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IMPACT OF SLEEP RESTRICTION AND FRAGMENTATION ON OBJECTIVE AND SUBJECTIVE SLEEP QUALITY – AN INTERVENTION STUDY

Abstract

Purpose: Nighttime sleep has a physical and mental regeneration function. Sleep restriction, fragmentation, and deprivation are present not only in sleep disorders but also in numerous mentally and physically high demanding jobs (e.g., shift-workers, astronauts). Impaired sleep can lead to an imbalance of the autonomic nervous system which is associated with autonomic stress, morbidity and mortality. The aim of our study was to investigate and compare the effects of short-term sleep fragmentation and sleep restriction including recovery sleep on objective as well as subjective sleep and on autonomic nervous system parameters.

Methodology: The randomized within-subjects repeated measure design consisted of 20 healthy male participants (mean age: 39.9 7.4 years, mean BMI: 25.5 2.2 kg/m). The protocol included one baseline night, one intervention night of either sleep deprivation (5 hours) or sleep fragmentation (light on every hour) and two recovery nights of undisturbed sleep. Each participant underwent a total of 2 x 4 nights, experiencing both interventions separated by a wash-out phase of one week. Measurements for each night included laboratory-based polysomnogaphy (PSG), pulse oximetry, and a psychomotor vigilance task (PVT), as well as subjective sleep data from four questionnaires on well-being, sleepiness, performance ability, and restfulness.

Results: During sleep fragmentation, objectively measured sleep efficiency did not change during the intervention night but increased during recovery night. During sleep restriction, sleep efficiency did not change, but duration of sleep stages shifted significantly (shorter wake phase and low-sleep stages) and were compensated during recovery sleep. PVT performance showed only a decreased reaction time after

sleep restriction. Subjective sleep data showed a reduced sleep quality after both interventions with a significant recovery effect after the first recovery night. The parameters of the autonomous nervous system (including heart rate variability, baroreceptor sensitivity, Kerdo index) are currently still being analyzed but seem to confirm the findings of a stronger effect during sleep restriction than fragmentation.

Conclusions: Results so far indicate that sleep restriction had a stronger negative effect on sleep quality and maybe even the autonomic nervous system than sleep fragmentation. However, in order to be more conclusive it might be advisable to add a second baseline and intervention night. It is planned to test the design with participants of a simulated 4-months isolation experiment in order to extract easily measurable indicators for restorative sleep and predictors that may be applied in situations of extreme conditions (e.g. space).