

Fiscal Year:	FY 2017	Task Last Updated:	FY 01/24/2018
PI Name:	Platts, Steven H. Ph.D.		
Project Title:	Effects of Long Duration Spaceflight on Venous and Arterial Compliance in Astronauts		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Cardiovascular Alterations Team		
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 (IRP Rev I)		
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	Congressional District:	36
Comments:			
Project Type:	FLIGHT,GROUND	Solicitation:	2012 Crew Health NNJ12ZSA002N
Start Date:	06/01/2013	End Date:	05/31/2017
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NSBRI
Contact Monitor:	Contact Phone:		
Contact Email:			
Flight Program:	Pre/Post Flight		
Flight Assignment:	ISS pre- and postflight NOTE: End date changed to 5/31/2017 per NSBRI (Ed., 1/27/16)		
Key Personnel Changes/Previous PI:			
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	<p>The overall objective of this study was to use non-invasive methodologies to investigate venous and arterial compliance in the head and neck and determine whether relationship existed between these cardiovascular parameters and the development of the spaceflight acquired neuro-ocular syndrome (SANS) in astronauts. The study included three separate but related research projects which address three specific aims.</p> <p>Specific Aim I: To determine whether previous spaceflight experience predisposes astronauts to lower venous compliance and/or the development of the spaceflight-associated neuro-ocular syndrome (SANS). This study was designed originally with an arm that sought to acquire ocular and cardiovascular parameters from astronauts completing a long-duration International Space Station (ISS) mission. During the course of the project, NASA's research priorities were realigned such that the flight portion of this study was removed from the flight queue. However, control data were collected in 7 astronauts who at the time of the study had not flown in space. The study designed was modified such that the test protocol included similar measures as an existing flight study (Fluid Shifts), allowing important comparisons between veteran astronauts and those without spaceflight experience. Also, these never-flown astronauts participated in two tests separated by 4-6 months to determine the stability of these measures across an interval similar to the duration of a long-duration ISS mission. While results from a veteran group of astronauts are not yet available from which to determine the effects of a prior spaceflight mission, importantly our data in never-flown astronauts suggest that our measures of arterial and venous compliance do not change over the same time frame as an ISS mission when subjects are not exposed to spaceflight.</p> <p>Specific Aim II: To evaluate the effect of 14-days of 6 degrees head-down tilt bed rest, a model of spaceflight, and aging on vascular compliance after using a test subject population similar to younger (25-35 yrs) and older (45-55 yrs) astronaut cohorts. Exposure to head-down tilt bed rest, a well-accepted analog to induce cardiovascular adaptations similar to spaceflight, has not resulted in findings representative of SANS that have been observed in some astronauts participating in long-duration ISS missions. Factors other than the cephalad fluid shift observed during spaceflight and bed rest have been hypothesized to contribute to the development of SANS but had not been tested. This bed rest study sought to investigate two of these, age and diet, with regard to vascular compliance and ocular measures. Specifically, 7 younger men and 4 older men participated in a 6 degrees head-down bed rest study under standard conditions, with the exception that a higher than normal sodium intake was prescribed to match the intake of ISS astronauts. Dietary sodium intake in this study was approximately 40% higher than in previous bed rest studies. For the majority of cardiovascular and ocular variables studied, there was no significant effect of bed rest. The bed rest-induced decrease in plasma volume did not appear to differ from plasma volume losses experience in other bed rest studies using standard dietary practices. Arterial diameters and flow were not different from pre- to post-bed rest at rest during the whole body tilting protocol (-20, -10, 0, +10, +20 degrees of tilt). Similarly, axial length and retinal nerve fiber layer were not different after bed rest. In contrast, internal jugular vein area was lower after bed rest in the head-down tilt postures, suggesting a decrease in venous compliance. This effect was transient and recovered to pre-bed rest levels after three days of normal ambulation. Unfortunately, we were unable to recruit a sufficient number of older subjects to test the interactions between aging and bed rest on the parameters studied. These results suggest that, even with a diet more closely matching that of astronauts during spaceflight, short-duration bed rest is not a good model for SANS. Future studies should address other factors specific to spaceflight which might produce a valid ground-based analog.