HUMANS ARE CAPABLE OF ACHIEVING SUFFICIENT SLEEP IN MICROGRAVITY

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INTRODUCTION

Studies consistently find that humans average approximately six hours of sleep per night in space, which is less than they sleep on Earth. Consensus recommendations suggest that humans need at least seven hours of sleep per night for appropriate functioning. Such short sleep duration has been associated with reduced alertness and performance in space. It is unclear whether this sleep loss is related to modifiable factors, such as irregular scheduling, poor sleep environment, and excessive workload or due to features of spaceflight that alter physiology (e.g., microgravity). Recent missions have afforded crew better, more stable sleep and work schedules, and an improved sleep environment, including private, dark, and quiet crew quarters. Hence, the evaluation of sleep under these conditions should provide insight into the causes of sleep deficiency observed in space thus far.

METHODS

Crewmembers (n = 19) who volunteered for the NASA Standard Measures protocol between January 2019 and March 2022 were provided with actiwatches (Phillips, Respironics, Bend OR) that they wore for two bouts of data collection lasting two weeks each before flight (at approximately L-270 and L-180), either continuously (n = 9) or for two weeks every two months while in space (n = 10), and for seven days postflight, immediately upon return to Earth (R+0). We compared sleep outcomes (sleep duration, wake after sleep onset [WASO], sleep efficiency) between phases of flight using mixed effects models, with participant included as a random effect.

RESULTS

Crewmembers provided data from 402 nights preflight, 2,137 nights inflight, and 275 nights postflight. They averaged 7.33 hours of sleep per night (± 1.16, SD) in space. Though this was significantly less sleep than they achieved preflight (7.87 ± 1.10) or postflight (7.75 ± 1.43, $p < .01$), this duration of sleep meets the recommended amount for optimal human health and well-being. WASO significantly decreased inflight (28.39 ± 15.20) compared to the preflight (46.73 ± 22.81) and postflight (50.53 ± 25.23, $p < .01$). Lastly, sleep efficiency significantly increased during the inflight phase (89.50 ± 8.84) compared to preflight (84.38 ± 8.33) and postflight (83.94 ± 8.55, $p < .01$).

CONCLUSIONS

We conclude that humans are capable of achieving sufficient sleep in space. Our findings suggest that modifiable factors such as regularly timed sleep schedules, optimized sleep environment, and moderate workload are likely responsible for the reduced sleep duration observed previously. However, future studies are needed to determine whether microgravity impacts sleep architecture and sleep quality. Going forward, it is imperative that crewmembers are provided with stable schedules, with moderate workload, and environments that are conducive to sleep.