Fiscal Year:	FY 2020	**Task Last Updated:**	FY 09/23/2019
PI Name:	Rutkove, Seward M.D.		
Project Title:	Approaching Gravity As a Continuum: Musculoskeletal Effects of Fractional Reloading		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Animal Biology: Vertebrate		
Space Biology Cross-Element Discipline:	(1) Musculoskeletal Biology		
Space Biology Special Category:	(1) Translational (Countermeasure) Potential		
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Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2018 Space Biology (ROSBio) NNH18ZTT001N-FG. App B: Flight and Ground Space Biology Research
Start Date:	10/01/2019	**End Date:**	09/30/2022
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No. of PhD Candidates:		**No. of Master' Degrees:**	
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No. of Bachelor's Candidates:		**Monitoring Center:**	NASA ARC
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Flight Program:			
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COI Name (Institution):	Bouxsein, Mary Ph.D. (Beth Israel Deaconess Medical Center, Inc./Harvard Medical School)		
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Task Description:	The effect of full mechanical unloading has been extensively studied in both rodents and humans using ground-based models. Recently, rodent partial weight bearing (PWB) models have revealed that partial gravity provides dose-dependent rescue of the musculoskeletal system as compared to full unloading. Separate work has also shown that after unloading, an abrupt mechanical reloading to 1g causes additional musculoskeletal injury. Here, we propose to employ both PWB and hindlimb unloading models sequentially to investigate gravity as a continuum and its impact on musculoskeletal adaptation to reloading. This work will have critical practical and scientific outcomes, and will provide for the first time, insights into the musculoskeletal responses to adult to fractional gravity after a period of microgravity (as would occur when traveling to Mars). It will also provide information on the mitigating effects of partial gravity after extended unloading. Our Specific Aims are: 1) To determine the physiological adaptations of the musculoskeletal system in males to the fractional gravity of either the Moon or Mars after experiencing microgravity in transit, 2) To determine the physiological adaptations of the musculoskeletal system in females to the fractional gravity of either the Moon or Mars after experiencing microgravity in transit, and 3) To investigate the potential musculoskeletal benefits of artificial gravity in-flight before returning to Earth. Specifically, we plan to investigate the resulting musculoskeletal alterations in transitioning from 2 weeks of 0g to 0.2, 0.4, and 0.7g, hypothesizing that there is a dose-dependence to the reloading, including recovery and associated injury. We will also assess the potential benefit of using these three levels of PWB as intermediate steps on the way to transitioning back to 1g. Thorough post mortem analyses, we will be able to identify the different processes that might be involved in reloading injury and its mitigation. Stress levels and metabolic/hormonal alterations will also be evaluated. Ultimately, we hope to provide the space biology community a deeper understanding of the musculoskeletal impact of fractional gravity in relation to both microgravity and Earth gravity.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 03/05/2024)