</p> <p>Specific Aim III: To determine whether previous spaceflight experience or training in high performance jet aircraft predisposes astronauts to lower venous compliance and/or the development of the Vision Impairment and Intracranial Pressure (VIIP) syndrome. Cardiovascular and ocular data acquired from 41 astronauts during medically-required testing were released from the Lifetime Surveillance of Astronaut Health to the Cardiovascular and Vision Laboratory to test for associations between cardiovascular health, high performance aircraft exposures, and ocular findings. Unfortunately, data regarding high performance aircraft exposures were not of sufficient quality and quantity to include this factor in our analyses. Of all the associations tested between the Framingham Risk Score and ocular outcomes, the only association was with visual acuity. Given the age of the astronaut population, this may reflect aging-associated decrements in cardiovascular health and vision. These results, in combination with the other flight and ground-based studies conducted by our group, will inform the development and inflight testing of countermeasures against SANS.</p>
Task Description:	
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>Improved understanding of the role of compliance of vasculature in the head and neck with regard to ocular structure and function provides benefits for patients suffering from medical conditions with similar symptoms to spaceflight-acquired neuro-ocular syndrome (SANS) on Earth, including Idiopathic Intracranial Hypertension (IIH). While the features of SANS experiences by astronauts are not consistently present in the patient populations, the data acquisition, imaging, and data analysis techniques explored in the execution of this project will have applications beyond these studies.</p>
Task Progress:	<p>The objective of this study was to complete three separate but related studies to understand how cardiovascular health relate to pathogenesis of spaceflight-associated neuro-ocular syndrome (SANS). Experimentally, we tested the relation between SANS symptoms and vascular compliance in the upper body (head and neck): (1) in young and older men before and after bed rest when consuming a high sodium diet similar to that of ISS astronauts and (2) in astronauts who have never flown in space compared to those who have completed a long duration ISS mission. Additionally, we used data mining techniques to examine a large set of medical data from astronauts who have previously flown on a long- or short- duration mission and have an associated SANS outcome to attempt to identify factors which might predispose astronauts to developing VIIP/SANS.</p> <p>Bed Rest Study: Data collection for the bed rest study was completed before the closure of the Flight Analogs Research Unit at University of Texas Medical Branch (UTMB) in Galveston, TX, on December 31, 2014. A compressed schedule resulted in study of 13 rather than the planned 20 subjects. Data analysis for the bed rest data was completed during the last funded year of this grant.</p> <p>Astronaut Ground Study: The study of astronauts who have never flown in space will serve as a control arm for the NASA-funded flight study, Fluid Shifts Before, During and After Prolonged Space Flight and Their Association with Intracranial Pressure and Visual Impairment. In the final year of this study, we recruited 7 astronauts who had never flown to participate in the ground portion of this study. All 7 astronauts participated in testing on two separate occasions, separated by a ~4-6 months (roughly equivalent to a long-duration mission on ISS). Data analysis has been completed.</p> <p>Data Mining Study: Approval for the data mining study was received from the Johnson Space Center (JSC) Institutional Review Board (IRB) and the Longitudinal Surveillance of Astronaut Health (LSAH) Board. In the final year of this</p>

study, a Johnson Space Center biostatistician analyzed in-flight and post-flight ocular outcomes to determine whether any relationships exists with cardiovascular health parameters. Preliminary results from the Bed Rest Study and the Data Mining Study were reported at the 2016 Human Research Program (HRP) Investigators' Workshop. Results from the Astronaut Ground Study will be reported at the 2017 HRP Investigators' Workshop.

Bibliography Type:

Description: (Last Updated: 03/01/2018)