

Fiscal Year:	FY 2019	Task Last Updated:	FY 05/09/2019
PI Name:	Smith, Scott M Ph.D.		
Project Title:	Space Biochemistry Profile		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HHC :Human Health Countermeasures		
Human Research Program Risks:	(1) Bone Fracture :Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) Food and Nutrition :Risk of Performance Decrement and Crew Illness Due to Inadequate Food and Nutrition (3) Immune :Risk of Adverse Health Event Due to Altered Immune Response (4) Nutrition :Risk of Inadequate Nutrition (5) Osteo :Risk Of Early Onset Osteoporosis Due To Spaceflight (6) Renal Stone :Risk of Renal Stone Formation		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Organization Name:	NASA Johnson Space Center		
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City:	Houston	State:	TX
Zip Code:	77058-3607	Congressional District:	36
Comments:			
Project Type:	FLIGHT	Solicitation / Funding Source:	2012 Crew Health NNN12ZSA002N
Start Date:	08/01/2013	End Date:	12/31/2020
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		
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date changed to 12/31/2020 per PI (Ed., 5/10/19) NOTE: End date changed to 12/31/2019 per PI (Ed., 6/5/18)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Zwart, Sara Ph.D. (Universities Space Research Association) Heer, Martina Ph.D. (University of Bonn, Germany)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	<p>As long-duration spaceflights continue and the operational suite of countermeasures is modified, the food system is updated, and the duration of missions lengthens, it will be important to evaluate and monitor a broad set of biomarkers for key physiological systems. The Nutritional Status Assessment Supplemental Medical Objective (aka "Nutrition SMO") was initiated in 2006, and has yielded significant clinical, operational, and research data. This proposal aims to extend the Nutrition SMO, under the guidelines provided in the NRA (NASA Research Announcement). Nutrition SMO data have been used to help identify or explain medical, scientific, and even engineering issues that have occurred during or after International Space Station (ISS) missions. The data have been used by Medical Operations on multiple occasions, to confirm the effectiveness of vitamin D supplementation, to test for nutrient toxicities (secondary to supplement use), to evaluate blood and urine chemistries after instances of kidney stones and gout symptoms in crewmembers, and to evaluate the effects of using a new exercise device on bone and calcium metabolism. The ISS Program Office has used these data to determine factors contributing to the Urine Processor Assembly failure and to make forward operational decisions. Perhaps most striking, the data provided evidence that one-carbon metabolism may be altered in crewmembers who experienced vision changes post flight, the highest Human Research Program risk. The relationship between nutritional status and 1-carbon metabolism would likely never have been discovered if the Nutrition SMO were not being conducted. The impact of the data collected to date provides a strong rationale for continuing with an updated version of this protocol, eliminating some tests while expanding others, to provide a repository of data to other scientific Disciplines. We have extensive experience with these types of analyses, sample and data management, transfer to data archives, and data reduction for medical, management, and research purposes.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>The findings from this study will help us better understand physiological adaptation to spaceflight, and will help evaluate countermeasure effectiveness. These results help the ISS Program, the Human Research Program (HRP), Space Medicine, Office of the Chief Health and Medical Officer (OCHMO), NASA engineers, individual astronauts, and other experiments. These results will also inform the general, medical, and scientific communities on human health and physiological issues in an altered gravity environment. There could be significant potential implications of these findings.</p>
Task Progress:	<p>Sample collection protocols were well executed on orbit, with many subjects completing pre-, in-, and postflight data collections. On orbit time constraints have led to some missing sessions. Sample returns were completed via SpaceX cargo return vehicles. Initial findings have been reported at several HRP IWS meetings and Investigator Working Group meetings (Twins, One Year Mission). The Twins study publication in 2019 was a major milestone. Data and samples have been provided to other investigations. Summary data have been provided to other groups working on NASA funded research, for collaborative publications to provide comparative human and animal data. Data have been provided to ECLSS (Environmental Control and Life Support Systems) engineers at Marshall Space Flight Center for their work on water reclamation from urine. Experiment has completed last sample collections. Reviewing, compiling, and presenting/publishing data will continue as analyses are completed.</p>
Bibliography Type:	Description: (Last Updated: 05/24/2023)
Abstracts for Journals and Proceedings	<p>Smith SM, Heer M, Zwart SR. "Biochemical profile: providing insight into vitamin status on ISS." 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. , Jan-2019</p>
Abstracts for Journals and Proceedings	<p>Smith SM, Heer M, Shackelford LC, Zwart SR. "Biochemical Profile: Providing insight into bone biochemistry on ISS missions." 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. , Jan-2019</p>
Articles in Peer-reviewed Journals	<p>Garrett-Bakelman FE, Darshi M, Green SJ, Gur RC, Lin L, Macias BR, McKenna MJ, Meydan C, Mishra T, Nasrini J, Piening BD, Rizzardi LF, Sharma K, Siamwala JH, Taylor L, Vitaterna MH, Afkarian M, Afshinnikoo E, Ahadi S, Ambati A, Arya M, Bezdán D, Callahan CM, Chen S, Choi AMK, Chlipala GE, Contrepois K, Covington M, Crucian BE, De Vivo I, Dinges DF, Ebert DJ, Feinberg JI, Gandara JA, George KA, Goutsias J, Grills GS, Hargens AR, Heer M, Hillary RP, Hoofnagle AN, Hook VYH, Jenkinson G, Jiang P, Keshavarzian A, Laurie SS, Lee-McMullen B, Lumpkins SB, MacKay M, Maienschein-Cline MG, Melnick AM, Moore TM, Nakahira K, Patel HH, Pietrzyk R, Rao V, Saito R, Salins DN, Schilling JM, Sears DD, Sheridan CK, Stenger MB, Tryggvadottir R, Urban AE, Vaisar T, Van Espen B, Zhang J, Ziegler MG, Zwart SR, Charles JB, Kundrot CE, Scott GBI, Bailey SM, Basner M, Feinberg AP, Lee SMC, Mason CE, Mignot E, Rana BK, Smith SM, Snyder MP, Turek FW. "The NASA Twins Study: A multidimensional analysis of a year-long human spaceflight." Science. 2019 Apr 12;364(6436):eaau8650. https://science.sciencemag.org/content/364/6436/eaau8650.long ; PubMed PMID: 30975860 , Apr-2019</p>