality Index, positive psychological well-being and symptoms of psychological distress were assessed with the Satisfaction with Life Scale and the Mood and Anxiety Symptom Questionnaire. In both white and African Americans high day-to-day variability in sleep duration was related to lower levels of subjective well-being controlling age, gender, educational and marital status, and BMI. By contrast, sleep duration, sleep onset latency, and time awake after sleep onset were not related to subjective well-being controlling covariates and other sleep variables. Moreover, the relationship between variability in sleep duration and well-being was partially mediated by subjective sleep quality. The findings show that great day-to-day variability in sleep duration—more than average sleep duration—is related to poor subjective sleep quality and poor subjective well-being.

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Variation in actigraphy-estimated rest-activity patterns by demographic factors.


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Rest-activity patterns provide an indication of circadian rhythmicity in the free-living setting. We aimed to describe the distributions of rest-activity patterns in a sample of adults and children across demographic variables. A sample of adults (N = 590) and children (N = 58) wore an actigraph on their nondominant wrist for 7 days and nights. We generated rest-activity patterns from cosinor analysis (MESOR, acrophase and magnitude) and nonparametric circadian rhythm analysis (IS: interdaily stability; IV: intradaily variability; L5: least active 5-hour period; M10: most active 10-hour period; and RA: relative amplitude). Demographic variables included age, sex, race, education, marital status, and income. Linear mixed-effects models were used to test for demographic differences in rest-activity patterns. Adolescents, compared to younger children, had (1) later M10 midpoints (β = 1.12 hours [95% CI: 0.43, 1.18] and lower M10 activity levels; (2) later L5 midpoints (β = 1.6 hours [95% CI: 0.9, 2.3]) and lower L5 activity levels; (3) less regular rest-activity patterns (lower IS and higher IV); and 4) lower magnitudes (β = -0.95 [95% CI: -1.28, -0.63]) and relative amplitudes (β = -0.1 [95% CI: -0.14, -0.06]). Mid-to-older adults, compared to younger adults (aged 18-29 years), had (1) earlier M10 midpoints (β = -1.0 hours [95% CI: -1.6, -0.4]; (2) earlier L5 midpoints (β = -0.7 hours [95% CI: -1.2, -0.2]); and (3) more regular rest-activity patterns (higher IS and lower IV). The magnitudes and relative amplitudes were similar across the adult age categories. Sex, race and education level rest-activity differences were also observed. Rest-activity patterns vary across the lifespan, and differ by race, sex and education. Understanding population variation in these patterns provides a foundation for further elucidating the health implications of rest-
Variations in rest-activity rhythm are associated with clinically measured disease severity in Parkinson's disease.


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The continuous, longitudinal nature of accelerometry monitoring is well-suited to capturing the regular 24-hour oscillations in human activity across the day, the cumulative effect of our circadian rhythm and behavior. Disruption of the circadian rhythm in turn disrupts rest-activity rhythms. Although circadian disruption is a major feature of Parkinson's disease (PD), rest-activity rhythms and their relationship with disease severity have not been well characterized in PD. 13 PD participants (Hoehn & Yahr Stage [H&Y] 1-3) wore a Philips
Actiwatch Spectrum PRO continuously for two separate weeks. Rest-activity rhythms were quantified by fitting an oscillating 24-hour cosinor model to each participant-day of activity data. One-way ANOVAs adjusted for demographics revealed significant variation in the amount (MESOR, $F = 12.76$, $p < .01$), range (Amplitude, $F = 9.62$, $p < .01$), and timing (Acrophase, $F = 2.7$, $p = .05$) of activity across H&Y Stages. Those with higher H&Y Stages were significantly more likely to be active later in the day, whereas those who shifted between H&Y Stages during the study were significantly more active than those who did not change H&Y Stage. Being active later in the day was also significantly associated with higher scores on the Movement Disorder Society's Unified Parkinson's Disease Rating Scale (MDS-UPDRS) Section III (motor symptom severity, $p = .02$), Section II (self-reported impact of motor symptoms on daily living, $p = .01$), and Total Score ($p = .01$) in an adjusted linear regression model; significant associations between MDS-UPDRS scores and activity levels were observed only in the unadjusted model. These findings demonstrate that continuous actigraphy is capable of detecting rest-activity disruption in PD, and provides preliminary evidence that rest-activity rhythms are associated with motor symptom severity and H&Y Stage.

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Various patterns of disrupted daily rest-activity rhythmicity associated with diabetes.

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Disruptions to sleep and circadian rhythms have now been recognized as common comorbidities in patients with medical illnesses. We aimed to determine if the diurnal rhythms for rest and activity were disrupted in parallel with the development of diabetic complications. Ninety outpatients in our diabetes clinic who had a body mass index <25 kg m(2) wore an actigraph for 7 consecutive days (42 men; mean age 68.7 ± 8.2 years). Patients with neuropsychiatric diseases, liver cirrhosis, renal failure, chronic obstructive pulmonary disease or blindness, or those who performed shiftwork were excluded. We grouped the actigraph recordings into 1-h periods and counted the number of minutes that showed activity. Stepwise regression analysis showed an association between a diabetic clinical background and measurements of circadian rhythms such as daytime activity, night-time activity, phase, interdaily stability, intradaily variability and relative amplitude. Higher age, body mass index, total cholesterol levels and insulin usage were associated with lower daytime activity and higher intradaily variability, whereas higher haemoglobin A1c levels and the presence of neuropathy were associated with greater daytime activity. The presence of proliferative retinopathy and increased levels of microalbuminuria were associated with higher intradaily variability and lower interdaily stability and amplitude. The presence of cardiovascular disease was associated with advanced phase, whereas painful neuropathy was associated with delayed phase. Our study demonstrated that different diabetic complications were associated
independently with a variety of alterations in the circadian rest and activity rhythms. Our findings have provided novel insights that may be helpful in developing interventions for sleep-wake disorders associated with diabetes.

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Very preterm infants show earlier emergence of 24-hour sleep-wake rhythms compared to term infants.

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BACKGROUND: Previous studies show contradictory results about the emergence of 24-h rhythms and the influence of external time cues on sleep-wake behavior in preterm compared to term infants. 

AIMS: To examine whether very preterm infants (<32 weeks of gestational age) differ in their emergence of the 24-h sleep-wake rhythm at 5, 11 and 25 weeks corrected age compared to term infants and whether cycled light conditions during neonatal intermediate care affects postnatal 24-h sleep-wake rhythms in preterm infants.

STUDY DESIGN: Prospective cohort study with nested interventional trial.

SUBJECTS: 34 preterm and 14 control term infants were studied. During neonatal hospitalization, preterm infants were randomly assigned to cycled light [7 am–7 pm lights on, 7 pm–7 am lights off, n=17] or dim light condition [Lights off whenever the child is asleep, n=17].

OUTCOME MEASURES: Sleep and activity behavior recorded by parental diary and actigraphy at 5, 11 and 25 weeks corrected age.

RESULTS: Sleep at nighttime and the longest consolidated sleep period between 12 pm–6 am was longer (mixed model analysis, factor group: p=0.02, resp. p=0.01) and activity at nighttime was lower (p=0.005) at all ages in preterm compared to term infants. Cycled light exposed preterm infants showed the longest nighttime sleep duration. Dim light exposed preterm infants were the least active.

