Fiscal Year:	FY 2021	**Task Last Updated:**	FY 08/16/2020
PI Name:	Reschke, Millard F Ph.D.		
Project Title:	Recovery of Functional Performance Following Long Duration Space Flight (Field Test)		
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) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) **Sensorimotor**:Risk of Altered Sensorimotor/Vestibular Function Impacting Critical Mission Tasks		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058-3607	**Congressional District:**	36
Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/22/2013	**End Date:**	06/30/2022
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
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Flight Program:	PostFlight		
Flight Assignment:	ISS Postflight studies NOTE: End date changed to 6/30/2022 per HHC (Ed., 6/28/2022)		
Key Personnel Changes/Previous PI:	August 2020 report: Inessa Kozlovskaya.passed this past February and was replaced with Elena Tomilovskaya as the Russian Co-Principal Investigator (PI). Jacob Bloomberg retired in September 2019 and was replaced with Scott Wood as Co-Investigator. Michael Stenger moved to a new science management position within Human Research Program (HRP) and was replaced by Stuart Lee as the lead of the Specific Aim 3 compression garment evaluation.		
COI Name (Institution):	Tomilovskaya, Elena Ph.D. (Institute of Biomedical Problems, Moscow) Rosenberg, Marissa Ph.D. (KBR/NASA Johnson Space Center JSC Neuroscience Laboratory) Lee, Stuart Ph.D. (KBR/NASA Johnson Space Center Cardiovascular and Vision Laboratory) Wood, Scott Ph.D. (NASA Johnson Space Center/Neuroscience Laboratory)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The Field Test (FT) proposal represents a joint effort between the Neuroscience and Cardiovascular Laboratories at the Johnson Space Center and the Institute of Biomedical Problems Sensorimotor Laboratory and Cardiovascular Laboratory, Moscow, Russia. The primary goal of this proposal is to determine functional performance in long-duration space flight crews beginning as soon after landing as possible (< 2 hr) with one to three immediate follow-up measurements on the day of landing. This goal has both sensorimotor and cardiovascular elements with an evaluation of NASA's new compression garment with the Russian traditional Kentavr garment. In addition to the immediate post-landing collection of data, post-flight data was acquired at several timepoints on landing day to characterize recovery to preflight baseline levels. Clearly measurable performance parameters such as the ability to perform a seat egress, recover from a fall or the ability to see clearly when walking, and related physiological data (orthostatic responses) are required to provide an evidence base for characterizing programmatic risks and variability among crewmembers. Overall, these early functional and related physiological measurements will allow for the establishment of a sensorimotor and cardiovascular recovery time constant that has not been previously captured in over 50 years of space flight. Specific Aims: 1. Quantify functional performance from measurements on long-duration crewmembers taken as close in time to landing as possible. 2. Develop a recovery timeline of functional performance on long-duration crewmembers. 3. Determine the efficacy of U.S. and Russian compression garments as countermeasures for alleviating orthostatic intolerance.
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research, which requires focused and constrained data gathering and analysis that is more appropriately obtained through a non-competitive proposal.
Research Impact/Earth Benefits:	Vestibular and sensorimotor alterations represent one of the greatest clinical challenges impacting crew activities following G-transitions. In order to capture the initial decrements in performance, we successfully developed a portable set of measures and recording instrumentation that was compatible with relatively harsh environments. The fall risks on Earth associated with vestibular and sensorimotor impairment are underestimated largely due to the lack of testing available to the general population. The National Institutes of Health has been actively funding efforts to develop a Toolbox of field measures for the vestibular, vision, and motor sensory domains. We propose that the portable measures validated during our Field Tests will be beneficial for the broader characterization of how vestibular and sensorimotor deficits contribute to fall risks on Earth.
