Fiscal Year:	FY 2018	**Task Last Updated:**	FY 12/19/2017
PI Name:	Fuller, Charles A. Ph.D.		
Project Title:	Head-Down Tilt as a Model for Intracranial and Intraocular Pressures, and Retinal Changes during Spaceflight		
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) **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:	95616-5270	**Congressional District:**	3
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2011 Crew Health NNJ11ZSA002NA
Start Date:	02/01/2013	**End Date:**	12/30/2018
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:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 12/30/2018 per H. Paul/JSC HRP (Ed., 12/22/17) NOTE: End date changed to 12/31/2017 per NSSC information (Ed., 4/20/2016) NOTE: End date will be 6/30/2017 per R. Brady/JSC HRP (Ed., 11/3/15)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Hoban-Higgins, Tana Ph.D. (University of California, Davis) Murphy, Christopher Ph.D. (University of California, Davis) Robinson, Edward Ph.D. (University of California, Davis) Gompf, Heinrich Ph.D. (University of California Davis)		
Grant/Contract No.:	NNX13AD94G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	This ground-based program is intended to address the etiology of visual system structural and functional changes observed in astronauts during both inflight and postflight periods. Using the well-documented rat hindlimb suspension (HLS) model, functionally equivalent to human head-down bedrest, we will examine the relationship between cephalic fluid shifts resulting from long-duration G-unloading and the regulation of intracranial and intraocular pressures, as well as the effects these same cephalic fluid shifts have on visual system structure and function. Animals will be chronically instrumented with biotelemetry to continuously measure intracranial pressure. Additionally, regular intraocular pressure measurements will be made by tonometry during long-term exposure to cephalic fluid shifts induced by suspension. MRI images visualizing the visual system morphology will also be collected from HLS and control animals at regular intervals. Retinal morphology and ultrastructure will be examined at specified intervals both during HLS and post-HLS recovery by both ophthalmic examinations and tissue histology evaluation. Changes in retinal/visual function will be regularly assessed electrophysiologically by measuring visual evoked potentials and electroretinograms. This program will utilize both male and female subjects in order to examine possible gender differences in these responses. We will also examine the possible contributory factors of aging and elevated atmospheric carbon dioxide (hypercapnia) on to these responses of the visual system. Further, in addition to mimicking the effects of long duration exposure to microgravity through the use of the HLS model, we will examine the responses of our measured outcomes during long-term recovery in the post-HLS period. Collectively, these data will help allow us to develop a model to both understand and predict the etiology of changes in visual structure and function in astronauts exposed to the microgravity of spaceflight and during postflight recovery. In summary, our ultimate goal is to develop a translational mammalian model by which the data generated using this model can facilitate the development of countermeasures to alleviate any visual system decrements arising from exposure to the microgravity spaceflight environment.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This research has the potential to help further our understanding of chronic cephalic fluid shifts on neurological and ophthalmic health. No innovative technologies have been developed during this period.
Task Progress:	This ground-based program, intended to address the etiology of visual system structural and functional changes observed in astronauts during both inflight and postflight periods utilizes the well-documented rat hindlimb suspension (HLS) model. This model is functionally equivalent to human head-down bedrest. This project examines the relationship between cephalic fluid shifts resulting from long-duration G-unloading and the regulation of intracranial and intraocular pressures, as well as the effects these same cephalic fluid shifts have on visual system structure and function. A proposal examining additional histological and genetic effects was integrated into our protocol, adding these measures. Data are collected from animals in long-term HLS and controls. In order to measure intracranial pressure, animals are chronically instrumented with biotelemetry. The biotelemetry transmitter also allows for the collection of body temperature and activity data. Additional data collected include intraocular pressure measured by tonometry and MRI images encompassing brain and visual system morphology. Retinal morphology and ultrastructure are also being examined at specified intervals both during HLS and post-HLS recovery by both ophthalmic examinations and tissue histology evaluation. Both male and female subjects are studied in order to examine possible gender differences in these responses. Additionally, we are examining the possible contributory factors of aging and elevated (1%) atmospheric carbon dioxide (hypercapnia) on to these responses of the visual system. Further, in addition to mimicking the effects of long duration exposure to microgravity through the use of the HLS model, we are examining the responses of our measured outcomes during long-term recovery in the post-HLS period. Collectively, these data will help allow us to develop a model to both understand and predict the etiology of changes in visual structure and function in astronauts exposed to the microgravity of spaceflight and during postflight recovery. In summary, our ultimate goal is the development of a translational mammalian model; the data generated using this model would be used to facilitate the development of countermeasures to alleviate any visual system decrements arising from exposure to the microgravity spaceflight environment. We utilized biotelemetry to record intracranial pressure. This required the review and testing of three biotelemetry systems, all of which claimed to allow continuous recording of biological pressure. To improve the ease and accuracy of data collection as well as to tailor the system to meet the needs of this research program, we have extensively revised the data acquisition software. Biotelemetry data have been collected from the young male, young female, and older male cohorts and is currently being collected from the older male hypercapnic cohort. Additional measurements of visual system function including complete ophthalmic clinical exams and measurement of intraocular pressure by tonometry have been performed. These will be complemented by tissue histology studies. The retinal imaging performed during this program included both fundus imaging with fluorescein angiography and OCT. During this period of performance, the research team has concluded the collection of data from cohorts of: young males, young females (to examine possible gender differences), and older males (to examine possible age effects). The older male cohort currently presents the most significant response to HLS and is currently under study in a hypercapnic environment (similar to that experienced on the ISS-International Space Station). This will allow us to determine if there is a role of increased CO_2 exposure in the etiology of these visual changes. This program is aimed at determining if long-term cephalic fluid shift can cause the effects seen on visual system structure and function during and after long-duration spaceflight. As such, animals were exposed to HDT (head down tilt) for a longer period of time than is utilized in most studies. We will continue to work with the Biospecimen Sharing Program at Ames Research Center to ensure that tissues not utilized in our analyses are available for other researchers, thus increasing the science yielded by this program.
Bibliography Type:	Description: (Last Updated: 10/09/2024)

Abstracts for Journals and Proceedings	Fuller CA, Gompf H, Hoban-HigginsTM, Robinson EL. "Hindlimb Suspension as a Model for Intracranial and Intraocular Pressures, and Retinal Changes During Spaceflight." Presented at the Experimental Biology 2017, Chicago, IL, April 22-26, 2017. FASEB J. 2017 Apr;31(1 Suppl):711.3. See also http://www.fasebj.org/content/31/1_Supplement.toc for searching. , Apr-2017