CONCLUSIONS: Preterm infants show an earlier emergence of the 24-h sleep-wake rhythm compared to term infants. Thus, the length of exposure to external time cues such as light may be important for the maturation of infant sleep-wake rhythms. Trial registry number: This trial has been registered at www.clinicaltrials.gov (identifier NCT01513226).

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The viability of an ecologically valid chronic sleep restriction and circadian timing protocol: An examination of sample attrition, compliance, and effectiveness at impacting sleepiness and mood.

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Chronic sleep restriction (SR) increases sleepiness, negatively impacts mood, and impairs a variety of cognitive performance measures. The vast majority of work establishing these effects are tightly controlled in-lab experimental studies. Examining commonly-experienced levels of SR in naturalistic settings is more difficult and generally involves observational methods, rather than active manipulations of sleep. The same is true for analyzing behavioral and cognitive outcomes at circadian unfavorable times. The current study tested the ability of an at-home protocol to manipulate sleep schedules (i.e., impose SR), as well as create a mismatch between a subject's circadian preference and time of testing. Viability of the protocol was assessed via completion, compliance with the SR, and success at manipulating sleepiness and mood. An online survey was completed by 3630 individuals to assess initial eligibility, 256 agreed via
email response
to participate in the 3-week study, 221 showed for the initial in-
person session,
and 184 completed the protocol (175 with complete data). The protocol
consisted
of 1 week at-home SR (5-6 hours in bed/night), 1 week wash-out, and 1
week
well-rested (WR: 8-9 hours in bed/night). Sleep was monitored with
actigraphy,
diary, and call-ins. Risk management strategies were implemented for
subject
safety. At the end of each experimental week, subjects reported
sleepiness and
mood ratings. Protocol completion was 83%, with lower depression
scores, higher
anxiety scores, and morning session assignment predicting completion.
Compliance
with the sleep schedule was also very good. Subjects spent
approximately 2 hours
less time in bed/night and obtained an average of 1.5 hours less
nightly sleep
during SR, relative to WR, with 82% of subjects obtaining at least 60
minutes
less average nightly sleep. Sleepiness and mood were impacted as
expected by SR.
These findings show the viability of studying experimental chronic
sleep
restriction outside the laboratory, assuming appropriate safety
precautions are
taken, thus allowing investigators to significantly increase
ecological validity
over strictly controlled in-lab studies.

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s19051075.

Video-Based Actigraphy for Monitoring Wake and Sleep in Healthy
Infants: A
Laboratory Study.


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Prolonged monitoring of infant sleep is paramount for parents and healthcare professionals for interpreting and evaluating infants' sleep quality. Wake-sleep patterns are often studied to assess this. Video cameras have received a lot of attention in infant sleep monitoring because they are unobtrusive and easy to use at home. In this paper, we propose a method using motion data detected from infrared video frames (video-based actigraphy) to identify wake and sleep states. The motion, mostly caused by infant body movement, is known to be substantially associated with infant wake and sleep states. Two features were calculated from the video-based actigraphy, and a Bayesian-based linear discriminant classification model was employed to classify the two states. Leave-one-subject-out cross validation was performed to validate our proposed wake and sleep classification model. From a total of 11.6 h of infrared video recordings of 10 healthy term infants in a laboratory pilot study, we achieved a reliable classification performance with a Cohen's kappa coefficient of $0.733 \pm 0.204$ (mean ± standard deviation) and an overall accuracy of $92.0\% \pm 4.6\%$.

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Volitional lifestyle in healthy elderly: its relevance to rest-activity cycle, nocturnal sleep, and daytime napping.

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Sleep-related problems are prevalent among the aged. The present study examined the influence of a mentally active or "volitional" lifestyle on the rest-activity cycle, nocturnal sleep, and daytime napping in the healthy elderly. 14 aged individuals with a high Volitional lifestyle (M = 74.1 yr. old) and 14 with a Low Volitional lifestyle (M = 73.0 yr. old) were screened by questionnaires including the Philadelphia Geriatric Center Morale scale and the Self-confidence scale. Their activity levels were monitored by a wrist actigraph system for 14 consecutive days. They were also asked to record daily sleep logs. The total times of nocturnal sleep and daytime napping did not differ between the groups. However, the acrophases of circadian (tau = 24 hr.) and circasemidian (tau = 12 hr.) activity cycles were more advanced in the Low Volitional group. In addition, the High Volitional group took a daytime nap with a better timing than did the Low Volitional group: the former started a nap during the phase in which their activity level was going down, whereas the latter when their activity level was going up. These results suggest that high volitional lifestyle may be related to better rest-activity cycle in the healthy elderly.

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Weak circadian rhythm increases neutropenia risk among breast cancer patients undergoing adjuvant chemotherapy.

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PURPOSE: Severe neutropenia is a common dose-limiting side effect of adjuvant breast cancer chemotherapy. We aimed to test the hypothesis that weak circadian rhythm is associated with an increased risk of neutropenia using a cohort study.

METHODS: We consecutively recruited 193 breast cancer patients who received adjuvant chemotherapy (5-fluorouracil, epirubicin, and cyclophosphamide followed by docetaxel; doxorubicin and cyclophosphamide; docetaxel and cyclophosphamide). Participants wore a wrist actigraph continuously for 168 h at the beginning of chemotherapy. Values of percent rhythm and double amplitude below medians represented weak circadian rhythm. Mesor measured the mean activity level and acrophase symbol the peak time of the rhythm. We used Cox proportional hazard regression model to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) of grade 4 neutropenia and febrile neutropenia in relation to actigraphy-derived parameters.

RESULTS: Low levels of percent rhythm (HR:2.59, 95% CI 1.50-4.72), double amplitude (HR:2.70, 95% CI 1.51-4.85), and mesor (HR: 2.48, 95% CI 1.44-4.29) were positively associated with the risk of grade 4 neutropenia during chemotherapy. Low levels of percent rhythm (HR: 2.41, 95% CI 1.02-5.69) and double amplitude (HR: 2.49, 95% CI 1.05-5.90) were also associated with
increased risks of febrile neutropenia. The HRs for acrophase were not statistically significant.

CONCLUSIONS: This study provides the first epidemiological evidence that increased risks of grade 4 neutropenia and febrile neutropenia are associated with weak circadian rhythm among adjuvant breast cancer patients. The results suggest that circadian rhythm might be one potential target for the prevention of chemotherapy–induced neutropenia among cancer patients.

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Weaker circadian activity rhythms are associated with poorer executive function in older women.

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STUDY OBJECTIVES: Older adults and patients with dementia often have disrupted circadian activity rhythms (CARs). Disrupted CARs are associated with health declines and could affect cognitive aging. We hypothesized that among older women, weaker CARs would be associated with poorer cognitive function 5 y later.

DESIGN: Prospective observational study.

SETTING: Three US clinical sites.

PARTICIPANTS: There were 1,287 community-dwelling older women (82.8 ± 3.1 y) participating in an ongoing prospective study who were free of dementia at the baseline visit.

