Sleep Fatigue in Space

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Annotated Bibliography on Sleep Fatigue in Space

Chua, E. C.-P., Fang, E., & Gooley, J. J. (2017). Effects of total sleep deprivation on divided attention performance. *PLOS ONE, 12*(11), e0187098. https://doi.org/10.1371/journal.pone.0187098

This study explores the direct causation of sleep deprivation to distractibility among participants; with a deficit in attention being noticeable across multiple activities. Top-down cognitive elements have been identified as a potential repelling force of fatigue to maintain accuracy with dual-task objectives. A multi-cortex approach was conducted by testing multiple senses individually after sleep deprivation. The study took place in a controlled laboratory environment, where 30 subjects had to maintain alertness for 40 hours while participating in attention driven tasks every 2 hours. A small participation pool may lower statistical relevance and the tasks performed may be physically irrelevant. Results show a large correlation with continuous wakefulness and a limited cognitive workload. This source will help present quantitative data to support the fact that a lack of sleep steadily erodes attention.

Custer, R. M., Lynch, K. M., Barisano, G., Herting, M. M., Åkerstedt, T., Nilsonne, G., Ahmadi, H., & Choupan, J. (2025). Effects of one-night partial sleep deprivation on perivascular space volume fraction: Findings from the Stockholm Sleepy Brain Study. *Sleep Medicine, 131*, 106537. https://doi.org/10.1016/j.sleep.2025.106537

This study introduces the effects of one-night partial sleep deprivation and how a reduction in stage N3 (deep sleep) reduces the brain's ability to clear waste. The study also connects a correlation between our perivascular space (PVS) volume and quality of participant restfulness. The argument strength of this article is slightly lacking, as it

struggled to define a meaningful interaction between variables. It also had small participation, with only 60 subjects. However, this study helps set a foundation to explore how fluid filled areas, our perivascular space, might affect sleep. In space, this fluid filled space might change due to lack of gravity and ultimately affect sleep within space. This will help create future research proposals to see how our PVS volume adapts in low gravity environments.

Love, J. (2023, September 18). *Science in space: Week of sept. 15, 2023 - sleep on station - nasa*. https://www.nasa.gov/humans-in-space/science-in-space-week-of-sept-15-2023-sleep-on-station/

The author explored investigative research conducted by NASA regarding sleep related interactions between astronauts and innate cognitive limitations. The location of these studies occurred on the International Space Station, and included circadian rhythms, sleep quality, and cognitive performance. Researchers used multiple technologies, such as Circadian Light, Drager Double Sensors, Dry-EEG Headbands, and ear-EEG hardware. The strength of this study resides in the integrations of both the physiological and psychological factors when exploring the causation of sleep induced fatigue. These variables are gathered and compared by multiple technologies creating a dependable result; however, raw statistical data is not present or shared within the article. This article is relevant as it shows the current technology that is being utilized by NASA researchers to explore the quality of sleep astronauts receive in space. This can help us to find out if any additional technology should be implemented in further research, or if this technology is found to be adequate, what other recommendations could be appropriate to ensure accurate recordings.

Pandi-Perumal, S. R., & Gonfalone, A. A. (2016). Sleep in space as a new medical frontier: The challenge of preserving normal sleep in the abnormal environment of space missions. *Sleep Science*, *9*(1), 1–4. https://doi.org/10.1016/j.slsci.2016.01.003

The authors Pandi-Perumal & Gonfalone reviewed several reports from NASA, the Russian Federal Space Agency, and four additional national space programs as well as individualized reports constructed by pilots. They found that not only was the quality of sleep limited in space, but astronauts also had a reduction in total time sleeping. The methodology of this article is strictly a literature review, it did not provide any original findings, or peer-review testing of sources referenced. The authors do frequently reuse a source that focuses on hypnotic drugs astronauts consume before spaceflight, and several sources from NASA. This source will be used to demonstrate that astronauts are indeed struggling to have restful nights and paired with other sources to explore how a 2 hour, compounding nightly deficit might negatively affect cognitive efficiency among astronauts, in regards to attention and cognitive workload.

Wingelaar-Jagt, Y. Q., Wingelaar, T. T., Riedel, W. J., & Ramaekers, J. G. (2021). Fatigue in aviation: Safety risks, preventive strategies and pharmacological interventions. *Frontiers in Physiology*, *12*, 712628. https://doi.org/10.3389/fphys.2021.712628

The research conducted by the authors explores the relationship between fatigue and its contribution to aviation accidents by impaired or compromised pilot performance. Psychomotor functioning and cognitive alertness seem to be disrupted due to sleep loss, disruptions with circadian rhythm, and prolonged periods of wakefulness. The authors also propose certain countermeasures to help limit negative events in both military and civilian aviation environments. The research is quantitative in nature, supported by

epidemiological data. The data is also shared within the article and consists of supportive references. However, as a literature review, it lacks its own methodology and relies on other articles. This article adds a historic literature review of dozens of previously explored variables and their correlation on how fatigue impacts decision-making and hinders certain cognitive functions. This adds a supportive narrative to my paper as I explore fatigue in space, and how that fatigue could negatively affect astronauts.