0306

THE EFFECTS OF CAFFEINE GIVEN 0, 3, OR 6 HOURS BEFORE BED ON OBJECTIVE SLEEP PARAMETERS MEASURED IN THE HOME

Drake C, Jefferson C, Kick A, Roth T
Sleep Disorders & Research Ctr, Henry Ford Hospital, Detroit, MI, United States

Introduction: Previous studies of the effects of caffeine on sleep have utilized laboratory PSG or self-reports and few have compared the disruptive effects of caffeine administered at different times prior to sleep. In the present study, sleep parameters were assessed at home using a headband sleep monitoring instrument that wirelessly transmits sleep data to a bedside display for processing (ZEO Inc.) to determine if disruptions in sleep could be detected when caffeine was administered at 0, 3 and 6 hours prior to habitual bedtime.
Methods: Seven normal sleepers (moderate caffeine intake) were given caffeine (400 mg; 0, 3, or 6 hrs before bedtime) in a double-blind crossover placebo controlled study. Monitoring of sleep was performed each night. Sleep-wake parameters (total sleep time (TST), wake time during sleep (WTDS), sleep efficiency, sleep latency, stage 1 and 2 sleep, slow wave sleep, REM sleep, and ZQ composite measure of sleep) were collected and automatically scored online using previously validated algorithms. Total time in bed was maintained at each subject's habitual schedule. Data was analyzed using repeated-measures ANOVA. **Results:** Sleep latency (6hr: +42.1; 3hr: +18.6; 0hr: +19.4minutes) and TST (6hr: -84.0; 3hr: -44.4; 0hr: -46.2minutes) showed large disrup- tions for each caffeine condition relative to placebo (n.s.). Changes in ZQ approached significance, P = .10 (6hr: -19.38; 3hr: -10.4; 0hr: -10.9units). Due to the limited sample size only pairwise differences in ZQ (placebo: 88.7 vs 6hr: 69.3, P = .08), SWS (placebo: 116.2 minutes vs 6hr: 45.2 minutes, P = .07), and stage 1 and 2 sleep (placebo: 286.4 minutes vs 6hr: 232.2 minutes, P = .044) achieved/approached statistical significance.
Conclusion: This ongoing study using objective monitoring of sleep parameters suggests that a moderate dose of caffeine even 6 hours prior to bedtime can have a large disruptive effect on sleep and that these effects can be assessed unobtrusively outside of the laboratory.
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0307

COMPARISON OF AUTOMATED AND VISUAL EDITING PROCEDURES FOR EEG SPECTRAL ANALYSIS OF NREM SLEEP

Cashmere D, Seres RJ, Pietrone RN, Miewald J, Germain A, Buysse DJ
Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, United States

Introduction: EEG artifacts may significantly affect NREM EEG power quantified with spectral analysis. Automated algorithms and visual inspection by a technician are two common methods for editing the EEG signal. The impact of automated or visual editing procedures on final NREM power values is uncertain. We compared NREM EEG power spectrum values using four different editing methods.
Methods: We selected six PSG studies representing a range of participant ages and diagnoses. Each record was edited for muscle, movement, and electrical artifacts using four different methods: 1) No artifact rejection 2) Automated artifact rejection only; 3) Automated artifact rejection plus targeted visual editing based on the power-frequency plot; and 4) Automated artifact rejection plus visual editing of the entire record in 4-second epochs. Method 3 used a program called Spec Edit developed at the University of Pittsburgh and modeled after a similar program by Havstad and Ehlers. NREM power-frequency curves and compressed spectral arrays corresponding to visually-scored epochs are examined to identify artifacts, which are then removed manually in 4 second epochs. Spectral analysis of whole-night NREM EEG was conducted as previously described.
Results: The average number of 4-second NREM epochs removed using the four methods were 0, 52+54.7, 254.5+449.2, and 521+426.14. Average whole-night NREM delta power values (0.5 to 4 Hz) were 57.3+69.9, 54.7+69.5, 48.4+71.5, and 47.6+72.5 microvolts/ Hz. Average whole-night values for beta power (20 to 32 Hz) were 0.1099+0.0432, 0.0612+0.0379, 0.0484+0.0228, and 0.0464+0.0226. Technician time to edit a record using Method 3 was ~15 minutes, and for Method 4 60-90 minutes.
Conclusion: The four artifact identification/rejection methods excluded very different numbers of epochs. Final EEG power values were very similar for Methods 3 and 4, despite the difference in technician time. Using an automated rejection algorithm plus targeted visual editing provides reliable quantitative EEG values while maximizing efficiency.
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0308

NIGHTTIME DRIVING AND FUEL USE: A HIGH-FIDELITY SIMULATOR STUDY IN A SLEEP LABORATORY

Van Dongen H[1], Belenky G[1], Moore JM[1], Bender AM[1], Huang L[2], Mott CG[2], Vila BJ[1]
[1]Sleep and Performance Research Center, Washington State University, Spokane, WA, United States, [2]Pulsar Informatics Inc., Philadelphia, PA, United States

Introduction: Although fatigue from sleep loss and circadian misalignment may compromise real-world driving, it is common in transportation industries to drive at night. We examined the effects of nighttime driving on performance in a high-fidelity driving simulator widely used to train professional drivers (PatrolSim IV, MPRI, Salt Lake City). We focus here on a calculated measure of fuel use, which in simulator scenarios we have shown to capture varying real-world fuel efficiencies reliably.
Methods: As part of a larger study in our sleep laboratory, 25 healthy adults (12f, ages 22-39) were randomized to either a daytime driving condition (N = 12) or a nighttime driving condition (N = 13). On the first day, subjects practiced driving the simulator, and went to bed at 22:00 for baseline sleep (10h TIB). Subjects in the daytime condition then had a rest day and again went to bed at 22:00 (10h TIB). They subsequently underwent five days with performance testing including 30min simulator drives four times daily (between 09:00 and 19:00); bedtimes remained the same as baseline. Subjects in the nighttime condition also had a rest day after baseline sleep, but went to bed at 15:00 for a transition nap (5h TIB). They subsequently underwent five nights with performance testing that included 30min simulator drives four times nightly (between 21:00 and 07:00); they went to bed at 10:00 (10h TIB) every day. During each simulator session, subjects drove a simulated Ford Taurus in a standardized scenario of rural highways. Ten straight, uneventful road segments with a speed limit of 55mph were used to extract data on cumulative fuel use (72Hz sampling). **Results:** Fuel use was analyzed as a function of time of day and com- pared between conditions (mixed-effects ANOVA). There was an inter- action of condition by time of day ($F[3,467] = 3.63$, $P = 0.013$). Fuel use was stable throughout daytime driving, but in the nighttime condition it increased steadily over time of night to 0.89% greater fuel use by the end of the night compared to daytime driving.
Conclusion: In this controlled laboratory study, nighttime driving involved a progressive decline of fuel economy over the hours of the night as measured in a high-fidelity driving simulator. The fuel use results tracked fatigue profiles predicted by fatigue and performance models and observed in other performance measures. If our results can be generalized to fatigue in real-world driving, they may provide a bot- tom-line incentive for transportation industries to manage fatigue. **Support (If Any):** FMCSA contract DTMC75-07-D-00006 and DURIP grant N00014-08-1-0802.