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PRE-FLIGHT BODY WEIGHT PREDICTS OCULAR CHANGES IN SPACE

Abstract

The weight of tissues generates compressive forces that press on body structures and act on the walls of vessels throughout the body. In microgravity tissues no longer have any weight and tissue compressive forces are lost. This suggests individuals who weigh more may show greater changes in vascular and tissue pressures in response to microgravity. Similarly, hydrostatic gradients are eliminated in weightlessness. Since hydrostatic pressures relate to the length of the hydrostatic column, the size of a fluid-filled structure can influence the pressure change seen in microgravity. This indicates anthropometric measures may also be important for predicting microgravity-induced changes. Our preliminary numerical modeling results show that increasing body weight leads to larger pressure changes in vessels and tissues in the transition to weightlessness. This may be relevant for the ocular changes seen during and after long-duration spaceflight (the Spaceflight-Associated Neuro-ocular Syndrome (SANS)). To test this hypothesis, we used data from the Longitudinal Study of Astronaut Health. Data from 45 individual long-duration astronauts (mean age 47, 36 Male, 9 Female, mean mission duration 165 days) who had pre- and post- flight measures of disc edema, choroidal folds, and manifest ocular refraction were analyzed. The mean pre-flight weights of astronauts who developed choroidal folds (No folds 173 lbs, Folds 195 lbs, $F=6.2$, $p=0.02$) and disc edema (No edema 174 lbs, Edema 209 lbs, $F=9.6$, $p=0.003$) were significant greater than those that did not develop choroidal folds or edema. The odds of developing disc edema was 50% in the highest weight quartile, and 0% in the lowest. For men, the odds were 43% in the highest quartile vs. 0% in the lowest. No women developed disc edema or choroidal folds. Using multiple linear regression, pre-flight weight was strongly related to refractive change ($t=2.6$, $p=0.01$), but not gender ($p=0.18$). Chest and weight circumference were also significantly greater in those who developed folds or edema. There was tendency for head circumference to also be related to refractive change ($p=0.07$). These data show that body weight and anthropometric factors may contribute significantly to microgravity-induced ocular changes. Independent effects of gender in this cohort are difficult to determine since the individuals with the highest body weights are male. As new hypotheses for how SANS develops are generated, the effect of body weight and other anthropometric measures need to be incorporated.