Y	777.0011			
Fiscal Year:	FY 2011	Task Last Updated:	FY 03/25/2011	
PI Name:	Perusek, Gail M.S.			
Project Title:	A New Harness For Use with Exercise Countermeasures for Space Medicine (CSM) Harness	s-Validation of Improved Comfor	t and Loading with the Center	
Division Name:	Human Research			
Program/Discipline:	HUMAN RESEARCH			
Program/Discipline Element/Subdiscipline:	HUMAN RESEARCHBiomedical countermeasures			
Joint Agency Name:		TechPort:	Yes	
Human Research Program Elements:	(1) HHC :Human Health Countermeasures			
Human Research Program Risks:	(1) Muscle:Risk of Impaired Performance Due to Reduc	ed Muscle Size, Strength and End	lurance	
Space Biology Element:	None			
Space Biology Cross-Element Discipline:	None			
Space Biology Special Category:	None			
PI Email:	Gail.P.Perusek@nasa.gov	Fax:	FY	
PI Organization Type:	NASA CENTER	Phone:	216-433-8729	
Organization Name:	NASA Glenn Research Center			
PI Address 1:	21000 Brookpark Road			
PI Address 2:	ISS and Human Research Project Office			
PI Web Page:				
City:	Cleveland	State:	ОН	
Zip Code:	44135	Congressional District:	10	
Comments:				
Project Type:	FLIGHT	Solicitation / Funding Source:	Directed Research	
Start Date:	02/28/2008	End Date:	03/31/2011	
No. of Post Docs:	0	No. of PhD Degrees:	3	
No. of PhD Candidates:	0	No. of Master' Degrees:	2	
No. of Master's Candidates:	1	No. of Bachelor's Degrees:	0	
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC	
Contact Monitor:	Norsk, Peter	Contact Phone:		
Contact Email:	Peter.norsk@nasa.gov			
Flight Program:	ISS			
	ISS Increment 20/21-25			
	NOTE: Change in Risks/Gaps per HRR information per IRP Rev E (Ed., 3/7/14)			
Flight Assignment.	NOTE: Change in Risks/Gaps per HRR information (Ed., 9/26/2011)			
r ngut Assignillent.	NOTE: End date changed to 3/31/2011 (from 9/1/2011) per discussion with PI (Ed., 2/25/2011)			
	NOTE: start/end dates changed per JSC info $(3/1/10)$			
	NOTE: start/end dates changed per JSC into $(4/2)/(09)$			
Key Personnel Changes/Previous PI:				
COI Name (Institution):	Owings, Tammy (Cleveland Clinic)			
Grant/Contract No.:	Directed Research			
Performance Goal No.:				
Performance Goal Text:				

Task Description:	This Station Development Test Objective (SDTO) assesses whether crewmembers can exercise more comfortably and at higher loads using a new treadmill harness developed through the Center for Space Medicine (CSM) and identified as the CSM Harness, as compared to the existing International Space Station (ISS) treadmill harness. The hypotheses are as follows: i) the CSM Harness will provide greater overall comfort than the current U.S. Treadmill with Vibration Isolation and Stabilization System (TVIS) harness (hereafter referred to as the ISS treadmill harness); ii) crewmembers will be able to tolerate higher external loads from the subject load device and/or Series Bungee System (SBS) Bungees; iii) load distribution measurements collected with strain-gage-based buckle transducer instrumentation between shoulders and higs will correlate with subjective measures of comfort; and iv) the CSM Harness will provide more effective wear and adjustability (easier adjustments, and adjustments will stay fixed once they are set, breathable biocide outer fabric, etc.). The CSM Harness design has potential to improve comfort, wear, and adjustment effectiveness on-orbit. To support this SDTO, NASA Glenn Research Center (GRC) delivered seven (7) flight-certified CSM Harnesses with buckle transducer instrumentation and the instrumentation for 7 ISS treadmill harnesses plus spares. The buckle transducer instrumentation will converge at a junction box, which shall interface with the Ambulatory Data Acquisition System (ADAS) for data recording. The ADAS has previously flown as payload hardware sponsored by the ISS Medical Project (ISSMP) for the Foot Experiment (Experiment Identifier: #96-E318, ISS Expeditions 6, 8, 11, 12) and will be provided by ISSMP. Subject loading data will be collected for eight total sessions in-flight (4 with each harness) with each of five subjects as part of this SDTO. For these 8 sessions, a unique harness evaluation protocol will be followed for the crewmembers' nominal treadmill exercise session.	
