Fiscal Year:	FY 2020	**Task Last Updated:**	FY 06/30/2020
PI Name:	Levine, Benjamin D. M.D.		
Project Title:	Coronary Anatomy and Physiology During 1 Year in Space		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	benjaminlevine@texashealth.org	**Fax:**	FY 214 345-4618
PI Organization Type:	UNIVERSITY	**Phone:**	214-345-4619
Organization Name:	The University of Texas Southwestern Medical Center at Dallas		
PI Address 1:	Institute for Exercise and Environmental Medicine (IEEM)		
PI Address 2:	7232 Greenville Ave, Suite 435		
PI Web Page:			
City:	Dallas	**State:**	TX
Zip Code:	75231-5129	**Congressional District:**	5
Comments:			
Project Type:	FLIGHT	**Solicitation:**	2018 HERO 80JSC018N0001-HHCHFBP: Human Health Countermeasures, Human Factors, Behavioral Performance. Appendix D
Start Date:	04/20/2020	**End Date:**	04/19/2021
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
Contact Email:	Peter.norsk@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bungo, Michael M.D. (University of Texas Health Science Center at Houston) Loerch, Linda M.S. (NASA Johnson Space Center)		
Grant/Contract No.:	80NSSC20K0987		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Since the majority of experienced astronauts are middle aged, they are at risk for developing serious cardiovascular events such as a myocardial infarction or sudden cardiac death, especially during high intensity exertion. Such events are life-threatening for the astronaut, and mission threatening for NASA. The principal investigator and colleagues have been leaders in developing strategies to identify asymptomatic individuals who may be at highest risk for such cardiovascular events. These studies led to the current flight medicine practice of screening all astronaut candidates (and following all active crew members) with coronary artery calcium (CAC) scoring. However atherosclerosis is a progressive process. So it would be possible for an astronaut to develop increasing CAC (and atherosclerosis) over time. Moreover, the development of vascular calcification may be preceded by substantial non-calcified plaque, which may be most prone to rupture and cause an acute coronary syndrome. Finally, coronary atherosclerosis impairs coronary endothelial function which can then both initiate and stimulate progression of atherosclerosis; myocardial contrast echocardiography (MCE) can non-invasively quantify coronary microvascular function to complement the structural assessment by coronary computerized tomography angiography (cCTA). Important for this project and the Request for Actions (RFA) is the potential for space radiation to accelerate atherosclerosis. Recent flight studies have suggested that non-coronary vascular beds may stiffen with reduced vascular reserve during 6 month International Space Station (ISS) missions, and ground based studies have identified the surprising capacity for coronary atherosclerosis to evolve rapidly under extreme stress. The global object of this project is to determine the effect of incremental doses of spaceflight on coronary anatomy and physiology, and to identify biomarkers that may be useful for early detection of accelerated atherosclerosis. To accomplish this objective, we propose to complete the following specific aims: Specific Aim 1: to test the hypothesis that coronary atherosclerosis will be accelerated by 1 year of spaceflight. We will perform cCTA: a) 1 year before flight upon crew selection; b) within 4-8 weeks of flight; c) soon (within 1-2 weeks) after 1 year in space; and d) after 1 year recovery. This strategy will allow us to compare the trajectory of coronary atherosclerosis before and after prolonged spaceflight. The extent of calcified and non-calcified plaque will be quantified, and markers of plaque vulnerability will be assessed. To provide context, we will also compare these data to well matched controls from the Cooper Clinic Longitudinal Study and the Progression of AtheRosclerotic PlAque DetermIned by Computed TomoGraphic Angiography IMaging (PARADIGM) cCTA registry. Specific Aim 2: to test the hypothesis that 1 year in space will impair coronary endothelial function and vasomotor reactivity. We will perform MCE before and after adenosine pre, in, and post-flight to quantify coronary microvascular function. Exploratory Aim 3: to test the hypothesis that a multimodality biomarker panel including blood (hs-troponin, NTproBNP, markers of oxidative stress and DNA damage) and relevant imaging (CAC, cCTA, MCE) can quantify risk of accelerated atherosclerosis before and during long duration flight. This study will provide critically important information regarding changes in coronary structure and function during 1 year in space, and will form the knowledge base to assess cardiovascular risk from multiyear exploration class missions. If the changes in the coronary circulation are as pronounced as the peripheral circulation, specific plans for monitoring and management in space can be developed including prevention and treatment. These aims will directly address Gap Degen-7 (Are there synergistic effects from other spaceflight factors (e.g., altered gravity (µ-gravity), stress, altered immune function, altered circadian rhythms, or other) that modify space radiation-induced degenerative diseases in a clinically significant manner?) and Gap CV1 (What are the in-flight alterations in cardiac structure and function?), and CV8 (Can manifestations of sub-clinical or environmentally induced cardiovascular diseases during spaceflight be predicted?).
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 10/16/2019)