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REVIEW OF POTENTIAL EXACERBATING FACTORS FOR SPACEFLIGHT-ASSOCIATED NEURO-OCULAR SYNDROME (SANS) AND EXPLORATION OF MITIGATION STRATEGIES

Abstract

The space environment is characterized by microgravity, which affects and poses a significant risk to astronaut health, that will only be exacerbated by the advent of long-duration spaceflight (LDSF). Amongst the various potential health issues are the effect that microgravity has on fluid-distribution in the body. A redistribution of brain extracellular-fluids has shown to have a correlation with spaceflight-duration. As the loss of significant gravitational force creates a cephalad fluid-shift, which results in venous congestion. Venous congestion marked by an accumulation of intrathoracic-fluid during the time course of spaceflight-mission can lead to a possible occurrence to Spaceflight-Associated Neuro-ocular Syndrome (SANS). SANS is a disease caused by a change in the gradient between intra-cranial and intra-ocular pressures that can lead to – papilloedema (swelling of the optic disc) and deformation of the eye. SANS findings have been documented in astronauts during and after LDSF with a post-flight degeneration in vision. The cumulative risk posed by long-duration and long-distance spaceflight needs to be properly determined to ensure astronauts remain healthy and capable of carrying out their duties in space. SANS poses a serious risk to astronauts' ability to complete missions by having an active role to inflammatory and hemodynamic stimulus preventing the cardiac mechanism and neurohormonal health. In this review, reports were found on SANS potential impact on terrestrial life on other planets (after interplanetary-flight), like Mars, which have a different gravitational-field than Earth. The National Aeronautics and Space Administration (NASA) has identified some factors that might exacerbate this disease: resistive exercise, high oral sodium intake, high ambient carbon dioxide, and in-flight pharmaceuticals. This paper considers to what extent NASA's identified factors affect the disease process, and to identify mitigation solutions for maintaining optimal astronaut health. A literature review was used to determine which parameters contribute to those health factors and why monitoring of exacerbating factors is a crucial process for spaceflight-performance. This study also evaluates the relationship between the identified factors with SANS cases and provides into insights of how these factors might be changed to reduce the impact of SANS. During this analysis, crew-safety is an important feature used. By comparing this result to the summary of our reviews, we discuss whether changes can take place for the identified factors, and to re-evaluate whether mitigation solutions are necessary for the scenarios identified.