

THE EFFECTS OF LONG DURATION BED REST ON BRAIN FUNCTIONAL CONNECTIVITY AND SENSORIMOTOR FUNCTIONING

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Long duration spaceflight has been associated with detrimental alterations in human sensorimotor functioning. Prolonged exposure to a head-down tilt (HDT) position during long duration bed rest can resemble several effects of the microgravity environment such as reduced sensory inputs, body unloading and increased cephalic fluid distribution. The question of whether microgravity affects other central nervous system functions such as brain functional connectivity and its relationship with behavior is largely unknown, but of importance to the health and performance of astronauts both during and post-flight. In the present study, we investigate the effects of prolonged exposure to HDT bed rest on resting state brain functional connectivity and its association with behavioral changes in 17 male participants. To validate that our findings were not due to confounding factors such as time or task practice, we also acquired resting state functional magnetic resonance imaging (rs-fMRI) and behavioral measurements from 14 normative control participants at four time points. Bed rest participants remained in bed with their heads tilted down six degrees below their feet for 70 consecutive days. Rs-fMRI and behavioral data were obtained at seven time points averaging around: 12 and 8 days prior to bed rest; 7, 50, and 70 days during bed rest; and 8 and 12 days after bed rest. 70 days of HDT bed rest resulted in significant increases in functional connectivity during bed rest followed by a reversal of changes in the post bed rest recovery period between motor cortical and somatosensory areas of the brain. In contrast, decreases in connectivity were observed between temporoparietal regions. Furthermore, post-hoc correlation analyses revealed a significant relationship between motor-somatosensory network connectivity and standing balance performance changes; participants that exhibited the greatest increases in connectivity strength showed the least deterioration in postural equilibrium with HDT bed rest. This suggests that neuroplastic processes may facilitate adaptation to the HDT bed rest environment. The findings from this study provide novel insights into the neurobiology and future risk assessments of long-duration spaceflight.

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