MEASUREMENTS AND RESULTS: Baseline actigraphy was used to determine CAR measures (amplitude, mesor, and rhythm robustness, analyzed as quartiles; acrophase analyzed by peak activity time < 13:34 and > 15:51). Five years later, cognitive performance was assessed with the Modified Mini-Mental Status Examination (3MS), California Verbal Learning Task (CVLT), digit span, Trail Making Test B (Trails B), categorical fluency, and letter fluency. We compared cognitive performance with CARs using analyses of covariance adjusted for a number of health factors and comorbidities. Women in the lowest quartile for CAR amplitude performed worse on Trails B and categorical fluency compared to women in the highest quartile (group difference \(d = 30.42\) sec, \(d = -1.01\) words respectively, \(P < 0.05\)). Women in the lowest quartile for mesor performed worse on categorical fluency \(d = -0.86\) words, \(P < 0.05\)). Women with a later acrophase performed worse on categorical fluency \(d = -0.69\) words, \(P < 0.05\)). Controlling for baseline Mini-Mental State Examination and sleep factors had little effect on our results.

CONCLUSION: Weaker circadian activity rhythm patterns are associated with worse...
cognitive function, especially executive function, in older women without dementia. Further investigation is required to determine the etiology of these relationships.

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Wearable technologies for developing sleep and circadian biomarkers: a summary of workshop discussions.

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The "International Biomarkers Workshop on Wearables in Sleep and Circadian Science" was held at the 2018 SLEEP Meeting of the Associated Professional Sleep Societies. The workshop brought together experts in consumer sleep technologies and medical devices, sleep and circadian physiology, clinical translational research, and clinical practice. The goals of the workshop were: (1) characterize the term "wearable" for use in sleep and circadian science and identify relevant sleep and circadian metrics for wearables to measure; (2) assess the current use of wearables in sleep and circadian science; (3) identify current barriers for applying wearables to sleep and circadian science; and (4) identify goals and opportunities for wearables to advance sleep and circadian science. For the purposes of biomarker development in the sleep and circadian fields, the workshop included the terms "wearables," "nearables," and "ingestibles." Given the state of the current science and technology, the limited validation of wearable devices against gold standard measurements is the primary factor limiting large-scale use of wearable technologies for sleep and circadian research. As such, the workshop committee proposed a set of best practices for validation studies and guidelines regarding how to choose a wearable device for research and clinical use. To complement validation studies, the workshop committee recommends the development of a public data repository for wearable data. Finally, sleep and circadian scientists must actively engage in the development and use of wearable devices to maintain the rigor of scientific findings and public health messages based on wearable technology.

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Wearing blue light-blocking glasses in the evening advances circadian rhythms in the patients with delayed sleep phase disorder: An open-label trial.

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It has been recently discovered that blue wavelengths form the portion of the visible electromagnetic spectrum that most potently regulates circadian rhythm. We investigated the effect of blue light-blocking glasses in subjects with delayed sleep phase disorder (DSPD). This open-label trial was conducted over 4 consecutive weeks. The DSPD patients were instructed to wear blue light-blocking amber glasses from 21:00 p.m. to bedtime, every evening for 2 weeks. To ascertain the outcome of this intervention, we measured dim light melatonin onset (DLMO) and actigraphic sleep data at baseline and after the treatment. Nine consecutive DSPD patients participated in this study. Most subjects could complete the treatment with the exception of one patient who hoped for changing to drug therapy before the treatment was completed. The patients who used amber lens
showed an advance of 78 min in DLMO value, although the change was not statistically significant (p = 0.145). Nevertheless, the sleep onset time measured by actigraph was advanced by 132 min after the treatment (p = 0.034). These data suggest that wearing amber lenses may be an effective and safe intervention for the patients with DSPD. These findings also warrant replication in a larger patient cohort with controlled observations.

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A Web-Based Photo-Alteration Intervention to Promote Sleep: Randomized Controlled Trial.

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BACKGROUND: Receiving insufficient sleep has wide-ranging consequences for health and well-being. Although educational programs have been developed to promote sleep, these have had limited success in extending sleep duration. To address this gap, we developed a Web-based program emphasizing how physical appearances change with varying amounts of sleep.

OBJECTIVE: The aims of this study were to evaluate (1) whether
participants can
detect changes in appearances as a function of sleep and (2) whether this
intervention can alter habitual sleep patterns.

METHODS: We conducted a 5-week, parallel-group, randomized controlled
trial among
70 habitual short sleepers (healthy adults who reported having <7
hours of sleep
routinely). Upon study enrollment, participants were randomly assigned
(1:1) to
receive either standard information or an appearance-based
intervention. Both
groups received educational materials about sleep, but those in the
appearance
group also viewed a website containing digitally edited photographs
that showed
how they would look with varying amounts of sleep. As the outcome
variables,
sleep duration was monitored objectively via actigraphy (at baseline
and at
postintervention weeks 1 and 4), and participants completed a measure
of sleep
hygiene (at baseline and at postintervention weeks 2, 4, and 5). For
each
outcome, we ran intention-to-treat analyses using linear mixed-effects
models.

RESULTS: In total, 35 participants were assigned to each group.
Validating the
intervention, participants in the appearance group (1) were able to
identify what
they looked like at baseline and (2) judged that they would look more
attractive
with a longer sleep duration (t26=10.35, P<.001). In turn, this
translated to
changes in sleep hygiene. Whereas participants in the appearance group
showed
improvements following the intervention (F1,107.99=9.05, P=.003),
those in the
information group did not (F1,84.7=0.19, P=.66). Finally, there was no
significant effect of group nor interaction of group and time on
actigraphy-measured sleep duration (smallest P=.26).

CONCLUSIONS: Our findings suggest that an appearance-based
intervention, while
not sufficient as a stand-alone, could have an adjunctive role in
sleep
promotion.

TRIAL REGISTRATION: ClinicalTrials.gov NCT02491138;

©Isabel Perucho, Kamalakannan M Vijayakumar, Sean N Talamas, Michael
Weekend–weekday advances in sleep timing are associated with altered reward–related brain function in healthy adolescents.


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Sleep timing shifts later during adolescence, thus conflicting with early school start times. This can lead to irregular weekday–weekend schedules and circadian misalignment, which have been linked to depression and substance abuse, consistent with disruptions in the processing of rewards. We tested associations between weekend–weekday shifts in sleep timing and the neural response to monetary reward in healthy adolescents, using actigraphy and a functional magnetic resonance imaging paradigm. Region–of–interest analyses focused on the medial prefrontal cortex (mPFC) and striatum, both of which are implicated in reward function. Analyses adjusted for pubertal stage, sex, and total sleep time. Greater weekend–weekday advances in midsleep were associated with decreased mPFC and striatal reactivity to reward, which could reflect reduced regulatory response and reward sensitivity. We speculate that circadian misalignment
associated with weekend shifts in sleep timing may contribute to reward-related problems such as depression and substance abuse.

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Weight loss in conservative treatment of obesity in women is associated with physical activity and circadian phenotype: a longitudinal observational study.


Introduction: The study investigates the association between circadian phenotype (CP), its stability (interdaily stability - IS) and physical activity (PA) in a weight loss (WL) programme. Methods: Seventy-five women in WL conservative treatment (BMI ≥ 25 kg/m²) were measured (for about 3 months in between 2016 and 2018) by actigraphy. Results: We observed a difference in time of acrophase (p = 0.049), but no difference in IS (p = 0.533) between women who lost and did not lose weight. There was a difference in PA (mesor) between groups of women who lost...
weight compared to those who gained weight \( (p = 0.007) \). There was a relationship between IS and PA parameters mesor: \( p < 0.001 \); and the most active 10 h of a day (M10):

\[ p < 0.001 \] - the more stable were women in their rhythm, the more PA they have.

