Sleep on Multiple Space Shuttle and International Space Station Missions

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INTRODUCTION

The success and effectiveness of manned space flight depends on the ability of crewmembers to maintain a high level of cognitive performance and vigilance while operating and monitoring sophisticated instrumentation. An inadequate quantity or quality of sleep may impair that ability. In order to understand sleep in space more completely, we conducted a large scale study of astronauts across multiple Space Shuttle and International Space Station (ISS) missions and assessed both objective and subjective measures of sleep as well as use of sleep medications.

METHODS

Since 2000, crewmembers assigned to shuttle flights (with inflight experiments authorized) were briefed about the opportunity to participate in this experiment. ISS crews were briefed beginning in 2006. Subjects wore a small light-weight ambulatory recording device [Actiwatch-L; Minimitter (Respironics), Bend, OR] for assessment of sleep-wakefulness activity and light exposure levels during three baseline data collection periods and the spaceflight mission. Additionally, crewmembers were instructed to complete a daily sleep log within 15 minutes of awakening (every day on Shuttle flights and for three one-week increments on ISS missions).

Baseline data were collected for two weeks approximately three months before launch and for 12 days prior to launch (L-11 until launch day L-0). Inflight, crewmembers donned the Actiwatch-L as soon as possible upon entering orbit and doffed it before landing. Postflight data were collected for one week immediately after landing (R+0 through R+7).

Sleep was estimated using Actiware Software [Version 3.4; Minimitter (Respironics)].

RESULTS

We report here the results of the first 39 Space Shuttle crewmembers across 15 shuttle flights (STS-104, -109, -111, -112, -113, -114, -115, -116, -121, -115, -116, -118, -120, -122, and -123) and the first six ISS crewmembers. Average nightly sleep during Shuttle flights was 5.9 ± 0.5 hours. Eighty-five percent of Shuttle crewmembers reported taking medications to promote sleep. Sleep medications were reported taken on 58% of inflight nights; two doses of sleep medication were taken on 24% of the nights when medication was used.

Eight hundred forty-four nights were recorded with actigraphy aboard the International Space Station. Preliminary results indicate that on 8% of nights, crewmembers slept less than five hours, and on 28% of the nights, crewmembers slept less than six hours. For two-thirds of the nights, crewmembers slept less than seven hours per night. The average nightly sleep duration was 6.6 ± 0.5 hours.

DISCUSSION

Preliminary analyses from the current study suggest that astronauts obtain inadequate sleep during shuttle and ISS missions. Prior ground-based research indicates that sleep loss, similar to that observed in the current study inflight, produces meaningful performance decrements. This highlights the need to develop effective countermeasures to promote sleep and wakefulness inflight. Additional analyses are in progress to examine factors influencing sleep during spaceflight.

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