Fiscal Year:	FY 2012	**Task Last Updated:**	FY 12/20/2011
PI Name:	Sibonga, Jean Ph.D.		
Project Title:	Feasibility Study: QCT Modality for Risk Surveillance of Bone - Effects of In-flight Countermeasures on Sub-regions of the Hip Bone		
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) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	jean.sibonga-1@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	281-483-4556
Organization Name:	NASA Johnson Space Center		
PI Address 1:	Bone Mineral Laboratory, SK 311		
PI Address 2:	2101 NASA Parkway		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	12/01/2011	**End Date:**	12/31/2015
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
Contact Email:	Peter.norsk@nasa.gov		
Flight Program:	Pre/Post Flight		
Flight Assignment:	ISS NOTE: Title change per HRP and PI to "Feasibility Study: QCT Modality for Risk Surveillance of Bone - Effects of In-flight Countermeasures on Sub-regions of the Hip Bone"; previously "Occupational Risk Surveillance for Bone: Pilot Study - Effects of In-flight Countermeasures on Sub-regions of the Hip Bone" (Ed., 1/23/2013)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Measurement of areal bone mineral density [BMDa, g/cm2] by dual-energy x-ray absorptiometry [DXA] is required by NASA for assessing skeletal integrity in astronauts. Advantages of DXA include the facts that BMDa is widely-applied predictor of fractures in the aging population and that there are BMDa-based guidelines for identifying persons at high risk for osteoporotic fractures. In contrast to the 2-d imaging by DXA, quantitative computed tomography [QCT] is a 3-d bone imaging technology that is used typically to scan the hip and spine. QCT is capable of measuring, volumetric BMD [BMD, mg/cm3] of separate cortical and trabecular sub-regions as well as of total (integral) bone. QCT is limited to research applications at this time because there is not enough medical evidence to determine how QCT data should be used in clinical practice. QCT however provides additional information on bone structure and increases the understanding of how bones respond to effectors of bone loss or gain. NASA recently convened a panel of clinical bone experts to review available medical and research information from astronauts who flew on long-duration space missions. As part of its charge, the panel identified a clinical trigger upon which the flight surgeon should have the astronaut evaluated further by a bone endocrinologist. Specifically, the Panel recommended that if restoration to preflight BMD is not observed for the hip trabecular compartment at two years after return to earth, then that astronaut should be evaluated for possible therapeutic intervention to prevent premature osteoporotic fractures. This pilot study proposes to use preflight and postflight QCT scanning of the hips in ISS astronauts to evaluate the ability of in-flight countermeasures to prevent the occurrence of this clinical trigger. This study further hypothesizes that QCT scanning can distinguish the effects of different categories of in-flight countermeasures/activities on distinct sub-regions of the hip bone. For example, this pilot study will demonstrate that biochemically-based countermeasures (e.g., dietary manipulation of acidic to basic amino acid intake or bisphosphonates medication) will have a detectable prevention of BMD loss in hip trabecular compartment while biomechanically-based countermeasures (exercise regimens) will have detectable expansion of cortical bone apposition -- increasing both bone cross-sectional area and integral BMD as a consequence. These different effects on hip morphology will be subsequently translated to an effect on hip bone strength of the ISS astronaut. The combination of countermeasures that impact both compartments will more likely result in greater hip bone strength -- as estimated by analyzing QCT data by Finite Element Modeling (FEM) -- than of any singly applied countermeasure. This assertion will be approached in this pilot study by addressing the following Aims in each ISS astronaut: 1) Characterize the response of i) trabecular and cortical BMDs of the hip and ii) cross-sectional areas of cortical bone, trabecular bone and integral bone, to countermeasures that are either based upon biochemistry or mechanical-loading – with QCT measures. 2) Translate the QCT-measured changes in hip bone morphology (Aim 1) to hip bone fracture loads (aka, “hip bone strength”) using FEM. 3) Characterize QCT-measured changes in hip bone morphology (Aim 1) following a 12-month postflight period on earth and, in addition, translate these changes to the percentage recovery of preflight hip bone strength determined by FEM. By addressing these aims, this pilot study, using a research tool, will provide preliminary data that are critical for clinical issues related to fracture risk: Are in-flight countermeasures and postflight activities sufficient to protect against incidence of a clinical trigger for medical intervention? Do countermeasures protect against a decline in bone strength? Can hip bone strength be sufficiently recovered?
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:	
Task Progress:	New project for FY2012.
Bibliography Type:	Description: (Last Updated: 05/24/2021)