Besides confirming a relationship between PA and WL, we also found a relation between WL and CP based on acrophase. Although no direct relationship was found for the indicators of rhythm stability (IS), they can be considered very important variables because of their close connection to PA - a main factor that contributes to the success of the WL programme.

Discussion: According to the results of the study, screening of the CP and its stability may be beneficial in the creation of an individualized WL plan.

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Conflict of interest statement: Competing interests The authors declare that they have no competing interests.


What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment.

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OBJECTIVES: Children in families of low socioeconomic status (SES) have been
found to have poor sleep, yet the reasons for this finding are unclear. Two possible mediators, presleep worries and home environment conditions, were investigated as indirect pathways between SES and children's sleep. PARTICIPANTS/METHODS: The participants consisted of 271 children (M (age) = 11.33 years; standard deviation (SD) = 7.74 months) from families varying in SES as indexed by the income-to-needs ratio. Sleep was assessed with actigraphy (sleep minutes, night waking duration, and variability in sleep schedule) and child self-reported sleep/wake problems (e.g., oversleeping and trouble falling asleep) and sleepiness (e.g., sleeping in class and falling asleep while doing homework). Presleep worries and home environment conditions were assessed with questionnaires. RESULTS: Lower SES was associated with more subjective sleep/wake problems and daytime sleepiness, and increased exposure to disruptive sleep conditions and greater presleep worries were mediators of these associations. In addition, environmental conditions served as an intervening variable linking SES to variability in an actigraphy-derived sleep schedule, and, similarly, presleep worry was an intervening variable linking SES to actigraphy-based night waking duration. Across sleep parameters, the model explained 5–29% of variance. CONCLUSIONS: Sleep environment and psychological factors are associated with socioeconomic disparities, which affect children's sleep.

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What method should be used to define 'night' when assessing diurnal systolic blood pressure variation in the elderly?
Diurnal blood pressure (BP) variation can be assessed by cusums-derived measures and by the day-night BP difference from time-, activity- and diary-defined 'night' periods. Reproducibility of diurnal systolic BP (SBP) variation by these different methods was studied in 19 active elderly normotensives, mean age 68.5 years. Subjects underwent simultaneous 24 h BP (Spacelabs 90207) and activity (Gaehwiler wrist actigraph) monitoring on two occasions (median interval 70 days). On the first occasion, mean diurnal SBP variation was 15.1 +/- 8.1 mm Hg by fixed-time definition of 'night' (22.07). When compared with 22-07 defined 'night' period, actigraph- and diary-defined 'night-time' was significantly reduced (-60 +/- 49, and -48 +/- 51 min, respectively) and consequently diurnal SBP variation was significantly greater at 18.2 +/- 8.1 mm Hg and 17.6 +/- 8.4 mm Hg, respectively. Actigraph recordings were also used to exclude 'night' BP readings associated with activity, but this did not significantly alter the diurnal SBP variation. Cusums-derived circadian alteration magnitude resulted in the greatest value for SBP variation (23.4 +/- 6.7 mm Hg). However, reproducibility of diurnal SBP variation was poor by fixed-time method with a coefficient of variation (CV) of > 50%, and only improved to 40% with diary use. Actigraph measurements, even if used to exclude BP values associated with disturbed sleep, did not improve this further. Cusums-derived measures of diurnal variation slightly improved reproducibility with a CV of 34.6% and may be a better method in the assessment of diurnal BP variation in the elderly.
What predicts inattention in adolescents? An experience-sampling study comparing chronotype, subjective, and objective sleep parameters.

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OBJECTIVE: Many adolescents sleep insufficiently, which may negatively affect their functioning during the day. To improve sleep interventions, we need a better understanding of the specific sleep-related parameters that predict poor functioning. We investigated to which extent subjective and objective parameters of sleep in the preceding night (state parameters) and the trait variable chronotype predict daytime inattention as an indicator of poor functioning.

METHODS: We conducted an experience-sampling study over one week with 61 adolescents (30 girls, 31 boys; mean age = 15.5 years, standard deviation = 1.1 years). Participants rated their inattention two times each day (morning, afternoon) on a smartphone. Subjective sleep parameters (feeling rested, positive affect upon awakening) were assessed each morning on the smartphone. Objective sleep parameters (total sleep time, sleep efficiency, wake after sleep onset) were assessed with a permanently worn actigraph. Chronotype was assessed with a self-rated questionnaire at baseline. We tested the effect of subjective and objective state parameters of sleep on daytime inattention, using
multilevel multiple regressions. Then, we tested whether the putative effect of the trait parameter chronotype on inattention is mediated through state sleep parameters, again using multilevel regressions.

RESULTS: We found that short sleep time, but no other state sleep parameter, predicted inattention to a small effect. As expected, the trait parameter chronotype also predicted inattention: morningness was associated with less inattention. However, this association was not mediated by state sleep parameters.

CONCLUSIONS: Our results indicate that short sleep time causes inattention in adolescents. Extended sleep time might thus alleviate inattention to some extent. However, it cannot alleviate the effect of being an 'owl'.

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Which Sleep Health Characteristics Predict All-Cause Mortality in Older Men? An Application of Flexible Multivariable Approaches.

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Study Objectives: Sleep is multidimensional, with domains including duration, timing, continuity, regularity, rhythmicity, quality, and sleepiness/alertness. Individual sleep characteristics representing these domains are known to predict health outcomes. However, most studies consider sleep characteristics in isolation, resulting in an incomplete understanding of which sleep characteristics are the strongest predictors of health outcomes. We applied three multivariable approaches to robustly determine which sleep characteristics increase mortality risk in the osteoporotic fractures in men sleep study.

Methods: In total, 2,887 men (mean 76.3 years) completed relevant assessments and were followed for up to 11 years. One actigraphy or self-reported sleep characteristic was selected to represent each of seven sleep domains. Multivariable Cox models, survival trees, and random survival forests were applied to determine which sleep characteristics increase mortality risk.

Results: Rhythmicity (actigraphy pseudo-F statistic) and continuity (actigraphy minutes awake after sleep onset) were the most robust sleep predictors across models. In a multivariable Cox model, lower rhythmicity (hazard ratio, HR [95%CI] =1.12 [1.04, 1.22]) and lower continuity (1.16 [1.08, 1.24]) were the strongest sleep predictors. In the random survival forest, rhythmicity and continuity were the most important individual sleep characteristics (ranked as the sixth and eighth most important among 43 possible sleep and non-sleep predictors); moreover, the predictive importance of all sleep information considered simultaneously followed only age, cognition, and cardiovascular disease.

Conclusions: Research within a multidimensional sleep health framework can jumpstart future research on causal pathways linking sleep and health,
new interventions that target specific sleep health profiles, and improved sleep screening for adverse health outcomes.

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Who benefits from adolescent sleep interventions? Moderators of treatment efficacy in a randomized controlled trial of a cognitive-behavioral and mindfulness-based group sleep intervention for at-risk adolescents.


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BACKGROUND: The aim of this study was to test moderators of therapeutic improvement in an adolescent cognitive-behavioral and mindfulness-based sleep intervention. Specifically, we examined whether the effects of the program on postintervention sleep outcomes were dependent on participant gender and/or measures of sleep duration, anxiety, depression, and self-efficacy prior to the interventions.

