Fiscal Year:	FY 2022	**Task Last Updated:**	FY 06/21/2022
PI Name:	Marshall-Goebel, Karina Ph.D.		
Project Title:	Mechanical and Gravitational Countermeasures to Ocular Changes During Strict Head-Down Tilt Bedrest		
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) **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:	77058	**Congressional District:**	36
Comments:	New affiliation as of spring 2022: NASA Johnson Space Center; Human Physiology, Performance, Protection & Operations (H-3PO) Laboratory New affiliation as of fall 2018: KBR/NASA Johnson Space Center, Cardiovascular and Vision Laboratory, Houston; previously at Massachusetts General Hospital		
Project Type:	Ground	**Solicitation / Funding Source:**	Directed Research
Start Date:	08/21/2020	**End Date:**	08/01/2022
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:	Brocato, Becky	**Contact Phone:**	
Contact Email:	becky.brocato@nasa.gov		
Flight Program:			
Flight Assignment:	End date changed to 08/01/2022 as Dr. Brandon Macias took over this project in August 2022. Original end date was 08/20/2024 (Ed., 8/30/22)		
Key Personnel Changes/Previous PI:	NOTE: P.I. changed to B. Macias effective 08/26/2022. For subsequent reporting, please see "Mechanical and Gravitational Countermeasures to Ocular Changes During Strict Head-Down Tilt Bedrest (PI: Macias)". (Ed. 8/30/2022) June 2022 report: CoInvestigators Alan Hargens, Jessica Jasien, and Benjamin Levine are no longer with the project (Ed., 7/22/22).		
COI Name (Institution):	Brunstetter, Tyson O.D., Ph.D. (NASA Johnson Space Center) Huang, Alex M.D., Ph.D. (Doheny Eye Institute) Kramer, Larry M.D. (University of Texas Health Science Center at Houston) Laurie, Steven Ph.D. (KBR/NASA Johnson Space Center) Lee, Stuart Ph.D. (KBR/NASA Johnson Space Center) Lovering, Andrew Ph.D. (University of Oregon) Martin, Bryn Ph.D. (Alcyone Therapeutics Inc.) Young, Millennia Ph.D. (NASA Johnson Space Center) Lytle, Jason (KBR/NASA Johnson Space Center)		

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Grant/Contract No.:	Directed Research
Performance Goal No.:	
Performance Goal Text:	
Task Description:	The Spaceflight Associated Neuro-ocular Syndrome (SANS) is associated with structural and functional ocular and brain changes and develops in ~2/3rds of astronauts during long-duration spaceflight. Although the etiology of SANS is unknown, a weightlessness-driven headward fluid redistribution relative to the upright position on Earth is hypothesized to be a primary initiating factor. A countermeasure that can successfully reverse this headward fluid shift for multiple hours per day may be needed to prevent SANS. Exposure to 30 days of the spaceflight analog strict 6 degree head-down tilt (HDT) bedrest induces the development of optic disc edema, a hallmark sign of SANS, in 2/3 of subjects; thus, NASA will utilize this platform to test the effectiveness of various countermeasures to prevent or reduce the development of SANS findings. This study will include a control group exposed to 30 days of strict 6 degree HDT. A second group of subjects will be exposed to 6 hours of 25 mmHg lower body negative pressure (LBNP), daily, during 30 days of strict 6 degree HDT bedrest. A third group of subjects will be exposed to 6 hours of upright posture per day, and 6 degree HDT for the remaining 18 h/day. This will help determine if daily exposure to 6 hours total of upright posture, fully reversing the headward fluid for the same duration of use as the LBNP group, is sufficient to prevent SANS findings, and thus can direct future countermeasure studies with respect to the duration needed to successfully prevent SANS. We will assess multiple cerebral, vascular, and ocular outcome measures to determine the effects of 30 days strict 6 degree HDT bedrest, and the ability of daily 6 hour exposure to LBNP or upright positioning to prevent these changes. Specific Aims: 1. To determine if daily exposure to actual (upright posture) and simulated (LBNP) hydrostatic pressure gradients prevents ocular and cerebral structural changes during 30 days of strict 6° head-down tilt bedrest. 2. To determine if daily exposure to actual (upright posture) and simulated (LBNP) hydrostatic pressure gradients prevents ocular functional changes during 30 days of strict 6° head-down tilt bedrest. 3. To determine if daily exposure to actual (upright posture) and simulated (LBNP) hydrostatic pressure gradients prevents vascular and cerebrospinal fluid changes during 30 days of strict 6° head-down tilt bedrest. This bedrest study will be implemented in the :envihab facility at the German Aerospace Center (DLR) in Cologne, Germany.
