

Fiscal Year:	FY 2022	Task Last Updated:	FY 05/24/2022
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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PI Organization Type:	NASA CENTER	Phone:	281-483-7204
Organization Name:	NASA Johnson Space Center		
PI Address 1:	Biomedical Research and Environmental Sciences Division/SK3		
PI Address 2:	2101 NASA Pkwy		
PI Web Page:			
City:	Houston	State:	TX
Zip Code:	77058-3607	Congressional District:	36
Comments:			
Project Type:	FLIGHT	Solicitation / Funding Source:	2012 Crew Health NNJ12ZSA002N
Start Date:	08/01/2013	End Date:	09/30/2022
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:	Stenger, Michael	Contact Phone:	281-483-1311
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date changed to 9/30/2022 per HRP HHC element and PI (Ed., 7/8/21) NOTE: End date changed to 12/31/2021 per PI (Ed., 2/25/21) 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. (University of Texas Medical Branch/) 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 in orbit, with many subjects completing pre-, in-, and postflight data collections. This protocol was terminated prematurely after E56/57, ending collection of valuable data with impact to the International Space Station (ISS) Program, the NASA Human Research Program (HRP), the Office of the Chief Health and Medical Officer (OCHMO), Space Medicine, Environmental Control and Life Support Systems (ECLSS), other investigations, and to individual astronauts. Data have been provided to other investigations (e.g., CardioOx, MARROW, TBone, Cartilage, SOLO, Telomeres) and requests from NASA's Life Sciences Data Archive (LSDA). Between Biochem Profile and the Nutritional Status Assessment Supplemental Medical Objective (Nutrition SMO), these have yielded 35 primary peer-reviewed publications, with more in work. Notable publications this year include collaborations with the Canadian Space Agency (CSA) sponsored TBone Team, collaborations with the NASA Immune Lab, and identification of the effect of oral contraceptives on serum albumin, likely contributing to risk of venous thromboembolism. The findings have been incorporated into books, chapters, and many review articles. Extended sample analyses continue, along with reviewing, compiling, and presenting/publishing data.</p>
Bibliography Type:	Description: (Last Updated: 05/24/2023)
Articles in Peer-reviewed Journals	<p>Zwart SR, Auñón-Chancellor SM, Heer M, Melin MM, Smith SM. "Albumin, oral contraceptives, and venous thromboembolism risk in astronauts." J Appl Physiol. 2022 May 1;132(5):1232-9. https://doi.org/10.1152/jappphysiol.00024.2022 ; PMID: 35389755 , May-2022</p>
Articles in Peer-reviewed Journals	<p>Mehta SK, Szpara ML, Rooney BV, Diak DM, Shipley MM, Renner DW, Krieger SS, Nelman-Gonzales MA, Zwart SR, Smith SM, Crucian BE. "Dermatitis during spaceflight associated with HSV-1 reactivation." Viruses. 2022 Apr;14(4):789. https://doi.org/10.3390/v14040789 ; PMID: 35458519; PMCID: PMC9028032 , Apr-2022</p>
Articles in Peer-reviewed Journals	<p>Krieger SS, Zwart SR, Mehta S, Wu H, Simpson RJ, Smith SM, Crucian B. "Alterations in saliva and plasma cytokine concentrations during long-duration spaceflight." Front Immunol. 2021 Aug 24;12:725748. https://doi.org/10.3389/fimmu.2021.725748 ; PMID: 34504500; PMCID: PMC8422944 , Aug-2021</p>
Articles in Peer-reviewed Journals	<p>Smith SM, Zwart SR. "Nutrition as fuel for human spaceflight." Physiology (Bethesda). 2021 Sep 1;36(5):324-330. https://doi.org/10.1152/physiol.00011.2021 ; PMID: 34431417 , Sep-2021</p>