Fiscal Year:	FY 2017	**Task Last Updated:**	FY 09/12/2016
PI Name:	Bouxsein, Mary Ph.D.		
Project Title:	Vertebral Strength and Fracture Risk following Long Duration Spaceflight		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Dynamic Loads**:Risk of Injury from Dynamic Loads (3) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	02215-5400	**Congressional District:**	7
Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	2014-15 HERO NNJ14ZSA001N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	01/01/2016	**End Date:**	07/01/2018
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**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:	Williams, Thomas	**Contact Phone:**	281-483-8773
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Flight Program:			
Flight Assignment:	NOTE: End date change to 7/1/2018 per NSSC information (Ed., 5/3/18) NOTE: Element change to Human Factors & Behavioral Performance; previously Space Human Factors & Habitability (Ed., 1/19/17) NOTE: Period of performance changed to 1/01/2016-12/31/2017 (originally 11/16/2015-11/15/2017) per NSSC information and B. Gore/JSC (Ed., 9/13/16)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Kopperdahl, David Ph.D. (O.N. Diagnostics)		
Grant/Contract No.:	NNX16AC15G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Mechanical loading is required for maintenance of the musculoskeletal system. Thus, exposure to microgravity induces marked bone loss in both humans and animals, and is a major concern for astronauts exposed to long-duration spaceflight, as they may be at increased risk for skeletal fragility and bone fractures. Most prior studies have relied on dual-energy X-ray absorptiometry (DXA), a 2D technique used to assess bone mass at different skeletal sites, to assess effects of spaceflight on bone strength and fracture risk. However, DXA-based measurements are limited in several regards. Newer technologies, including 3D quantitative computed tomography (QCT) are able to overcome the limitations of DXA. Moreover, QCT images can be used to estimate bone strength using a standard engineering approach called finite element analysis. Indeed, QCT images have been used successfully to demonstrate negative effects of spaceflight on hip bone density and strength. However, a similar examination of the effects of spaceflight on vertebral strength has not been performed. Thus the degree of spinal deconditioning and subsequent risk of vertebral fracture following long-duration spaceflight remains unknown. Specific Aims: 1) Determine changes in lumbar vertebral strength in long-duration International Space Station (ISS) astronauts 2) Compute subject-specific load-to-strength ratio to estimate risk of vertebral fracture in long-duration ISS astronauts 3) Perform Biomechanical Computed Tomography (BCT) analysis — aka finite element analysis of QCT scans on spine scans for up to 18 astronauts at up to visits (pre, post, and 1 Year, for all n=18; one additional visit for n=8), and analyzing two vertebral levels per subject (total number of BCT analyses = 124)
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This research will help us to better understand risk factors for vertebral fracture. Vertebral fractures are the most common fracture among older adults on Earth, with a prevalence of 30-50% among those over age 50. Improved insight into the factors that increase risk for vertebral fracture could advance the clinical management of older adults and inform better approaches to prevent these fractures.
Task Progress:	In the first 8 months, we have secured IRB (Institutional Review Board) approval from both Beth Israel Deaconess Medical Center (BIDMC) in Boston and NASA's Johnson Space Center in Houston. We have worked with NASA personnel to clarify what data will be transferred to BIDMC. Transfer of all astronaut CT images and other data should take place in the near future, and then data analysis can commence.
Bibliography Type:	Description: (Last Updated: 02/21/2024)