Rationale for HRP Directed Research:		
Research Impact/Earth Benefits:	Improved harnessing may be utilized in ground-based simulators (e.g., the enhanced Zero-gravity Locomotion Simulator at NASA Glenn and/or the standalone Zero-gravity Locomotion Simulator at University of Texas Medical Branch) for human test subjects research including bed rest studies. Improved harnessing may improve crewmember comfort during treadmill exercise aboard the International Space Station, reduce chafing, bruising, scarring experienced currently. Improved comfort may allow crewmembers to run more readily at full body-weight on the subject loading system, thus potentially improving benefit of exercise and musculoskeletal health.	
Task Progress:	The on-orbit treadmill harness Station Development Test Objective (SDTO) evaluation ran from Increment 21 through 25 aboard the International Space Station (September 2009 through November 2010). A total of six (6) crewmembers participated in the protocol. One (1) crewmember opted out of the protocol voluntarily. Debrief sessions have occurred per nominal procedures. All crewmembers completed questionnaires after select sessions (typically every 3rd or 4th exercise session) which included a modified Borg scale for pain (0-10 scale, 10 being worst imaginable pain) for each harness in specific body areas (neck, shoulders, back, hips, waist, and overall), perceived load ratio (% load at hip vs. % load at shoulders), perceived total load, narrative responses relating to harness fit and comfort, and nine (9) questions relating to harness performance and effectiveness as ranked on a Likert scale (1 to 5, strongly disagree to strongly agree). As a top-level summary, questionnaire responses and crew debriefs confirmed that overall, one (1) crewmembers preferred the ISS Treadmill harness, one (1) crewmember expressed no preference, and four (4) crewmembers preferred the Center for Space Medicine (CSM) harness. Note the Operational Nomenclature designation for the CSM harness was changed to "Glenn Harness." Load data were captured for 3 of 6 crewmembers, issues that arose were troubleshot and fixed. Post-flight inspections of returned Glenn Harnesses (n=3) showed that they held up well to wear and tear. Overall, the Glenn Harness compared favorably in this on-orbit side-by-side comparison as measured by the crew comfort questionnaire and crew debriefs. Specific areas for improvement have been identified, and forward recommendations will be provided to the Human Research Program. The protocol developed for the SDTO provided valuable insight into crew comfort issues, design improvements, and loading preferences for exercise harnessing, and lays the groundwork for better harnessing systems and training protocols.	
Bibliography Type:	Description: (Last Updated: 08/30/2018)	
Abstracts for Journals and Proceedings	Perusek GP, Sheehan CC, Savina MC, Owings TM, Ryder JW. "On-orbit evaluation of a new treadmill harness for improved crewmember comfort and load distribution: Results from ISS Increments 21 thru 25." Presented at the 18th IAA Humans in Space Symposium, Houston, TX, April 11-15, 2011. 18th IAA Humans in Space Symposium, Houston, TX, April 11-15, 2011. , Apr-2011	
Abstracts for Journals and Proceedings	Perusek GP, Sheehan CC, Savina MC, Gilkey KM, Novotny SC, Kuklis MM, Milstead JR, Henley BC, Streicher MC, Davis BL. "A new harness for use with exercise countermeasures: Validation of improved comfort and loading with the Center for Space Medicine harness." Presented at the 2009 NASA Human Research Program Investigators' Workshop, League City, TX, February 2-4, 2009. 2009 NASA Human Research Program Investigators' Workshop, League City, TX, February 2-4, 2009. Abstract #1007. , Feb-2009	

Articles in Peer-reviewed Journals	Novotny SC, Perusek GP, Rice AJ, Comstock BA, Bansal A, Cavanagh PR. "A harness for enhanced comfort and loading during treadmill exercise in space." Acta Astronaut. 2013 Aug-Sep;89:205-14. http://dx.doi.org/10.1016/j.actaastro.2013.03.010, Aug-2013
Awards	Sheehan CC, Perusek GP. "Silver Snoopy (Astronauts' Personal Achievement Award), October 2009." Oct-2009