

Fiscal Year:	FY 2023	Task Last Updated: FY 11/01/2022	
PI Name:	Rosa-Caldwell, Megan Ph.D.		
Project Title:	Influence of Sex Hormones on Nervous System and Musculoskeletal Health in Micro- and Martian Fractional Gravity in Rat Analogues		
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 (2) Neurobiology		
Space Biology Special Category:	None		
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Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2018 Space Biology (ROSBio) NNH18ZTT001N-FG2. App D: Flight and Ground Space Biology Research
Start Date:	01/04/2021	End Date:	01/03/2023
No. of Post Docs:	1	No. of PhD Degrees:	
No. of PhD Candidates:	1	No. of Master' Degrees:	
No. of Master's Candidates:		No. of Bachelor's Degrees:	
No. of Bachelor's Candidates:		Monitoring Center:	NASA ARC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	No significant personnel changes. PI/Post-Doc: Megan Rosa-Caldwell PI/Mentor: Seward Rutkove		
COI Name (Institution):	Bouxsein, Mary Ph.D. (Beth Israel Deaconess Medical Center, Inc./Harvard Medical School) Rutkove, Seward M.D. (Mentor: Beth Israel Deaconess Medical Center, Inc./Harvard Medical School)		
Grant/Contract No.:	80NSSC21K0311		
Performance Goal No.:			
Performance Goal Text:			

