Fiscal Year:	FY 2016	**Task Last Updated:**	FY 08/02/2015
PI Name:	Goel, Namni Ph.D.		
Project Title:	Biomarkers as Predictors of Resiliency and Susceptibility to Stress in Space Flight		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline-- Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	60612	**Congressional District:**	7
Comments:	NOTE: Formerly at the University of Pennsylvania until July 2019.		
Project Type:	GROUND	**Solicitation / Funding Source:**	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	10/01/2014	**End Date:**	09/30/2017
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	1
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	3
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	N/A		
COI Name (Institution):	Abel, Ted Ph.D. (University of Pennsylvania) Basner, Mathias M.D., Ph.D. (University of Pennsylvania) Bhatnagar, Seema Ph.D. (Children's Hospital of Philadelphia) Dinges, David Ph.D. (University of Pennsylvania) Kirkpatrick, James M.D. (Hospital of the University of Pennsylvania) Weljie, Aalim Ph.D. (University of Pennsylvania)		
Grant/Contract No.:	NNX14AN49G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	This proposal is responsive to the NASA Behavioral Health and Performance gap (BMed5) to find individual characteristics that predict successful adaptation and performance in an isolated, confined, and extreme environment, especially for long duration missions. The project also relates to Human Research Program (HRP) Sleep Gap 4 to identify indicators of individual susceptibilities and resiliencies to sleep loss and circadian rhythm disruption, to aid with individualized countermeasure regimens, for autonomous, long duration, and/or distance exploration missions. The proposal is also responsive to BMed 1 and BMed 2, and Sleep Gap 2 and Sleep Gap 9. To address these gaps, this proposal will assess biomarkers as predictors of resiliency and susceptibility (individual differences) to performance stress and sleep loss using the HRP Human Exploration Research Analog (HERA) and the Hawaii Space Exploration Analog and Simulation (HI-SEAS) high fidelity space analog facilities. We will conduct a ground-based experiment—strongly anchored in our previous laboratory-based research—on N=32 healthy men and women (ages 26-55) in the HERA facility (short-duration analog) and on N=6 healthy men and women (ages 21-65) in the HI-SEAS facility (long-duration analog) to determine the predictive validity of a set of relevant, valid, and reliable biomarkers for distinguishing those who are more resilient versus those who are more susceptible to the adverse neurobehavioral effects of the combination of high performance demands and total sleep deprivation (TSD) stressors—two conditions commonly experienced in space flight. These biomarkers include the following: cardiovascular measures (blood pressure, heart rate, and heart rate variability, stroke volume and cardiac output), salivary cortisol, catecholamines (dopamine, noradrenaline, and adrenaline), an inflammatory marker (C Reactive Protein; CRP), metabolomic markers (via unbiased metabolomics), and microRNAs (epigenetic markers). The project deliverable will be a countermeasure (set of diverse biomarkers) for distinguishing those who are more resilient versus those who are more susceptible to the adverse neurobehavioral effects of high performance demands and sleep loss stressors. If valid markers of such susceptibility can be found, it will be possible to optimize and individualize crew resources, and mitigate stress and other behavioral health and performance risks autonomously during long-duration space flight.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The project's research will deliver a countermeasure (set of diverse biomarkers) for distinguishing those who are more resilient versus those who are more susceptible to the adverse neurobehavioral effects of high performance demands and sleep loss stressors. If valid markers of such susceptibility can be found, it will be possible to optimize and individualize crew resources, and mitigate stress and other behavioral health and performance risks autonomously during long-duration space flight. This information would also be of use on Earth in applied occupations that demand similar risks and stressors.
Task Progress:	We have successfully integrated the complex, multifaceted five-day stress and sleep loss experiment into HERA. We have successfully collected data in the first three missions of 2015 (N=12 subjects). This includes the following biomarkers: blood markers from 6 time points in 12 subjects (72 blood markers); 2 saliva markers each from 6 time points in 12 subjects (144 saliva markers); blood pressure markers from 6 time points in 12 subjects (72 blood pressure markers); stroke volume from 6 time points in 12 subjects (72 stroke volume markers); cardiac output from 6 time points in 12 subjects (72 cardiac output markers); and heart rate from 6 time points in 12 subjects. [70 heart rate markers-- two heart rate monitor data points (one each from two different crew members) were not collected due to the crewmembers mistakenly not turning the heart rate device on. However, we can use heart rate collected from the echocardiography and/or blood pressure devices, as needed.] We also have 11 neurobehavioral tests for 12 subjects (132 neurobehavioral tests). Finally, we have continuous actigraphy data on N=12 subjects for 14-days each (a total of 168 days of actigraphy). The last mission of 2015 will begin in August. It is projected that biomarker, neurobehavioral, and actigraphy data collection will continue successfully and by the end of the mission we will data from a total of N=16 subjects.
Bibliography Type:	Description: (Last Updated: 09/28/2023)
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