



## Automatic Detection of Cortical Arousals in Sleep using Bi-direction LSTM Networks

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0140

### EXAMINING THE EFFECTS OF MODERATE BLAST EXPOSURE ON SLEEP: OBSERVATIONS FROM SPECIALIZED MILITARY TRAINING EXERCISES

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**Introduction:** Sleep disruption is prevalent among active military personnel. For some, there is the added environmental stressor of repetitive, low-level blast exposures. Though there are subjective reports that blasts affect sleep, objective measurement is lacking. In this observational study, we examined sleep across 2-week military training with exposure to blast. Across all training days blast intensity was low (<2psi), except for a single day, Day 7 (peak pressure M=7.99psi, SD=1.66). As such, we predicted that sleep would be acutely fragmented and shortened following that moderate blast exposure.

**Methods:** Participants were 31 males, aged 25–42 years. Sleep efficiency (SE) and total sleep time (TST) were measured using wrist-worn actigraphy. Peak intensity of blast exposure was captured daily via helmet-mounted pressure sensors. Training Day 5 was selected as baseline as participants were not exposed to blast training or night operations. Pairwise comparisons t-test (TST) and Wilcoxon matched-pairs (SE) were run to compare sleep at baseline to the training days (6–10).

**Results:** TST was consistently short (daily M≤6hours) and there were no significant differences in TST between the training days. Although SE was significantly different between Day 5 and Day 8 (reflecting sleep following blast on Day 7), this reduction in sleep efficiency did not seem to reflect an acute effect of blast, but a more general decline in SE observed between baseline and Days 7, 8, 9, and 10 (p<.05).

**Conclusion:** TST was consistently short (daily M≤6hours) and there were no significant differences in TST between the training days. Although SE was significantly different between Day 5 and Day 8 (reflecting sleep following blast on Day 7), this reduction in sleep efficiency did not seem to reflect an acute effect of blast, but a more general decline in SE observed between baseline and Days 7, 8, 9, and 10 (p<.05).

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0141

### EFFECT OF EVENING ALCOHOL INTAKE ON POLYSOMNOGRAPHIC SLEEP IN HEALTHY ADULTS

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**Introduction:** Alcohol is frequently and erroneously considered a sleep-promoting factor, possibly due to its sedative effect. Limited data exist on the impact of alcohol consumption on sleep structure. The current study aims to evaluate polysomnographic (PSG) macro- and micro-structure following a simulated evening social drinking context in which individuals received different amounts of wine, according to weekly and daily NIAAA recommended low-risk drinking limits.

**Methods:** Eight healthy adults (5 women; Age: 45.4 ± 8.7 years; Body mass index: 25.4 ± 4.3 Kg.m<sup>-2</sup>) underwent an adaptation/clinical and three PSG recordings at the SRI sleep laboratory. On experimental nights, different doses of alcohol were given to participants within 2h before bedtime (placebo night: 0g of alcohol; weekly limit dose night (weekly limit / 7: WD): ~28g of alcohol for men and ~14g for women;

daily limit dose night (DD): ~56g of alcohol for men and ~42g for women). Standard PSG and power spectral electroencephalographic (EEG) analysis was performed.

**Results:** Pre-sleep breathalyzer alcohol content (BAC) was 0.01 ± 0.01 g/dL on the WD nights and 0.05 ± 0.01 g/dL on the DD nights. BAC was 0 on the placebo nights. The amount of wake after sleep onset was higher (p=0.042) on the DD, compared to the placebo, nights. REM sleep duration was lower (p=0.003) on the DD, compared to WD, nights, with a trend for increased N3 sleep on the DD nights. Quantitative EEG analysis showed a significant increase in Beta1 (15-23 Hz) on the DD, compared to the placebo nights, in both NREM (p=0.034) and REM (p=0.035) sleep. Beta1 in REM sleep was also elevated on the DD, compared to WD, nights (p=0.038).

**Conclusion:** Sleep disturbances were evident in both sleep macro- and micro-structure following evening alcohol consumption within NIAAA recommended low-risk drinking limits and with moderate BAC levels.

**Support (If Any):** This study was supported by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) R21AA024841 grant (to IMC and MdZ).

0142

### AUTOMATIC DETECTION OF CORTICAL AROUSALS IN SLEEP USING BI-DIRECTION LSTM NETWORKS

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**Introduction:** Cortical arousals are transient events that occur during sleep. Although they can occur naturally, arousals are often used to evaluate sleep-wake dysfunction. The gold standard for detecting arousals is visual inspection of polysomnography recordings. Manual annotation of arousals is time consuming and has been shown to have a high inter- and intra-scorer variation. This study proposes a method to fully automate detection of arousals using recent advances in machine learning.

**Methods:** The proposed method in this study extracted features from electroencephalography (EEG), electrooculography (EOG) and chin electromyography (EMG) to compute a probability of arousals through a bi-directional long short-term memory neural network. The study used a dataset of 233 nocturnal PSGs of population-based samples from Wisconsin Sleep Cohort (WSC) and 30 nocturnal PSGs of clinical samples from the Stanford Sleep Cohort (SSC). The model was trained on 186 recordings from WSC and annotations from two scorers. The model was tested on 47 recordings from WSC and then compared to a set of 3 annotations from 9 independent scorers on 30 recordings from both cohorts by measure of Fleiss' Kappa (level of agreement greater than chance).

**Results:** The model obtained a precision of 0.79, a recall of 0.8 and F1-score of 0.79 on the 47 recordings from WSC. The model was robust to different sleep stages showing an F1-score of 0.71 ± 0.19, 0.8 ± 0.13, 0.89 ± 0.18 and 0.8 ± 0.17 (mean ± SD) for N1, N2, N3 and REM sleep, respectively. Preliminary results comparing the scorers show a Fleiss' Kappa of 0.38 ± 0.12, while including the model predictions result in a Fleiss' Kappa of 0.4 ± 0.1.

