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EFFECTS OF LONG TERM HUMAN SPACEFLIGHT: A CONSOLIDATED REVIEW ON THE  
PATHOPHYSIOLOGY OF SANS AND ITS COUNTERMEASURES

**Abstract**

Elemental to the exploration of space by human beings is the understanding of the effects that microgravity conditions have on the human body; one of the key aspects of that being understanding how spaceflight impacts the human brain. According to neuroimaging studies, spaceflight has been linked to decreased frontal and temporal gray matter volumes, increased somatosensory cortex, and upward displacement of the brain within the skull. The researchers also had access to pre- and post-clinical examinations and tests that were used to detect changes in cognition and movement. This led to the discovery that astronauts who returned from long-duration International Space Station (ISS) missions had a substantial 10.7 percent change in total ventricular volume of the brain, compared to astronauts who returned from short-duration Space Shuttle missions, who had no changes in ventricular volume. The present state of knowledge about spaceflight-related changes to the brain as evaluated by magnetic resonance imaging is encapsulated in this review, with a focus on mission duration. This spaceflight-associated neuro-ocular syndrome (SANS) poses a significant risk to future exploration-class human spaceflight missions, such as missions to Mars. Exploratory comparison between participants who developed SANS and those who did not was conducted, and discovered asymmetric lateral ventricle enlargement in the SANS group. Hence future research is needed to better understand how changes in the brain caused by spaceflight affect crew health and performance, with the goal of establishing comprehensive monitoring and countermeasure measures for long-duration space travel in the future. This paper aims to compile and analyze the data logged from various post space flight MRI scans to better understand the effects of this phenomenon on the nervous system and its effects during long term spaceflight in microgravity. The paper shall also explore ways to decrease the effects of this syndrome.