METHOD: Secondary analysis of a randomized controlled trial conducted with 123 adolescent participants (female = 59.34%; mean age = 14.48 years, range 12.04–16.31 years) who had elevated levels of sleep problems and anxiety symptoms. Participants were randomized into either a group sleep improvement intervention (n = 63) or group active control 'study skills' intervention (n = 60). The sleep intervention ('Sleep SENSE') was cognitive behavioral in approach, incorporating sleep education, sleep hygiene, stimulus control, and cognitive restructuring, but also had added anxiety-reducing, mindfulness, and motivational interviewing elements. Components of the active control intervention ('Study SENSE') included personal organization, persuasive writing, critical reading, referencing, memorization, and note taking. Participants completed the Pittsburgh Sleep Quality Index (PSQI), Spence Children's Anxiety Scale (SCAS), Center for Epidemiologic Studies Depression Scale (CES-D), and General Self-Efficacy Scale (GSE) and wore an actigraph and completed a sleep diary for five school nights prior to the interventions. Sleep assessments were repeated at postintervention. The trial is registered with the Australian New Zealand Clinical Trials Registry (ACTRN12612001177842; http://www.anzctr.org.au/TrialSearch.aspx?searchTxt=ACTRN12612001177842&isBasic=True).

RESULTS: The results showed that compared with the active control intervention, the effect of the sleep intervention on self-reported sleep quality (PSQI global...
score) at postintervention was statistically significant among adolescents with relatively moderate to high SCAS, CES-D, and GSE prior to the intervention, but not among adolescents with relatively low SCAS, CES-D, and GSE prior to the intervention. The results were consistent across genders. However, the effects of the sleep intervention on actigraphy-measured sleep onset latency and sleep diary-measured sleep efficiency at postintervention were not dependent on actigraphy-measured total sleep time, SCAS, CES-D, or GSE prior to the intervention.

CONCLUSIONS: This study provides evidence that some sleep benefits of adolescent cognitive-behavioral sleep interventions are greatest among those with higher levels of anxiety and depressive symptoms, suggesting that this may be an especially propitious group to whom intervention efforts could be targeted. Furthermore, adolescents with lower levels of self-efficacy may need further targeted support (e.g. additional motivational interviewing) to help them reach treatment goals.

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Who is pre-occupied with sleep? A comparison of attention bias in people with psychophysiological insomnia, delayed sleep phase syndrome and good sleepers using the induced change blindness paradigm.

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Cognitive models of insomnia suggest that selective attention may be involved in maintaining the disorder. However, direct assessment of selective
attention is limited. Using the inducing change blindness (ICB) paradigm we aimed to determine whether there is attentional preference for sleep-related stimuli in psychophysiological insomnia (PI) relative to delayed sleep phase syndrome (DSPS) and good sleepers (GS). In the ICB task, a visual scene, comprising both sleep-related and neutral stimuli, 'flickers' back and forth with one element (sleep or neutral) of the scene changing between presentations. Therefore, a 2 x 3 totally between-participants design was employed. The dependent variable was the number of flickers it took for the participant to identify the change. Ninety individuals (30 per group) were classified using ICSD-R criteria, self-report diaries and wrist actigraphy. As predicted, PI detected a sleep-related change significantly quicker than DSPS and GS, and significantly quicker than a sleep-neutral change. Unexpectedly, DSPS detected a sleep-related change significantly quicker than GS. No other differences were observed between the two controls. These results support the notion that there is an attention bias to sleep stimuli in PI, suggesting that selective attention tasks such as the ICB may be a useful objective index of cognitive arousal in insomnia. The results also suggest that there may be an element of sleep preoccupation associated with DSPS. Results are discussed with reference to other experiments on attentional processing in insomnia.

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PMID: 16704577  [Indexed for MEDLINE]


Women with Postpartum Weight Retention Have Delayed Wake Times and Decreased Sleep Efficiency During the Perinatal Period: A Brief Report.

Sharkey KM(1), Boni GM(2), Quattrucci JA(2), Blatch S(3), Carr SN(2).
OBJECTIVE: This study assessed sleep and circadian rhythms across the perinatal period in new mothers with and without postpartum weight retention (PPWR).

METHODS: Weight was measured at 2 and 16 weeks postpartum in 21 women with previous major depression or bipolar disorder (mean age 29.5±4.7 years) who self-reported pre-pregnancy weight during third trimester. Wrist actigraphy was acquired at 33 weeks gestation and postpartum weeks 2, 6, and 16. Circadian phase was measured at 33 weeks gestation and 6 weeks postpartum. The Horne-Östberg Morningness-Eveningness Questionnaire and Pittsburgh Sleep Quality Inventory were completed during third trimester. Women were classified as PPWR+ if weight at 16 weeks postpartum exceeded pre-pregnancy weight by ≥5kg.

RESULTS: Compared to pre-pregnancy, average weight gain (±SD) was 6.3±8.8 kg at 2 weeks postpartum and 5.2±8.5 kg at 16 weeks postpartum. ANOVA showed that PPWR+ women (n=8, 38%) had later sleep offset times and lower sleep efficiencies than PPWR- women at all time points and were more likely to report snoring during pregnancy.

CONCLUSIONS: Data from this small sample showed that women with PPWR had more disturbed sleep and later wake times and were more likely to report symptoms of sleep-disordered breathing. Future work in larger samples should examine whether interventions to improve sleep during pregnancy decreases PPWR.
Work and sleep quality in railway employees: an actigraphy study.

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This actigraphy study tests whether daily work stressors (time pressure, social stressors), work resources (control, social support) and mental detachment from work predict sleep quality, when controlling for demands and control after work. Fifty-two railway employees participated during five consecutive workdays by completing diary questionnaires and wearing an actigraphy device. The results confirmed that social stressors from supervisors predicted more frequent sleep fragmentation and lower sleep efficiency the following night. Higher levels of daily time control at work predicted shorter sleep-onset latency and better self-reported sleep quality. Leisure time control as a covariate turned out to be a private resource, followed by fewer awakenings the following night. Detachment after work related negatively to social stressors and time pressure at work but was unrelated to indicators of sleep quality; detachment after work neither mediated nor moderated the relationship between social stressors from supervisors and sleep quality. Work redesign to increase time control and reduce social
stressors is recommended to preserve daily recovery in railway employees.

Practitioner summary: Sleep is important to renew health- and safety-related resources in railway employees. This diary and actigraphy study shows that higher daily work stressors were antecedents of lower sleep quality the following night, while more time control was followed by better sleep quality. Work redesign could promote health and safety by improving sleep quality.

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Work–family conflict, cardiometabolic risk, and sleep duration in nursing employees.