Task Progress:	Following the transition of landing site data collection to the Standard Measures project, the Field Test was extended to complete data collection and analysis with the Russian cosmonauts. During this reporting period, the final three Russian subjects completed the Field Test (FT) following the 58S, 59S, and 61S Soyuz landings. Together the NASA and Russian teams collected data on a total of 38 different United States Orbital Segment (USOS) and Russian crewmembers in both the pilot and full Field Test, with 7 Russian crewmembers being tested twice (total of 45 tests). Eighteen subjects (7 Russian, 11 USOS) completed the reduced FT (pilot) protocol and 27 subjects (16 Russian and 11 USOS) participated in the full FT. Of the full FT, two (1 Russian, 1 USOS) were one-year mission crewmembers and one (USOS) was on orbit for 9 mo. Lee et al. (Front Physiol, 2020--see Bibliography section) published the results of the portion of FT designed to demonstrate the ability of a lower body gradient compression garment (GCG) to protect against an excessive increase in heart rate and a decrease in blood pressure during standing after long-duration spaceflight. In this manuscript, they presented the results of the eleven USOS astronauts (9 M, 2 F) that completed the full FT protocol. The stand test protocol consisted of 2 min of prone rest followed by 3.5 min of standing. Subjects completed one familiarization session and two preflight data collection sessions in standard clothing. Three tests on landing day while wearing GCG were conducted 1-4 h (R+0A), ~12 h (R+0B), and ~28 h after landing (R+0C). All astronauts completed the stand test preflight. Three astronauts were unable to attempt the stand test at R+0A, and one of these was unable to start the test at R+0B. One astronaut was unable to complete 3.5 min of standing at R+0B (test ended at 3.3 min). A review of the individual's blood pressure data revealed no hypotension but the astronaut reported significant motion sickness. Of the astronauts who participated in testing on landing day, the heart rate and mean arterial pressure responses to standing (stand-prone) were not different than preflight at any of the postflight sessions. Therefore, wearing the GCG after space flight prevented the tachycardia that normally occurs while standing after space flight without compression garments and protected against a decrease in blood pressure during a short stand test. A special issue of the Russian journal Aerospace and Environmental Medicine (Aviakosmicheskaia i ekologicheskaia meditsina) is pending publication to honor the Co-PI of the FT, our long-time colleague Dr. Inessa Kozlovskaya, who passed away in February 2020. In this issue, Reschke et al. (see Bibliography section) summarize the FT methodology, which has provided the basis for the sensorimotor portion of the Standard Measures which will be conducted through the remainder of the International Space Station (ISS) program. As an example of the functional deficits observed, Reschke et al. (Aersop Environ Med, 2020) presented results for 38 FT subjects on the seat egress and walking task that involved turning 180 degrees and stepping over obstacles. Significant increases in the time-to-complete this task on landing day were observed. The differences were greatest for the first trial using the 5 cm obstacle ($t(37)= 10.5$, $p<0.01$) but were also highly significant for the 10 cm ($t(37)= 8.0$, $p<0.01$) and 15 cm obstacles ($t(37)= 7.6$, $p<0.01$). The greater difference for the 5 cm obstacle was likely due to the fact that this was the first trial. This task referred to as the Walk and Turn with Obstacle has recently been added to the Standard Measures protocol. The completion of the data analysis and publications has been impacted by COVID-19 related delays in receiving the final set of Russian data. This transfer is expected during the upcoming fall (2020). A major focus of the analysis this past year has been on characterizing the time course of recovery of three measures that were included in both pilot and full FT protocols. We anticipate the draft manuscript describing these results to be submitted in the early portion of FY21.

Bibliography Type:	Description: (Last Updated: 06/28/2023)
Abstracts for Journals and Proceedings	Reschke MF, Bloomberg JJ, Tomilovskaya ES, Peters BT, Rosenberg MJ, Clément G, Wood SJ, Kozlovskaya IB. "Countermeasures for vestibular and sensorimotor disturbances as NASA, Russia and other international space flight programs prepare for lengthy missions." 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. Abstracts. 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. , Jan-2020
Articles in Other Journals or Periodicals	Reschke MF, Kozlovskaya IB, Lysova N, Kitov V, Rukavishnikov I, Kofman IS, Tomilovskaya ES, Rosenberg MJ, Osetsky N, Fomina E, Grishin A, Wood SJ. "Joint Russian-USA Field Test: Implications for deconditioned crew following long duration spaceflight." Aviakosm Ekolog Med. 2020; in press. , Oct-2020
Articles in Peer-reviewed Journals	Lee SMC, Ribeiro LC, Laurie SS, Feiveson AH, Kitov VV, Kofman IS, Macias BR, Rosenberg M, Rukavishnikov IV, Tomilovskaya ES, Bloomberg JJ, Kozlovskaya IB, Reschke MF, Stenger MB. "Efficacy of gradient compression garments in the hours after long-duration spaceflight." Front Physiol. 2020 Jul 17;11:784. https://doi.org/10.3389/fphys.2020.00784 ; PMID: 32765292; PMCID: PMC7379894 , Jul-2020