Fiscal Year:	FY 2019	**Task Last Updated:**	FY 03/04/2019
PI Name:	Smith, Scott M Ph.D.		
Project Title:	Astronaut Vision Issues and One Carbon Metabolism: Expanded Polymorphism Evaluation and Evaluation in a Potential Analog Population		
Division Name:	Human Research		
Program/Discipline:			
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) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058-3607	**Congressional District:**	36
Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	04/06/2016	**End Date:**	04/30/2020
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:			
Flight Assignment:	NOTE: Extended to 4/30/2020 per PI (Ed., 1/28/19)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Zwart, Sara Ph.D. (University of Texas Medical Branch) Chang, Alice M.D. (Mayo Clinic, Rochester, MN) Gregory, Jesse Ph.D. (University of Florida) Chen, John M.D., Ph.D. (Mayo Clinic, Rochester, MN) Zeisel, Steven M.D., Ph.D. (University of North Carolina at Chapel Hill) Gibson, C. Robert O.D. (Coastal Eye Associates) Mader, Thomas M.D. (U.S. Army (retired))		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Background We have documented a genetic predisposition for some astronauts to develop ophthalmologic issues. From a limited study of 5 single-nucleotide polymorphisms (SNPs), we found one SNP associated with a greater risk of ophthalmic findings (e.g., choroidal folds, cotton wool spots), and another SNP that was protective against optic disc edema. In light of these findings, we proposed two studies which were combined in this project. Thus, this project has two major goals: 1. To extend the one-carbon pathway SNP assessment as related to astronaut ophthalmologic findings. (One Carbon Expansion study) 2. To evaluate patients with polycystic ovary syndrome (PCOS) and/or Idiopathic intracranial hypertension (IIH) to assess one-carbon biochemistry and genetics and their possible correlation with ophthalmologic findings. (PCOS study) While these studies alone will not identify the mechanism(s) of astronaut ophthalmologic issues, we aim to clarify the genetic relationship to ophthalmic findings, and to document the utility of PCOS as a clinical population that could be used for studies that may ultimately allow for the definition of the mechanism of and means to prevent or treat these potentially vision-threatening processes in astronauts. Specific Aims The study has the following specific aims: 1. Test for multiple SNPs of the 85 major genes involved in one-carbon metabolism in ISS (International Space Station) crewmembers (a total of 523 SNPs), and relate these data to existing one-carbon biochemistry and metabolomic data, along with existing vision and related medical data. 2. Compare the same one-carbon metabolism genetics and biochemistry and ophthalmologic data from patients in one of four treatment groups: i. women diagnosed with PCOS without IIH ii. women diagnosed with PCOS and IIH iii. women diagnosed with IIH without PCOS iv. controls (neither PCOS nor IIH)
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research. This study has two major goals: 1. To utilize existing samples where possible to extend the scope of the initial One Carbon study. This was initially submitted and reviewed in the NNJ14ZSA001N-OMNIBUS NRA. HRP Management has now asked we submit this as directed research. 2. To add testing to an ongoing clinical trial at the Mayo Clinic. Timing is critical given that study is ongoing. The primary study is a clinical trial of pharmaceutical treatment for PCOS. We propose to extend this study by collecting a blood sample for one carbon biochemical and genetic testing, along with ophthalmologic exams, with the aim of documenting the utility of this population as an analog group for future VIIP research.
Research Impact/Earth Benefits:	While much research is in progress to understand vision issues in astronauts, a key question remains as to why only some individuals are affected. Our preliminary data suggest that some individuals may have a genetic predisposition for vision issues, related to one-carbon metabolism. Our initial study was intentionally constrained given our concerns about it being the first study involving individual genetic testing at NASA. In light of the crewmember response to that study (>97% participation) and the initial findings from that effort, we now propose to evaluate a wider range of one-carbon metabolism SNPs, to help clarify and verify that one-carbon metabolism is indeed the source of this effect, and to identify possible associations with ethnicity. The results of this study could be profound, and may have significant implications for the direction of NASA vision countermeasure research, for operational decisions regarding treatment of affected astronauts, and for informing the general medical and scientific communities, where research is ongoing to understand the role of one-carbon metabolism genetics in other cerebrovascular issues.
Task Progress:	Both projects continue to proceed, albeit slowly. Subject recruitment for both projects continues, and initial analyses have been conducted. In FY19, we begin data analysis with initial findings, with more complete work to be completed in FY20. One carbon study findings were also included in the Twins Study reporting.
Bibliography Type:	Description: (Last Updated: 05/24/2023)
Articles in Peer-reviewed Journals	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, Afshinnekoo E, Ahadi S, Ambati A, Arya M, Bezdan D, Callahan CM, Chen S, Choi A, Chlipala GE, Contrepois KP, Covington M, Crucian BE, De Vivo I, Dinges DF, Ebert DJ, Feinberg J, Gandara J, George K, 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 S, Maienschein-Cline MG, MacKay M, Melnick A, Moore TM, Nakahira K, Patel HH, Pietrzyk R, Rao V, Saito R, Salins D, Schilling JM, Sears DD, Sheridan C, Stenger MB, Tryggvadottir R, Urban AE, Vaisar T, Van Espen B, Zhang J, Ziegler MG, Zwart SR, Charles JB, Kundrot C, Scott G, Bailey SM, Basner M, Feinberg AP, Lee SMC, Mason CE, Mignot E, Rana BK, Smith SM, Snyder M, Turek FW. "The NASA Twins Study: A multi-dimensional analysis of a year-long human spaceflight." Science. 2019 Apr 12;364(6436):eaau8650. https://science.sciencemag.org/content/364/6436/eaau8650 ; PubMed PMID: 30975860 , Apr-2019
Articles in Peer-reviewed Journals	Smith SM, Zwart SR. "Spaceflight-related ocular changes: the potential role of genetics, and the potential of B vitamins as a countermeasure." Curr Opin Clin Nutr Metab Care. 2018 Nov;21(6):481-8. https://doi.org/10.1097/MCO.0000000000000510 ; PubMed PMID: 30169456 , Nov-2018