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We investigated associations of work–family conflict and work and family conditions with objectively measured cardiometabolic risk and sleep. Multilevel analyses assessed cross-sectional associations between employee and job characteristics and health in analyses of 1,524 employees in 30 extended-care facilities in a single company. We examined work and family conditions
in relation to: (a) validated, cardiometabolic risk score based on measured blood pressure, cholesterol, glycosylated hemoglobin, body mass index, and self-reported tobacco consumption and (b) wrist actigraphy-based sleep duration. In fully adjusted multilevel models, work-to-family conflict but not family-to-work conflict was positively associated with cardiometabolic risk. Having a lower level occupation (nursing assistant vs. nurse) was associated with increased cardiometabolic risk, whereas being married and having younger children at home was protective. A significant Age × Work-to-Family Conflict interaction revealed that higher work-to-family conflict was more strongly associated with increased cardiometabolic risk in younger employees. High family-to-work conflict was significantly associated with shorter sleep duration. Working long hours and having children at home were both independently associated with shorter sleep duration. High work-to-family conflict was associated with longer sleep duration. These results indicate that different dimensions of work-family conflict may pose threats to cardiometabolic health and sleep duration for employees. This study contributes to the research on work-family conflict, suggesting that work-to-family and family-to-work conflict are associated with specific health outcomes. Translating theory and findings to preventive interventions entails recognition of the dimensionality of work and family dynamics and the need to target specific work and family conditions.

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Working memory and sleep in 6- to 13-year-old schoolchildren.
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OBJECTIVE: To study the associations between sleep quality/quantity and performance in auditory/visual working memory tasks of different load levels.

METHOD: Sixty schoolchildren aged 6 to 13 years from normal school classes voluntarily participated. Actigraphy measurement was done during a typical school week for 72 consecutive hours. It was timed together with the working memory experiments to obtain information on children's sleep during that period. The n-back task paradigm was used to examine auditory and visual working memory functions.

RESULTS: Lower sleep efficiency and longer sleep latency were associated with a higher percentage of incorrect responses in working memory tasks at all memory load levels (partial correlations, controlling for age, all p values < .05, except in visual 0-back and auditory 2-back tasks); shorter sleep duration was associated with performing tasks at the highest load level only (partial correlations, controlling for age, p < .05). Also in general linear models (controlling for age, gender, and socioeconomic status), sleep efficiency (F = 11.706, p = .050) and latency (F = 3.588, p = .034) were significantly associated with the mean incorrect response rate in auditory working memory tasks.

CONCLUSIONS: Sleep quality and quantity affect performance of working memory tasks in school-age children. In children with learning difficulties the possibility of underlying sleep problems should be excluded.

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PMID: 12500080  [Indexed for MEDLINE]
Working memory capacity is decreased in sleep-deprived internal medicine residents.


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BACKGROUND: Concerns about medical errors due to sleep deprivation during residency training led the Accreditation Council for Graduate Medical Education to mandate reductions in work schedules. Although call rotations with extended shifts continue, effects on resident sleep-wake times and working memory capacity (WMC) have not been investigated.

OBJECTIVES: The objective of this study was to measure effects of call rotations on sleep-wake times and WMC in internal medicine residents.

METHODS: During 2 months of an internal medicine training program adhering to ACGME work-hour restrictions (between April 2006 and June 2007), residents completed daily WMC tests, wore actigraphy watches, and logged their sleep hours. This observational study was conducted during a call month requiring 30-hour call rotations every fourth night, whereas the noncall month, which allowed sleep/wake cycle freedom, was used as the control.

MAIN OUTCOME MEASURES: Sleep hours per night and WMC testing.

RESULTS: Thirty-nine residents completing the study had less sleep per night during their call month (6.4 vs 7.3 h per night noncall, p < 0.001) and sleep per night varied from 3.7 to 10.1 hours. Call rotation caused greater self-assessed sleepiness and reduced WMC recall scores (-2.6/test, p < 0.05), and more math errors occurred when on call (+1.07/test, p < 0.04). Full recovery of WMC did not occur until the fourth day after call. On-call rotation on the first
month had a confounding detrimental effect on WMC. CONCLUSION: A month of call rotations reduced overall sleep per night; sleep hours per night were variable, and WMC was adversely affected. Decreased WMC could explain impaired judgment during sleep deprivation, although clinical error rates were not evaluated.

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Working night shifts affects surgeons' biological rhythm.

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BACKGROUND: Chronic sleep deprivation combined with work during the night is known to affect performance and compromise residents' own safety. The aim of this study was to examine markers of circadian rhythm and the sleep-wake cycle in surgeons working night shifts.

METHODS: Surgeons were monitored prospectively for 4 days: pre call, on call, post call day 1 (PC1), and post call day 2 (PC2). The urinary metabolite of melatonin and cortisol in saliva were measured to assess the circadian rhythm. Sleep and activity were measured by actigraphy. Subjective measures were assessed by the Karolinska Sleepiness Scale and Visual Analog Scale of fatigue, general well-being, and sleep quality.
RESULTS: For both metabolite of melatonin and cortisol, a significant difference
(P < .05) was found in the measurement period between on call and pre
call values. There was increased sleep time during the day on call and on
PC1. For all subjective measures, a marked deterioration was seen on PC1.
CONCLUSION: Surgeons' circadian rhythm was affected by working night shifts.

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Working through the pain: a controlled study of the impact of persistent pain on performing a computer task.

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OBJECTIVES: A large percentage of employees experience persistent pain while at work. This situation can become costly to employers with large amounts of lost production—time, absenteeism, and long-term disability. The link or transition between working through (ignoring) pain and disabling pain is unknown. This paper presents the results of a controlled study examining the impact of persistent pain on performance in a working population. Benefits of early detection are discussed.

METHODS: This was a controlled, repeated measures study using 3 types of measures: questionnaires (pain, pain anxiety, daily memory, and attention mistakes); actigraphic monitoring to assure the absence of sleep deprivation; and the Performance Assessment Battery, a computer-based series of tests. Participants were studied during 3 time periods (9:00 AM, 3:00 PM, and
RESULTS: Forty participants (20 pain, 20 controls) were studied. For all tasks, pain participants were slower than controls with significant findings on 2 tasks and less accurate with significant differences on 1 task. DISCUSSION: Unlike other studies that either induced pain or used persons with complex pain conditions, this study used participants with a low level of pain intensity and had a majority still engaged in full-time employment. Our results found that people with persistent low-level pain demonstrate a reduction in performance compared with controls. Our study revealed that using a sensitive tool to detect minor performance deficits could indicate pain interference. The early detection of pain interference would provide an opportunity for prevention programs to have a pre-emptive effect on work-related musculoskeletal disorders.

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Working under daylight intensity lamp: an occupational risk for developing circadian rhythm sleep disorder?

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A 47-yr-old male was admitted to the Institute for Fatigue and Sleep Medicine complaining of severe fatigue and daytime sleepiness. His medical history included diagnosis of depression and chronic fatigue syndrome. Antidepressant drugs failed to improve his condition. He described a gradual evolvement of an irregular sleep-wake pattern within the past 20 yrs, causing marked distress and
severe impairment of daily functioning. He had to change to a part-time position 7 yrs ago, because he was unable to maintain a regular full-time job schedule. A 10-day actigraphic record revealed an irregular sleep-wake pattern with extensive day-to-day variability in sleep onset time and sleep duration, and a 36 h sampling of both melatonin level and oral temperature (12 samples, once every 3 h) showed abnormal patterns, with the melatonin peak around noon and oral temperature peak around dawn. Thus, the patient was diagnosed as suffering from irregular sleep-wake pattern. Treatment with melatonin (5 mg, 2 h before bedtime) did not improve his condition. A further investigation of the patient's daily habits and environmental conditions revealed two important facts. First, his occupation required work under a daylight intensity lamp (professional diamond-grading equipment of more than 8000 lux), and second, since the patient tended to work late, the exposure to bright light occurred mostly at night. To recover his circadian rhythmicity and stabilize his sleep-wake pattern, we recommended combined treatment consisting of evening melatonin ingestion combined with morning (09:00 h) bright light therapy (0800 lux for 1 h) plus the avoidance of bright light in the evening. Another 10-day actigraphic study done only 1 wk after initiating the combined treatment protocol revealed stabilization of the sleep-wake pattern with advancement of sleep phase. In addition, the patient reported profound improvement in maintaining wakefulness during the day. This case study shows that chronic exposure to bright light at the wrong biological time, during the nighttime, may have serious effects on the circadian sleep-wake patterns and circadian time structure. Therefore, night bright light exposure must be considered to be a risk factor of previously unrecognized occupational diseases of altered circadian time structure manifested as irregularity of the 24 h sleep-wake cycle and melancholy.
Worsening of rest–activity circadian rhythm and quality of life in female breast cancer patients along progression of chemotherapy cycles.

