Fiscal Year:	FY 2020	**Task Last Updated:**	FY 01/20/2021
PI Name:	Diaz Artiles, Ana Ph.D.		
Project Title:	Predicting Acute Cardiovascular and Ocular Changes due to Changes in the Gravitational Vector and Effects of Countermeasures		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2019 HERO 80JSC019N0001-FLAGSHIP & OMNIBUS: Human Research Program Crew Health. Appendix A&B
Start Date:	09/01/2020	**End Date:**	08/31/2021
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No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
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Key Personnel Changes/Previous PI:			
COI Name (Institution):	Dunbar, Bonnie Ph.D. (Texas A&M University)		
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Task Description:	Exposure to weightlessness results in the removal of hydrostatic pressure gradients and a permanent headward fluid shift, causing a redistribution of blood. Additionally, in space postural changes do not occur and thus, astronauts are not exposed to daily fluid shifts (between supine and upright postures) as we are on Earth. This has currently unknown consequences, but it might be related to a series of neuro-ocular and functional changes developed in some astronauts during both short and long-duration spaceflight, collectively known as Spaceflight Associated Neuro-ocular Syndrome (SANS). While the exact etiology of SANS is currently unknown, chronic fluid redistribution affecting intravascular, interstitial, and cerebrospinal fluids and pressures is widely hypothesized to be a contributing factor. Additionally, recently demonstrated stagnant and retrograde blood flow and venous thrombosis in the left internal jugular vein during spaceflight could also be associated with sustained headward blood and tissue fluid shift. Based on the current knowledge and hypotheses, countermeasures focused on producing hydrostatic gradients or reducing the microgravity-induced fluid shift, such as lower body negative pressure (LBNP) or centrifugation, become particularly interesting. LBNP shifts fluids from the head to the lower body and is expected to reduce the translaminar pressure across the eye and thus, might prevent some of the ocular changes and remodeling associated with SANS. LBNP is also a promising countermeasure to enhance venous flow in the upper body. Similarly, head-to-foot (Gz) centrifugation also produces a fluid shift and induces hydrostatic gradients within the vessels in the body, which may also reduce intraocular pressure (IOP), reduce the translaminar pressure, and enhance venous flow. However, at present, it is not possible to estimate the overall physiological response (both acute or long term) of a particular “dose” of artificial gravity (AG) or LBNP, and more specifically and relevant to our purposes, the response in the upper body and in the eye. The objective of this ground-based research effort is to generate acute gravitational dose-response curves of cardiovascular (CV) and ocular variables due to changes in the gravitational vector, with and without countermeasures. We propose to use both experimental and computational approaches to leverage the advantages of each one of these research methodologies. We propose to conduct a set of three human experiments to generate the desired dose-response curves experimentally. The experiments will include exposure to multiple tilt angles (360° spectrum) in prone and supine postures, LBNP, and centrifugation. We also propose to develop a numerical model capable of predicting the expected acute CV and ocular changes in those conditions. The model will be validated with the experimental data generated during the experiments, and then will be used to simulate additional conditions where data collection is difficult, expensive, or infeasible. Results from this investigation will inform current and future countermeasure development and in-flight prescriptions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 07/28/2023)