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Task Description:	In this ground-based rodent study, we aim to systematically define molecular signatures of cardiovascular performance across doses of acute simulated galactic cosmic radiation (Five-ion GCR) at early and late timepoints post-exposure. We also will determine the contribution of biological sex and the combined effects of GCR and microgravity on clinically relevant and emerging measures of cardiovascular health. We hypothesize that exposure to space radiation alone or in combination with microgravity results in early and late changes in the structure, transcriptome, redox signaling, and cytokine milieu of cardiovascular tissue, some of which have known links to decreased performance, aging, and increased cardiovascular disease (CVD) risk. We further posit that other less invasive clinically relevant measures of immune, behavior, and neuromotor function will be informative towards extrapolating the effects of deep space missions on human cardiovascular health. To achieve the project goals and test the hypothesis, we will take advantage of a rare tissue sharing opportunity from a recently funded Human Research Program (HRP) study. The experiment design of this funded investigation includes a GCR dosing study on crew age-matched female and male mice (6 months old) as well as combined exposure study with simulated microgravity. A comprehensive panel of outcomes will be assessed in the funded study and includes measures of immune health, brain molecular and structural changes, behavior, anxiety, cognition, and neuromotor function. Our proposed approach is to measure clinically relevant indicators of cardiovascular performance also will be compared to corresponding blood data to link immune and cardiovascular responses. To further facilitate extrapolation of results to humans, rodent RNAseq data will be compared to publicly available human RNAseq datasets from aging and CVD progression studies. The results from analysis of rodent cardiovascular findings will be interpreted in light of behavioral testing results to gain			
Rationale for HRP Directed Research:				
Research Impact/Earth Benefits:	This study is expected to contribute to increased understanding on the mechanisms of spaceflight-induced degenerative changes in cardiovascular tissue and the clinical endpoints they suggest. This study also is expected to provide insight on the latency period for radiation-induced cardiovascular changes and any sex differences in these outcomes. Lastly, our findings are expected to generate testable hypotheses for the development of countermeasures and less invasive surrogate biomarkers to monitor cardiovascular health in-flight and after return. Cardiovascular deconditioning observed in spaceflight resemble aspects of cardiovascular aging and disease on Earth. Hence, this study also may prove informative in the development new therapies for cardiovascular disease on Earth.			
Task Progress:	<ul> <li>Spaceflight leads to cardiovascular deconditioning in the absence of mitigation strategies. Cardiovascular changes in response to spaceflight are attributed to altered microgravity levels and the ensuing eephalad fluid shift. Overall reductions in physical activity and other factors — such as nutritional changes, elevated CO2 levels, and a demanding workload — also may be contributing factors. Although the litterature is mixed, some of the reported cardiovascular changes associated with exposure to the spaceflight environment include reductions in left ventricular mass, transient atrial distension and heart rhythm disturbances. Orthostatic intolerance and stiffer carotid arteries also have been observed in spaceflight crew upon return to Earth. Changes in venous blood flow and thrombus formation also are potential risks of space radiation relative to International Space Station (ISS) missions. The development of effective countermeasures for deep space missions requires an understanding of the anticipated spectrum of cardiovascular outcomes. Human studies as described above have shed light on how the cardiovascular system responds to microgravity (and other current environmental stressors in low Earth orbit). However, there is limited information on whether cardiovascular responses to deep space radiation alone will be similar to the effects of microgravity or in combination. Therefore, in this investigation, we aimed to (1) determine radiation does and time-dependence on measures of cardiovascular the space radiovascular changes indueed by simulated space radiation results in long-term changes to the space flight factors also was assessed.</li> <li>Our central hypothesis is that exposure to simulated space radiation results in long-term changes to the transcriptome, redox signaling, and cytokine milieu of cardiovascular the sposure to single factor exposure. In our first study, female and male c37BL/G mice (23-24 week old) were exposed to a single dose of 515 GS (GCR). Hu was conducted for sub</li></ul>			
Bibliography Type:	Description: (Last Updated: 06/19/2025)			