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Chemotherapy and its associated side effects can induce the disruption of circadian rest–activity rhythm and may have negative consequences on health-related quality of life (HRQoL) of cancer patients. In the current study, repeated-measures cross-sectional design was implemented to determine the status of circadian rest–activity rhythm and to assess the HRQoL of newly diagnosed female breast cancer patients those were planned to receive six cycles of chemotherapy. Rest activity and HRQoL were assessed in twenty-five patients during chemotherapy cycles 1st (C1), 3rd (C3), and 6th (C6) immediately after they reported to the outdoor ward of the Regional Cancer Center, Pt. J.N.M. Medical College, Dr. B.R. Ambedkar Memorial Hospital, Raipur, India. Wrist actigraphs for consecutive spans of 3–4 days were used to record the rest–activity rhythm, and its parameters were computed with the help of Cosinor Rhythmometry. Quality of life (QoL) parameters were assessed using EORTC QLQ-C30
and QLQ-BR23. Results revealed that average scores of all rhythm parameters, such as MESOR, amplitude, acrophase, rhythm quotient, circadian quotient, peak activity, dichotomy index, and autocorrelation coefficient; and all functional scales of QLQ-C30, such as physical, role, emotional, cognitive, and social, and global quality of life statistically significantly decreased with the increasing number of chemotherapy cycles (C1 to C3 and C6). Scores of symptom scales of QLQ-C30, such as fatigue, pain, dyspnoea, insomnia, appetite loss, and diarrhea increased significantly from C1 to C6. Among the QLQ-BR23 scales, scores of sexual functioning, sexual enjoyment, breast symptoms, and arm symptoms significantly decreased, whereas scores of systemic therapy side effects, and upset by hair loss significantly increased across the chemotherapy cycles. We conclude that rest-activity rhythm disrupted and HRQoL of breast cancer patients worsened along the increasing number of chemotherapy cycles. We suggest that along with the treatment protocol, level of disruption of these parameters should be assessed and managed with the proper interventions that prominently include timing of the chemotherapy administration. The latter is pivotal for maintenance of these parameters, which are likely to enhance the physiological ability of patients for better treatment responses and may improve the overall QoL and survival of the patients.

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Carney CE(1), Lajos LE, Waters WF.
This study compared the accuracy of reporting adherence to sleep instructions in participants who were informed that adherence would be verified with an actigraph (aware group) to participants not informed the actigraph would be used to assess adherence (unaware of group). Participants were college students (N = 68), who were screened for psychiatric or sleep disorders or extremes in circadian tendency. The UG had later actigraph estimates of bedtime than the AG, but the two groups did not differ on their self-report of adherence to the sleep rules. Only the UG had later actigraphic estimates of bedtimes that violated the sleep rules. These findings have implications for the accuracy of sleep diary self-reports as well as for the use of actigraphs in studies requiring people to follow specific sleep schedule instructions.

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Wrist actigraphic scoring for sleep laboratory patients: algorithm development.

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Wrist actigraphy is employed increasingly in sleep research and clinical sleep medicine. Critical evaluation of the performance of new actigraphs and software is needed. Actigraphic sleep–wake estimation was compared with
polysomnographic
(PSG) scoring as the standard in a clinical sleep laboratory. A
convenience
sample of 116 patients undergoing clinical sleep recordings
volunteered to
participate. Actiwatch-L recordings were obtained from 98
participants, along
with 18 recordings using the newer Spectrum model (Philips
Electronics), but some
of the actigraphic recordings could not be adequately aligned with the
simultaneous PSGs. Of satisfactory alignments, 40 Actiwatch recordings
were used
as a training set to empirically develop a new Scripps Clinic
algorithm for
sleep-wake scoring. The Scripps Clinic algorithm was then
prospectively evaluated
in 39 Actiwatch recordings and 16 Spectrum recordings, producing
epoch-by-epoch
sleep-wake agreements of 85-87% and kappa statistics averaging 0.52
(indicating
moderate agreement). Wake was underestimated by the scoring algorithm.
The
correlations of PSG versus actigraphic wake percentage estimates were
r = 0.6690
for the Actiwatch and r = 0.2197 for the Spectrum. In general, using a
different
weighting of activity counts from previous and subsequent epochs, the
Scripps
Clinic algorithm discriminated sleep-wake more successfully than the
manufacturer's Actiware algorithms. Neither algorithm had fully
satisfactory
agreement with PSG. Further evaluations of algorithms for these
actigraphs are
needed, along with controlled comparisons of different actigraphic
designs and
software.

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Wrist actimetry circadian rhythm as a robust predictor of colorectal
cancer
patients survival.

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The disruption of the circadian timing system (CTS), which rhythmically controls cellular metabolism and proliferation, accelerated experimental cancer progression. A measure of CTS function in cancer patients could thus provide novel prediction information for outcomes, and help to identify novel specific therapies. The rest-activity circadian rhythm is a reliable and non-invasive CTS biomarker, which was monitored using a wrist watch accelerometer for 2 days in 436 patients with metastatic colorectal cancer. The relative percentage of activity in-bed versus out-of-bed (I < O) constituted the tested CTS measure, whose prognostic value for overall survival (OS) and progression-free survival (PFS) was determined in a pooled analysis of three patient cohorts with different treatment exposures. Median OS was 21.6 months [17.8-25.5] for patients with I < 0 above the median value of 97.5% as compared to 11.9 months [10.4-13.3] for those with a lower I < 0 (Log-rank p < 0.001). Multivariate analyses retained continuous I < 0 as a joint predictor of both OS and PFS, with respective hazard ratios (HR) of 0.954 (p < 0.001) and 0.970 (p < 0.001) for each 1% increase in I < 0. HRs had similar values in all the patient subgroups tested. The circadian physiology biomarker I < 0 constitutes a robust and independent quantitative predictor of cancer patient outcomes, that can be easily and cost-effectively measured during daily living. Interventional studies involving 24-h schedules of clock-targeted drugs, light intensity, exercise and/or meals are needed for
testing the relevance of circadian synchronization for the survival of patients with disrupted rhythms.

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Young adolescent sleep is associated with parental monitoring.

