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EFFECTS OF LONG-DURATION SPACEFLIGHT ON GREY MATTER OF CNS

Abstract

During space missions, astronauts must deal with microgravity, confinement, isolation, and immobility, to name a few factors. As a result, long-duration space travel has the potential to harm human physiology. Although research has primarily focused on the cardiovascular and musculoskeletal systems, the precise impact of spaceflight on the human central nervous system has yet to be discovered. The central nervous system (CNS) is subjected to a diverse variety of environmental stresses during spaceflight. Several studies have found that after spaceflight, the brain undergoes macrostructural changes, including as changes in brain location, tissue volumes, and cerebrospinal fluid distribution and dynamics. Changes in brain tissue microstructure and connection including vestibular, cerebellar, visual, motor, somatosensory, and cognitive function were also documented. Several studies have found that spaceflight causes focal Grey Matter (GM) alterations in the brain. Following spaceflight, both astronauts and cosmonauts have observed decreased GM volume at the orbitofrontal and temporal poles. Recent investigations have found increased GM in the SMA, pre-central, and post-central gyrus, confirming prior findings of enhanced GM in sensory and motor areas of the brain. It's worth noting that the majority of these GM changes occurred in tandem with changes in CSF and FW, as well as a shift in brain location in the skull. In addition, the scientists discovered GM abnormalities in the thalamus and occipital cortex, which they believe are the result of fluid accumulation in the visual pathway or the downstream effects of changes in the optic nerve itself. GM volume alterations, on the other hand, were mostly resolved about six months after the trip. Longer-duration space travel is still a question. This research focuses on the reasons for grey matter deterioration and attempts to gain a deeper understanding at the molecular level. Our approach will be to focus primarily on protein pathways, protein aggregation, and molecular mechanisms of cellular toxicity, and to do so, we will be studying the autophagy pathway using a computational model and simulating microgravity, martian, and lunar gravity conditions for a longer-term study, with the goal of determining when GM degradation begins and how quickly it progresses. This understanding must be expanded, especially in light of long-duration interplanetary missions (such as Mars missions) and space tourism. Furthermore, the new knowledge may be useful for vestibular patients, patients with neurodegenerative illnesses, and the elderly who are dealing with multisensory deficiency syndromes, immobility, and inactivity.