<p>Task Description:</p>	<p>POSTDOCTORAL FELLOWSHIP</p> <p>In this postdoctoral fellowship, we propose to evaluate the impact of sex hormones on neuronal and musculoskeletal health in micro and Martian gravity environments by assessing naïve and castrated/ovariectomized male and female rats. We hypothesize micro- and fractional gravity will result in differential aberrations to sex hormone status in female and male rats; these sex hormone aberrations will moderate neurological and musculoskeletal declines in micro- and fractional gravity environments. We will study these rats over a 4-week period and investigations will include a series of neurophysiological and functional measures, blood analyses, and a detailed series of post-mortem histological studies. With completion of this work, we will have a far deeper understanding of the relationship between hormonal status and neuronal and musculoskeletal function. This proposed work will be specifically responsive to the following subtopics in Appendix D:</p> <ul style="list-style-type: none"> • (AB1-A): Behavior and underlying neural function, including circadian effects, controlling ability of animals to sense and respond to their environment. • (AB1-B): Studies to characterize interactions between multiple physiological systems. • (AH1-E): Effects of fractional gravity provided by spaceflight centrifugation or ground microgravity/partial gravity analogs to gain insights into mechanisms of how animals sense, respond, and adapt to gravity shifts that are less than 1G.
<p>Rationale for HRP Directed Research:</p>	<p>Research Impact/Earth Benefits:</p> <p>This project investigates how sex hormones influence musculoskeletal health in both males and females during conditions that produce muscle loss. This work has impact on life on Earth because it is important to understand how different atrophic conditions (for example, bed rest) may differ between males and females. Additionally, understanding if, or how, sex hormones interact with muscle and bone health during atrophic conditions will develop our overall understanding of muscle biology, as well as facilitate the development of possible interventions to blunt muscle loss for patients on Earth.</p>
<p>Task Progress:</p>	<p>After ~ 1.75 years working on this project, we are happy to note that we have completed all animal work for the proposed study.</p> <p>Upon receiving notification of selection in September 2020, we immediately started planning so the study could start as soon as funds became available. We originally planned to complete the surgeries in our own laboratory; however, we learned that Charles River could complete the surgeries before shipping animals. We opted for this option because completing the surgeries in our home laboratory would require borrowing shared surgical spaces with other researchers and this option would allow us to complete more animals in a shorter time period. In a minor change from the original proposal, animals had surgeries completed at 11 weeks of age and arrived at Beth Israel Deaconess Medical Center at 12 weeks of age (as opposed to surgeries at 12 weeks of age). After the appropriate acclimation period (48 hours), we then began estrous cycle monitoring of female rats. This two week measurement period allows for determination of baseline estrous cycle for each animal as well as confirms the ovariectomy surgery. Males have this 2 week waiting period but are just gently handled without any additional monitoring/measurements.</p> <p>Since starting data collection in January of 2021, we have thus far completed 120 animals over the 42 day protocol. We completed animal data collection in May of 2022. Since completion of animal data collection, we have been analyzing data collected for 120 animals across > 20 outcome variables. We have also completed hormone analysis in the serum of the animals.</p> <p>With the preliminary data generated from this grant, we have submitted 5 abstracts for virtual and in-person scientific meetings. Abstracts submitted to various conferences have resulted in multiple scientific awards. Additionally, the Post-Doc Principal Investigator on the grant (Dr. Rosa-Caldwell) was invited to give a talk at the 3rd International Conference on Musculoskeletal and Neural Interactions in Atlanta, GA in August. Moreover, Dr. Rosa-Caldwell was also invited to give a symposium talk at the Canadian Society for Exercise Physiology Annual Meeting in Fredericton, New Brunswick, Canada.</p> <p>Additionally, a Harvard Medical School/Massachusetts Institute of Technology M.D./Ph.D. student, Anna Wadhwa, completed an 8-week rotation in the laboratory during this project. Ms. Wadhwa assisted the data analysis of muscle and fat changes during the partial/micro-gravity interventions. Afterwards, she wrote and submitted an abstract to the New England Chapter of the American College of Sports Medicine. Her abstract was selected as a finalist for the Ph.D. student research award and Ms. Wadhwa won this award.</p> <p>Overall, we have made significant progress in the completion of this project and believe, given the current trajectory, will successfully complete this project within our designated timeframe. We have begun writing scientific manuscripts with the data generated from this project. We anticipate the first publications from this project to be submitted by the end of 2022.</p>
<p>Bibliography Type:</p>	<p>Description: (Last Updated: 03/05/2024)</p>
<p>Abstracts for Journals and Proceedings</p>	<p>Wadhwa A, Rosa-Caldwell ME, Mortreux M, Sung D-M, Boussein ML, Kaiser UB, Rutkove SB. "Sex differences in musculoskeletal health after exposure to spaceflight analog environments." New England Chapter of American College of Sports Medicine Conference, Providence, Rhode Island, October 13-14, 2022.</p> <p>Abstracts. New England Chapter of American College of Sports Medicine Conference, Providence, Rhode Island, October 13-14, 2022. , Oct-2022</p>
<p>Abstracts for Journals and Proceedings</p>	<p>Rosa-Caldwell ME, Mortreux M, Sung D-M, Schreurs A-S, Boussein ML, Kaiser UB, Rutkove SB. "Sex hormones are not solely responsible for musculoskeletal loss sex differences during disuse." American College of Sports Medicine Annual Meeting, San Diego, California. May 31-June 4, 2022.</p> <p>Abstracts. American College of Sports Medicine Annual Meeting, San Diego, California. May 31-June 4, 2022. , Jun-2022</p>

Abstracts for Journals and Proceedings	Rosa-Caldwell ME. "Regulation of muscle function during muscle atrophies: Sex differences and why they matter." 3rd International Conference on Musculoskeletal and Neural Interactions, Atlanta, Georgia, August 23-25, 2022. Invited Presentation. Abstracts. 3rd International Conference on Musculoskeletal and Neural Interactions, Atlanta, Georgia, August 23-25, 2022. , Aug-2022
Abstracts for Journals and Proceedings	ME Rosa-Caldwell. "Mitochondrial contributions to disuse atrophy: Let's talk about sex." Annual Meeting of the Canadian Society for Exercise Physiologists, Fredericton, New Brunswick, Canada, November 2-5, 2022. Invited Presentation. Abstracts. Annual Meeting of the Canadian Society for Exercise Physiologists, Fredericton, New Brunswick, Canada, November 2-5, 2022. , Nov-2022