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OBJECTIVES: Insufficient sleep can increase risk for adverse psychological and physical outcomes. Parental monitoring of daily activities is associated with youth health behaviors. We examined parental monitoring of waking and bedtime behaviors and sleep in a community sample of high-risk youth.
METHODS: One-hundred sixty-five 10- to 14-year-olds from low-socioeconomic status families participated (11.8 years ±1.16, 52% female; 78% Black/African American). Parents and youth evaluated parental monitoring of waking activities. Parent expectations about bedtime and parent knowledge about adolescent's bedtime and sleep routine were independently rated. Youth sleep was assessed via parent report and actigraphy over 7 days.
RESULTS: More parental knowledge about bedtime was associated with longer parent-reported sleep duration ($\beta = .18$, $P < .05$). Parental monitoring of waking activities (youth reported) was associated with more actigraph-assessed sleep over 7 days ($B = 2.73$, $SE = .91$), weekdays ($B = 2.44$, $SE = .01$), and weekends ($B = 3.88$, $SE = .141$, all $Ps < .05$), whereas parent reported monitoring was associated with more sleep on weekdays only ($B = 2.10$, $SE = .87$, $P < .05$). Parental knowledge and expectations about bedtime behaviors were not associated with actigraph-assessed sleep ($P$ values > .05). Parental monitoring of waking and bedtime behaviors was not associated with sleep duration variability ($P$ values > .05).

CONCLUSIONS: Parental monitoring of waking activities may indirectly influence adolescent sleep via increased structure and felt security in the parent-adolescent relationship. Youth perception of monitoring may be particularly relevant for youth sleep duration.

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Young children with Down syndrome show normal development of circadian rhythms, but poor sleep efficiency: a cross-sectional study across the first 60 months of life.

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OBJECTIVES: To evaluate sleep consolidation and circadian activity rhythms in infants and toddlers with Down syndrome (DS) under light and socially entrained conditions within a familiar setting. Given previous human and animal data suggesting intact circadian regulation of melatonin across the day and night, it was hypothesized that behavioral indices of circadian rhythmicity would likewise be intact in the sample with DS.

METHODS: A cross-sectional study of 66 infants and young children with DS, aged 5-67 months, and 43 typically developing age-matched controls. Sleep and measures of circadian robustness or timing were quantified using continuous in-home actigraphy recordings performed over seven days. Circadian robustness was quantified via time series analysis of rest-activity patterns. Phase markers of circadian timing were calculated alongside these values. Sleep efficiency was also estimated based on the actigraphy recordings.

RESULTS: This study provided further evidence that general sleep quality is poor in infants and toddlers with DS, a population that has sleep apnea prevalence as high as 50% during the preschool years. Despite poor sleep quality, circadian rhythm and phase were preserved in children with DS and displayed similar developmental trajectories in cross-sectional comparisons with a typically developing (TD) cohort. In line with past work, lower sleep efficiency scores
were quantified in the group with DS relative to TD children. Infants born with
DS exhibited the worst sleep fragmentation; however, in both groups, sleep
efficiency and consolidation increased across age. Three circadian phase markers
showed that 35% of the recruitment sample with DS was phase-advanced to an
earlier morning schedule, suggesting significant within-group variability in the
timing of their daily activity rhythms.
CONCLUSIONS: Circadian rhythms of wake and sleep are robust in children born with
DS. The present results suggest that sleep fragmentation and any resultant
cognitive deficits are likely not confounded by corresponding deficits in
circadian rhythms.

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Zeitgebers and their association with rest-activity patterns.
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Zeitgebers such as light, eating and physical activity provide input to the circadian clock. Chronic circadian misalignment is associated with significant adverse health effects. An improved understanding of the impact of the timing of zeitgebers on the stability of 24-hour rest-activity rhythm in free-living settings may identify behavioural and environmental intervention targets. A total of 133 healthy adults, aged 21–60 years, wore a wrist actigraph for 7 consecutive days. We applied a non-parametric analysis to activity counts to derive rest-activity patterns. We administered a questionnaire through a smartphone app to collect self-reported timing of light exposure, eating episodes and physical activity. To assess the relationship between timing exposures (first and last exposure to outdoor light, first exposure to indoor light, last eating episode, first eating episode, morning physical activity proportion, evening physical activity proportion) and rest-activity or sleep outcomes (bedtimes, total sleep time, inter-daily stability, intra-daily variability, L5 and M10 midpoint), we first calculated Spearman correlations, using the false discovery rate method to control for multiple comparisons. From those significant associations, we then fit regression models adjusting for age, sex, race, household income, education level, study site, body mass index, as well as physical activity.
Finally, we tested for interaction between chronotype and each timing-related exposure and stratified the analysis by morning type. All zeitgebers, except for evening physical activity proportion, were correlated with at least four of the seven sleep and rest-activity outcomes. In adjusted analysis, later timing of first (after 6:30 to 7:45 AM versus earlier) and last exposure to indoor light (after 11:00 PM versus earlier) and first (after 7:45-9:45 AM versus earlier) and last eating episode (after 8:00-09:00 PM versus earlier) were associated with a shift of 0.60-1.39 hours to later bedtimes, M10 and L5 midpoints (i.e. timing of peak activities or inactivities). Later timing of first exposure to outdoor light (after 09:30 AM versus earlier) was also associated with 0.51 (95% CI: 0.19 to 0.83) hours longer total sleep time. Higher morning physical activity proportion (≥ 33%) was associated with 0.95 (95% CI: −1.38 to −0.53) hours earlier in-bed time and 0.69 (95% CI: −1.14 to −0.24) hours earlier out-of-bed time, 0.92 (95% CI: −1.41 to −0.42) hours earlier M10 and 0.96 (95% CI: −1.42 to −0.49) min earlier L5 midpoint. The results did not change substantially with further adjustment for total activity. There was a significant interaction between morning chronotype and first eating episode with rest-activity patterns (p < 0.05), with first eating episode associating with timing of activities only in non-morning type adults. Timing of zeitgebers was associated with sleep and rest-activity patterns, including bedtimes, L5 and M10 midpoint. Future research should evaluate the impact of manipulating zeitgebers on both circadian rhythms and health outcomes.

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The Zurich 3-step concept for the management of behavioral sleep disorders in children: a before-and-after study.

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OBJECTIVES: Several strategies have been found to be effective for the treatment of childhood behavioral sleep disorders. One which has yet to be evaluated is the Zurich 3-step concept, which combines basic notions of the two-process model of sleep regulation (introducing a regular rhythm and adjusting bedtime to sleep need) with behavioral strategies. This uncontrolled before-and-after study describes our concept and its step-wise approach, assesses changes in sleep-wake variables and behavior problems, and also examines associations between changes in sleep-wake variables and behavior problems.

METHODS: A total of 79 children with sleep problems (age range 6-47 months, 42% females) were included. Sleep problems were assessed by the Infant Sleep Questionnaire, sleep-wake variables by diary and actigraphy, and behavior problems of children ≥ 18 months by the Child Behavior Checklist.

RESULTS: A significant decrease in nocturnal wake duration (Cohen's d = -0.34) and a significant increase in the duration of the longest continuous nocturnal sleep period (Cohen's d = 0.19) were found from before to after intervention (on average 2.7 months, SD 1.5). The variability for sleep onset and end time
decreased, and actigraphically measured circadian rest-activity cycle measures improved. Parent-reported internalizing and total behavior problems also decreased (Cohen's d = 0.66).

CONCLUSIONS: The findings of both objective and subjective assessment techniques suggest that the Zurich 3-step concept is effective. Thus, the intervention concept may be useful in clinical practice with sleep-disordered children.

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