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Author: Ms. Emily Scircle
Medical University of South Carolina, United States

Dr. Mark Rosenberg
Medical University of South Carolina, United States
Dr. Elizabeth Mellencamp
Medical University of South Carolina, United States
Dr. Aaron Bush
Mayo Clinic, United States

INVESTIGATING SPACEFLIGHT-ASSOCIATED NEURO-OCULAR SYNDROME (SANS) DISTRIBUTION THROUGH ASTRONAUT EYE COLOR VARIATION

Abstract

As humanity ventures further into space, our understanding of the physiological effects of microgravity on the human body continues to evolve. With the burgeoning opportunities for space tourism, an urgent need arises to assess the health risks associated with prolonged spaceflight comprehensively. Among these risks looms Spaceflight-Associated Neuro-Ocular Syndrome (SANS), a condition characterized by diminished near-visual acuity, visual scotomas, headaches, and deteriorating distance vision (Mader et al., 2011). This syndrome, affecting up to 23% of astronauts in short-duration flights and 48% reporting visual changes after long duration space flight International Space Station missions (Mader et al., 2011), presents a significant occupational hazard in space exploration.

The space environment introduces unique stressors such as microgravity-induced fluid shifts and radiation exposure, which may precipitate ocular changes leading to visual impairment. While the precise mechanisms underlying retinal damage in SANS remain elusive, hypotheses include alterations in intracranial pressures, impairment of vestibular drainage (Iwasaki et al., 2011), and long-term radiation exposure, which can induce oxidative damage to retinal pigment epithelial cells.

Recent studies have highlighted associations between SANS incidence and deficiencies in folate and methylmalonic acid, further underscoring the multifactorial nature of this syndrome (National Aeronautics, 2020). Furthermore, parallels between SANS symptoms and those of age-related macular degeneration (AMD) and radiation retinopathy suggest potential shared pathophysiological pathways.

This research endeavors to deepen our understanding of SANS etiology, with a specific focus on the potential role of radiation exposure, including its effects across varying wavelength energies, on the human retina. By examining the correlation between astronaut eye color and SANS incidence, this study lays the groundwork for a comprehensive investigation into the impact of unfiltered space radiation on ocular health.

Given the variable degrees of radiation exposure contingent upon mission duration and position relative to the Van Allen Belt, this research assumes heightened significance as humanity plans for extended missions into deep space. Ultimately, our ongoing analysis aims to inform strategies for mitigating the risks posed by SANS and promoting the well-being of astronauts during prolonged space missions.