

Fatigue-Related Countermeasures for Long-Duration Exploration Missions

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The NASA Human Research Program's (HRP) Behavioral Health and Performance Element (BHP) supports and conducts research to mitigate deleterious outcomes related to fatigue, sleep loss, circadian desynchronization, and work overload. Objective evidence indicates that within the context of the International Space Station (ISS), sleep is reduced and there is circadian misalignment. Despite chronic sleep loss and high workloads; however, astronauts successfully complete their missions. Contributing to their success is not only the tremendous skills and capabilities of each astronaut, but also the collaborative team efforts amongst the crew, between flight and ground crews, and through real-time care provided by medical personnel.

It is anticipated that risks to human health and performance will increase in the context of exploration missions, where crewmembers will venture to deep space for extended durations and in small vehicles with limited communication with home. Hence, fatigue-related countermeasures are being developed and/or validated that include unobtrusive monitoring technologies to detect fatigue-related performance decrements, environmental countermeasures, and sleep education and training for flight and ground crews. Given that fatigue is an issue in current ISS missions, the BHP works collaboratively with Space Medicine operations to collect data in the operational environment, to validate fatigue-related countermeasures, and provide evidence-based mitigations.

Our presentation will summarize fatigue-related operational research that is underway through NASA's BHP in partnership with its operational counterparts. Efforts include studies evaluating the effects of hypnotics, lighting protocols as countermeasures for circadian entrainment, and investigations involving education and training. This presentation will further identify, based on flight and terrestrial evidence, additional sleep and circadian countermeasures that may still be needed to support exploration missions. Lessons learned from transitioning research deliverables into ISS operations will also be discussed.