**Conclusion:** Cortical arousals were detected automatically with the proposed algorithm with a high performance and robustness to

different sleep stages. Preliminary results comparing nine independent scorers demonstrates a low inter-scorer reliability with a similar agreement to the model predictions.

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### 0143

#### ASSOCIATIONS BETWEEN SLOW WAVE SLEEP DURATION, INSULIN RESISTANCE, AND RESPIRATORY EFFORT-RELATED AROUSALS IN YOUNG ADULTS

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**Introduction:** Sleep duration has decreased significantly in the US over the past 50 years. Short sleep duration and sleep disruption have been associated with obesity, insulin resistance (IR) and increased risk of type 2 diabetes (T2DM). When examining the sleep patterns of obese young adults, obstructive sleep apnea (OSA) with severe blood oxygen desaturation is rare, while respiratory effort-related arousals (RERAs) resulting in sleep disruption are common. However, it is still unclear as to how the presence of RERAs in young adults plays a role in IR. Thus, we hypothesized that RERAs would be associated with decreased slow wave sleep (SWS) duration and higher IR and mediate the association between short SWS and IR.

**Methods:** 21 cognitively normal subjects (age  $20 \pm 1.4$ , BMI  $34 \pm 5.9$ ) completed one night nocturnal polysomnography (NPSG). Apneas were defined as absence of airflow for  $\geq 10''$ . Hypopnea (3% or arousal) were defined as a reduction in the amplitude of breathing by 30% or more for  $\geq 10''$  accompanied by  $\geq 3\%$  decline in blood O<sub>2</sub>Sat or an arousal. Standard QUICKI scores were generated using fasting insulin and glucose. Pearson correlations were performed to study the associations between QUICKI, SWS duration and RERAs (measured as AHI3a).

**Results:** A significant association was found between QUICKI and SWS [ $r=0.44$ ,  $p=.046$ ]. There was a significant relationship between SWS and RERAs [ $r=-0.46$ ,  $p=0.034$ ]. However, we found no association between QUICKI and RERAs (and therefore no mediation effects).

**Conclusion:** Our findings suggest a relationship between increased IR and decreased SWS in the young obese. The presence of RERAs had an effect on the duration of SWS, which could be relevant for glucose control, school performance, and quality of life. We weren't able to show the effects of SWS on IR were mediated by RERAs. One of the limitations was the small sample size and cross-sectional design, which limits the understanding of the directionality of these associations. Future studies on metabolic disorders and sleep are required to better understand the physiological effects of IR on sleep in younger populations.

**Support (If Any):**

### 0144

#### SUBJECTIVE, BUT NOT OBJECTIVE, MEASURES OF SLEEP CONTINUITY ARE ASSOCIATED WITH PERCEIVED STRESS IN A COMMUNITY SAMPLE

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**Introduction:** Poor sleep is associated with a range of worse physical health outcomes including cardiovascular disease morbidity and mortality. One potential pathway is through the effects of stress. However, findings on the relationship between perceived stress and sleep are mixed with few studies comparing/contrasting specific subjective vs. objective sleep continuity parameters above and beyond global self-reported sleep quality indices (e.g., single time-point retrospective questionnaires or single questions). This study addresses this gap in the literature in a community cohort with contemporary measurement strategies.

**Methods:** Participants were a community sample of 300 healthy adults (150 men, 150 women) ages 21 to 70 years enrolled in the North Texas Heart Study (PI: Ruiz). The sample was stratified by age within gender and race/ethnicity, and the mean age at enrollment was 42.44 years (SD=12.76). At baseline, participants completed the Perceived Stress Scale (PSS), a 10-item validated scale of the frequency of stressful beliefs in the past month. Actigraphy using AW Spectrum Actiwatches and sleep diary data were collected over a 48-hour period. All dependent variables were averaged over the study period. Actigraphic and sleep-diary measures of sleep continuity included sleep onset latency, wake after sleep onset, terminal wakefulness, sleep efficiency, and actigraphic number of awakenings.

**Results:** Linear regressions were conducted for each sleep parameter. Average PSS score was not significantly associated with objective measures of sleep latency, wake after sleep onset, number of awakenings, and sleep efficiency, all  $b$ 's < 1.29, all  $p$ 's < 0.48. However, among subjective indices, higher average PSS score was significantly associated with longer sleep latency, longer terminal wakefulness, and lower sleep efficiency, all  $b$ 's > 3.8, all  $p$ 's < .04.

**Conclusion:** The current study demonstrates a relationship between perceived stress and subjective but not objective sleep continuity indices. These findings may have bearing on how the associations between sleep and perceived stress can be interpreted.

**Support (If Any):** The North Texas Heart Study was supported by the National Heart, Lung, and Blood Institute.

### 0145

#### THE ACUTE EFFECTS OF INTERMITTENT LIGHT EXPOSURE IN THE EVENING ON ALERTNESS AND SUBSEQUENT SLEEP ARCHITECTURE

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**Introduction:** To explore the acute effects of intermittent light in the evening on alertness and sleep structure, we compared subjective and objective alertness and sleep structure among three conditions of light exposure (for 3 hours): intermittent bright light (30-minute pulse of bright light [ $\sim 1000$  lux] alternating with 30-minute dim light [ $\sim 5$  lux] for three times), continuous bright light, and dim light.

**Methods:** The participants included fifteen healthy volunteers ( $20 \pm 3.4$  years; 7 males) who were scheduled to stay in the sleep