Fiscal Year:	FY 2018	**Task Last Updated:**	FY 08/06/2018
PI Name:	Scott, Jessica Ph.D.		
Project Title:	Influence of Exercise Modality on Cerebral-Ocular Hemodynamics and Pressures		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) **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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Zip Code:	10065	**Congressional District:**	12
Comments:	NOTE (Ed., 8.1.18): Moved to Memorial Sloan Kettering Cancer Center, New York, NY, in summer 2017; formerly at Universities Space Research Association, Houston		
Project Type:	GROUND	**Solicitation / Funding Source:**	2013 HERO NNJ13ZSA002N-Crew Health OMNIBUS
Start Date:	10/01/2014	**End Date:**	01/09/2018
No. of Post Docs:	1	**No. of PhD Degrees:**	1
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:	2	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: New grant 80NSSC17K0573 issued for this work when PI moved to Memorial Sloan Kettering Cancer Center in Summer 2017; end date changed to 1/09/2018 (Ed., 8/1/18)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Haykowsky, Mark Ph.D. (University of Alberta) Martin, David B.A. (Wyle Laboratories, Inc.) Ploutz-Snyder, Lori Ph.D. (Universities Space Research Association) Ploutz-Snyder, Robert Ph.D. (Universities Space Research Association) Stenger, Michael Ph.D. (Wyle Laboratories, Inc.) Ozgur, Omar M.D. (New York Eye and Ear Infirmary) Hamilton, Scott M.B.A. (New York Eye and Ear Infirmary)		
Grant/Contract No.:	80NSSC17K0573 ; Internal Project		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	NOTE (Ed., 8/1/18): New grant 80NSSC17K0573 issued in August 2017 for this work when PI moved to Memorial Sloan Kettering Cancer Center in summer 2017; end date changed to 1/09/2018. CENTRAL OBJECTIVES: To date, 19 out of 25 long-duration crew members (76%) have experienced in-flight and/or post-flight vision changes. These changes define the visual impairment/intracranial pressure (VIIP) syndrome (Ed. note August 2018--now known as Spaceflight Associated Neuro-ocular Syndrome). Although the exact cause of VIIP is unknown at this time, it is suspected that the microgravity-induced shift in fluids from the lower body to the upper body (cephalad fluid shift) plays a significant role. This fluid shift, in turn, may cause an elevation in intracranial pressure (ICP) and intraocular pressure (IOP). Another factor that has been proposed to contribute to VIIP is exercise. Although moderate and high intensity aerobic or resistance exercise have clearly identified benefits for cardiac, muscle, and bone health, whether such exercise contributes to the development of VIIP is unknown. METHODS: Our overall goal is to characterize the impact of 3 exercise modalities used by astronauts on cerebral blood flow, ICP, and IOP. We propose to use head down tilt (HDT), a ground based analog that is well established to elicit similar cephalad fluid shifts as spaceflight. Subjects will undergo 3 HDT sessions: 1) HDT + resistance exercise, 2) HDT + moderate intensity aerobic exercise, and 3) HDT + high intensity aerobic exercise. During and following each HDT session cerebral blood flow, IOP, and ICP will be measured. SIGNIFICANCE: Information characterizing factors contributing to the VIIP syndrome is of fundamental importance for sustaining human presence in space and extending the exploration of our Solar system. NASA's Human Research Program (HRP) has therefore established risks and gaps related to determining the etiology of visual acuity and ocular structural and functional changes observed in- and post-flight, and identifying safe and effective countermeasure to mitigate changes in ocular structure and intracranial hypertension. This proposal addresses the NASA request for short-term proposals that could lead to novel breakthroughs addressing one or more risks and gaps. Our proposal is specifically relevant for: Risk of Spaceflight-Induced Intracranial Hypertension/Vision Alterations and the following Gaps: Gap VIIP1: What are the etiological mechanisms and contributing risk factors for ocular structural and functional changes seen in-flight and post-flight? Gap VIIP13: Identify preventative and treatment countermeasures to mitigate changes in ocular structure and function and intracranial pressure during spaceflight. It is expected that results from the proposed investigation will provide important information that could ultimately not only improve the well being of astronauts in microgravity and upon return to Earth, but could also enhance the well-being of numerous populations such as individuals with intracranial hypertension and glaucoma.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Research Impact: This project will provide essential data and methods to quantify the impact of exercise on ICP and IOP during a cephalad fluid shift. Additionally, results from this investigation will provide important information to protect the health and mission readiness of current International Space Station (ISS) crew and to safeguard the fitness of even longer duration astronauts for Moon and Mars missions. Earth Benefits: There is currently no evidence on concurrent cerebral and ocular hemodynamics and pressures during exercise in the upright or spaceflight analog conditions. This data will enable accurate assessment of exercise-induced differences in cerebral-ocular hemodynamics and pressures between exercise in a 1G environment and exercise in the spaceflight environment. It is expected that results from the proposed investigation will also provide information that could enhance the well-being of numerous clinical populations such as individuals with intracranial hypertension and glaucoma. We are also testing novel technology that could be used in clinical settings. Specifically, we evaluated acquisition of IOP continuously using a contact lens (Triggerfish, Sensimed), and the reliability and validity of a 3D imaging tool to quantify cephalad fluid shift induced facial edema. These tools could be applied to a patient being followed for thyroid eye disease, or a space occupying lesion such as an orbital tumor producing proptosis.
Task Progress:	Exercise normalized cephalad fluid shift-induced changes in cerebral-ocular hemodynamics and pressures. Manuscript is currently in final preparation stages for submission to peer-reviewed journal. Expected submission date to Proceedings of the National Academy of Sciences: September 2018.
Bibliography Type:	Description: (Last Updated: 09/05/2019)
Articles in Peer-reviewed Journals	Scott JM, Tucker WJ, Martin D, Crowell JB, Goetchius E, Ozgur O, Hamilton S, Otto C, Gonzales R, Ritter M, Newby N, DeWitt J, Stenger MB, Ploutz-Snyder R, Ploutz-Snyder L, Morgan B, Haykowsky MJ. "Association of exercise and swimming goggles with modulation of cerebro-ocular hemodynamics and pressures in a model of spaceflight-associated neuro-ocular syndrome." JAMA Ophthalmol. 2019 Jun 1;137(6):652-9. https://doi.org/10.1001/jamaophthalmol.2019.0459 ; PubMed PMID: 30998818 ; PubMed Central PMCID: PMC6567831 [Reported originally in Aug 2018 as "to be submitted" and in Other journals category] , Jun-2019