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SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS): A NEW SCALE TO
DETECT THE INCIDENCE AND SEQUENCE OF SANS FINDINGS IN A SYSTEMATIC REVIEW
AND META-ANALYSIS

Abstract

Background: Neuro-ocular findings including optic disc edema, globe flattening, cotton wool patches, choroidal folds, and hyperopic refractive error shift have been described after long-duration space flight (LDSF). These findings have been termed, Space Flight Associated Neuro-ocular Syndrome (SANS). SANS may affect vision or mission safety and quality especially in future long-duration missions (e.g., a manned mission to Mars).

If we want to mitigate the risk of SANS symptoms effectively, we have to determine the risk priority, exact mechanism and address the incidence of each symptom severally in the astronauts. Therefore, we conducted a systematic review and meta analysis of the available literature to date for SANS to define the incidence and sequence of specific neuro-ocular signs in SANS over time.

Methods: We searched PubMed, Scopus and WOS using broad terms of SANS. R software was used in the statistical analysis; We pooled the available published mean differences (with a 95% Confidence interval) pre- and post-flight for optical coherence tomography (OCT) derived total retinal thickness (TRT) and choroidal thickness; and conducted a qualitative binary assessment of SANS signs including optic disc edema, choroidal folds, cotton wool spots, hyperopic shift, and globe flattening.

Results: After screening by title, abstract and full-text, 19 papers met our inclusion criteria (population size = 294 astronauts). Our results showed that the OCT of retinal nerve fibre layer (RNFL) thickening is the most prevalent finding in SANS (82%), followed by optic disc edema (75%) and choroidal folds (71%). Cotton wool spots showed the lowest incidence of (55%). Pre and post flight TRT analysis showed a significant increase of TRT post-flight by $17.81 \mu\text{m}$ (95% CI 5.16, 30.46, I²=64%). For choroidal thickness (pre- and post-flight) there was a significant increase of $32.83 \mu\text{m}$ (95% CI 15.93, 49.72, I²=49%).

Conclusion: Astronauts develop an unusual constellation of neuro-ocular findings called SANS. We found that the incidence after LDSF in astronauts based upon optical coherence tomography (OCT)

measurements of TRT may be as high as 82% compared with subjective clinical findings of optic disc edema and choroidal folds. We hope that our work will guide future case definitions for SANS to be modified to account for the possibly higher incidence of SANS after LDSF.