SPACE LIFE SCIENCES SYMPOSIUM (A1)
Behaviour, Performance and Psychosocial Issues in Space (1)

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BEHAVIORAL AND PSYCHOSOCIAL CHANGES DURING A 520-DAY SIMULATED INTERPLANETARY MISSION TO MARS

Abstract

INTRODUCTION The Mars 520-day project of the Russian Institute for Biomedical Problems (IBMP) focused on the effects of 520 days of isolation and confinement on a crew of 6 astronaut surrogates living in a facility that simulated a spaceflight to/from Mars. It is the longest simulated high-fidelity mission conducted to date, providing an opportunity to measure the sleep-wake behaviors of crew members throughout a period of confined isolation from Earth's light-dark cycles, which will be typical of an interplanetary space flight. METHODS Wrist actigraphy (Philips Actiwatch Spectrum, Philips Respironics, Bend, OR, USA) was used to measure crewmembers' sleep durations, sleep-wake cycle timing, and light exposure throughout the 520-days of confined isolation during the Mars mission. Actiwatch data were harvested electronically on a weekly basis and jettisoned from the facility for retrieval, electronic upload to a secure site, quality control evaluation, variable extraction, and data graphics and archiving. Data acquisition rates on all 6 crewmembers were >98.0% complete, yielding 4.39 million minutes of valid actigraphy data obtained throughout the 520-day study. Actigraphic data were scored and binned into three states: wake, rest and sleep, with accompanying light exposure. RESULTS Physical activity showed a consistent profile of change across the 520-day mission, and cumulative functions revealed differences

among crewmembers. The amount of sleep varied among crewmembers, as did the circadian timing of the sleep-wake cycle. Sleep-wake patterns included the typical 24h cycle, a biphasic (anchor sleep plus nap sleep) 24h cycle, and a prolonged sleep-wake period (circa 25h). CONCLUSIONS Crewmembers on a simulated mission to Mars displayed systematic changes in sleep duration and activity levels across the mission. They also exhibited substantial differences in sleep-wake pattern variability that may pose a challenge to effective crew coordination and performance during long-duration missions. ACKNOWLEDGEMENTS Research supported by the National Space Biomedical Research Institute through NASA NCC 9-58, and in part by the Institute for Experimental Psychiatry Research Foundation. J.P. Sutton is the Friedkin Chair for Research in Sensory System Integration and Space Medicine and Director of the Center for Space Medicine, Baylor College of Medicine. We thank the crewmembers of the 520-day study for their participation and for providing the data; the crewmembers of the 105-day pilot study for helping identify the optimal data acquisition techniques for the 520-day study; A.I. Grigoriev, I.B. Ushakov, E.P. Demin and M.S. Belakovskiy of the Institute for Biomedical Problems in Moscow for creating the simulation.