Acronym: Sleep-Long

Title: Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Long

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Developer(s): Johnson Space Center, Human Research Program, Houston, TX

Sponsoring Agency: National Aeronautics and Space Administration (NASA)

Increment(s) Assigned: 14, 15, 16, 17

Mission Assigned:

Brief Research Summary (PAO): Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Long (Sleep-Long) will examine the effects of spaceflight and ambient light exposure on the sleep-wake cycles of the crew members during long-duration stays on the space station.

Research Summary:

- Previous research on Space Shuttle crewmembers has shown that sleep is disrupted on orbit. This experiment will examine whether sleep is disrupted during long duration stays on the International Space Station (ISS).
- A wrist-worn Actiwatch will record the activity of the crewmembers and the ambient light to which they are exposed.
- Data collected from sleep logs will also be used to evaluate the crewmembers' subjective evaluation of their sleep and alertness.
- This work will help in defining light requirements, sleep-shifting protocols, and workload plans for future explorations missions, and determine if further countermeasures to sleep disruption will need to be tested.

Detailed Research Description: The success and effectiveness of manned spaceflight depends on the ability of crewmembers to maintain a high level of cognitive performance and vigilance while operating

and monitoring sophisticated instrumentation. Astronauts during short duration space flights, however, commonly experience sleep disruption and may experience misalignment of circadian phase during spaceflight. Both of these conditions are associated with insomnia, and impairment of alertness and cognitive performance.

There is little information on the effect of long-duration spaceflight on sleep and circadian rhythm organization. This experiment will use state of the art ambulatory technology to monitor sleep-wake activity patterns and light exposure in crewmembers aboard ISS. Subjects will wear a small, light-weight activity and light recording device (Actiwatch) for the entire duration of their mission. The sleep-wake activity and light exposure patterns obtained in-flight will be compared with baseline data collected on Earth before and after spaceflight. These data should help us better understand the effects of spaceflight on sleep as well as aid in the development of effective countermeasures for long-duration spaceflight.

Project Type: Payload

Images and Captions:


This image of an Actiwatch Activity Monitor next to a ruler to demonstrate the size of the Actiwatch. Image courtesy of NASA.


NASA Image: S104E5114 - Astronaut, Janet Kavandi on STS-104 wearing an Actiwatch on her right wrist for recording activities.


NASA Image: ISS014E05119 - The Sleep-Long Actiwatch is visible on the left arm of Astronaut Michael Lopez-Alegria the Expedition 14 Commander. The Actiwatch monitors light and activity patterns of crewmembers.


NASA Image: ISS014E12135 - Expedition 14 Flight Engineer, Astronaut Suni Williams, performs her daily tasks while wearing the Actiwatch device as seen on her left arm in the lower portion of this image.

NASA Image: ISS015E09441 - Expeditions 14 and 15 Astronaut and Flight Engineer (FE-2), Sunita Williams, is seen here entering data at a computer workstation for the Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Long (Sleep-Long) experiment in the U.S. Laboratory/Destiny.

Operations Location: ISS Inflight

Brief Research Operations:

- Crewmembers will wear Actiwatches (that will record wrist activity, allowing estimation of sleep-wake cycles and also records the light exposure of the crewmember) and will complete sleep logs.

Operational Requirements: A total of 20 long-duration crewmembers are needed as subjects for the experiment. Baseline data for each subject must be collected for two weeks between L-120 (launch minus 120 days) and L-75 and from L-11 through L-0. Recovery in sleep patterns after spaceflight will be assessed from R+0 (return plus 0 days) to R+8.

Operational Protocols: Crewmembers will put on the Actiwatches as soon as possible upon entry into orbit and wear them throughout the flight. Crewmembers will maintain sleep logs; they will be required to keep the log for seven consecutive days, for three separate weeks throughout the mission. Crewmembers will download data from the Actiwatches every 26 days and change the battery at the end of the increment. On the last day of the mission, crewmembers will doff and stow the Actiwatches.

Category: Human Research and Countermeasure Development for Exploration

Subcategory: Human Behavior and Performance

Space Applications: The information derived from this study will help to better understand the effects of spaceflight on sleep-wake cycles. The countermeasures that will be developed will improve sleep during missions which in turn will help maintain alertness and lessen fatigue of the crew during long duration spaceflights.

Earth Applications: A better understanding of insomnia is relevant to the millions of people on Earth who suffer nightly from insomnia. The advancement of state of the art technology for monitoring, diagnosing, and assessing treatment effectiveness is vital to the continued treatment of insomnia on Earth. This work could benefit the health, productivity and safety of groups with a high prevalence of insomnia, such as shift workers and the elderly.

Manifest Status: Ongoing

Availability: Operated on ISS

Supporting Organization: Exploration Systems Mission Directorate (ESMD)

Previous Missions: Sleep-Short, a similar investigation was performed with short duration crew members during STS-104, STS-109, STS-111, STS-112, STS-113, STS-114, STS-121, STS-115, STS-116, STS-118, and STS-120.

Results: Analysis is ongoing.

Results Publications:

Related Publications:
Dijk D, Neri DF, Wyatt JK, Ronda JM, Riel E, Ritz-De Ceccoa A, Hughes RJ, Elliott AR, Prisk GK, West JB, Czeisler CA. Sleep, performance, circadian rhythms, and light-dark cycles during two space shuttle flights. American Journal of Physiology Regulatory Integrative Comparative Physiology. 2001 ;281:R1647-R1664.

Monk TH, Buysse DJ, Billy BD, DeGrazia JM. Using nine 2-h delays to achieve a 6-h advance disrupts sleep, alertness, and circadian rhythm. Aviation Space and Environmental Mediceine. 2004 ;75:1049-1057.

Mallis MM, DeRoishia CW. Circadian Rhythms, Sleep, and Performance in Space. Aviation Space and Environmental Medicine. 2005 ;76(6 Suppl): B94-107.

Monk TH, Buysse DJ, Billy BJ. Using daily 30-min phase advances to achieve a 6-hour advance: Circadian rhythm, sleep, and alertness. Aviation Space and Environmental Medicine. 2006 ;77(7): 677-686.

Web Sites: Sleep Medicine at Harvard Medical School
International Space Station Medical Project (ISSMP)

Related Payload(s): Sleep-Short