Rationale for HRP Directed Research:	The Element recommended this task be implemented as a directed task due to the highly constrained nature of this research, which brings to maturation work that was recently completed in a precursor study (the Venous Congestion Countermeasure Study, VCCM). In the VCCM study, this combined team of investigators, comprised of Johnson Space Center (JSC) personnel and external experts, tested different combinations of mechanical countermeasures in a laboratory setting of acute posture changes in order to determine the most efficacious mechanical countermeasure. The identified countermeasure now needs to be tested on subjects exposed to 30-days of strict 6º head-down tilt (HDT) bedrest, with an expectation that this will ultimately lead to testing of the countermeasure during spaceflight. Time constraints are a secondary rationale, as the bedrest study is slated to start in the spring of 2021, and NASA's Research Operations Integration Element requires the proposed science immediately in order to finalize implementation.
Research Impact/Earth Benefits:	Data collection has been completed for campaigns 1 (September-November 2021) and 2 (January-March 2022) of this bedrest study (n = 23, including 12 LBNP countermeasure subjects and 11 upright posture countermeasure subjects). In this reporting period, personnel from the Cardiovascular and Vision Laboratory (CVL) traveled to the German Aerospace Center (DLR) to provide in-person training sessions to DLR staff and to oversee baseline data collection (BDC) on the 12 subjects who participated in the first campaign of the study. Due to unforeseen issues with the Dynamic Vessel Analyzer (DVA) hardware that resulted in the company being unable to train DLR staff prior to BDC as planned, a CVL team member collected all BDC data on the 12 subjects and then returned to DLR on an additional unplanned trip to collect recovery day 2 data (R+2) and continue training DLR staff to perform DVA measurements so that they could successfully collect data on R+12. Data analysis for campaign 1 (n=6 LBNP subjects, n=6 upright posture countermeasure subjects) is complete; data analysis for campaign 2 is ongoing (n=6 LBNP subjects, n=5 upright posture countermeasure subjects). In addition to the originally planned data analyses, we supported the analysis of lower body negative pressure (LBNP) environmental and physiological data. We also streamlined the data analysis workflow to improve efficiency of data organization and subsequent analysis for the large volume of data generated in the study.
Task Progress:	NOTE: P.I. changed to B. Macias effective 08/26/2022. For subsequent reporting, please see "Mechanical and Gravitational Countermeasures to Ocular Changes During Strict Head-Down Tilt Bedrest (PI: Macias)". (Ed. 8/30/2022) June 2022 Report: Data collection has been completed for campaigns 1 (September-November 2021) and 2 (January-March 2022) of this bedrest study (n = 23, including 12 LBNP countermeasure subjects and 11 upright posture countermeasure subjects). In this reporting period, personnel from the Cardiovascular and Vision Laboratory (CVL) traveled to the German Aerospace Center (DLR) to provide in-person training sessions to DLR staff and to oversee baseline data collection (BDC) on the 12 subjects who participated in the first campaign of the study. Due to unforeseen issues with the Dynamic Vessel Analyzer (DVA) hardware that resulted in the company being unable to train DLR staff prior to BDC as planned, a CVL team member collected all BDC data on the 12 subjects and then returned to DLR on an additional unplanned trip to collect recovery day 2 data (R+2) and continue training DLR staff to perform DVA measurements so that they could successfully collect data on R+12. Data analysis for campaign 1 (n=6 LBNP subjects, n=6 upright posture countermeasure subjects) is complete; data analysis for campaign 2 is ongoing (n=6 LBNP subjects, n=5 upright posture

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Bibliography Type:	Description: (Last Updated: 07/14/2025)