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| **Fiscal Year:** | FY 2017 | **Task Last Updated:** | FY 12/14/2016 |
| **PI Name:** | Weaver, Ashley Ph.D. | | |
| **Project Title:** | Quantitative CT and MRI-based Modeling Assessment of Dynamic Vertebral Strength and Injury 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:** | No |
| **Human Research Program Elements:** | (1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H) | | |
| **Human Research Program Risks:** | (1) **Dynamic Loads**:Risk of Injury from Dynamic Loads | | |
| **Space Biology Element:** | None | | |
| **Space Biology Cross-Element Discipline:** | None | | |
| **Space Biology Special Category:** | None | | |
| **PI Email:** | asweaver@wakehealth.edu | **Fax:** | FY |
| **PI Organization Type:** | UNIVERSITY | **Phone:** | 336-716-0944 |
| **Organization Name:** | Wake Forest University | | |
| **PI Address 1:** | Biomedical Engineering/ Health Sciences | | |
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| **PI Web Page:** | | | |
| **City:** | Winston-Salem | **State:** | NC |
| **Zip Code:** | 27101-4101 | **Congressional District:** | 12 |
| **Comments:** | | | |
| **Project Type:** | FLIGHT,GROUND | **Solicitation / Funding Source:** | 2015-16 HERO NNJ15ZSA001N-Crew Health (FLAGSHIP, NSBRI, OMNIBUS). Appendix A-Crew Health, Appendix B-NSBRI, Appendix C-Omnibus |
| **Start Date:** | 10/01/2016 | **End Date:** | 09/30/2019 |
| **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:** | Williams, Thomas | **Contact Phone:** | 281-483-8773 |
| **Contact Email:** | thomas.j.will1@nasa.gov | | |
| **Flight Program:** | ISS | | |
| **Flight Assignment:** | | | |
| **Key Personnel Changes/Previous PI:** | | | |
| **COI Name (Institution):** | Stitzel, Joel Ph.D. ( Wake Forest University )<br>Tooze, Janet Ph.D. ( Wake Forest University ) | | |
| **Grant/Contract No.:** | NNX16AP89G | | |
| **Performance Goal No.:** | | | |
| **Performance Goal Text:** | | | |

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| **Task Description:** | Prolonged periods of near weightlessness can cause damage to astronauts' musculoskeletal system. This damage can increase the risk of skeletal tissue failure (e.g., fractures, tears) when experiencing forceful, dynamic loads. Fractures of the spine during dynamic conditions such as launch or landing could cause a mission to fail. This study will measure this degradation of astronauts' vertebrae and spinal muscles during missions aboard the International Space Station (ISS). We will then determine the extent of vertebral weakening of crewmembers during long-duration missions. Changes in pre- and post-flight vertebral geometry, volume, cortex thickness, and bone mineral density will be measured from existing lumbar quantitative computed tomography (qCT) scans, as well as from planned qCT scans of the cervical, thoracic, and lumbar spine from six ISS crewmembers. Likewise, the pre- and post-flight spinal muscle volumes will be analyzed using both existing magnetic resonance imaging (MRI) scans and planned MRI scans from six ISS crewmembers. The qCT and MRI scans will be analyzed to determine structural and material changes in the cervical, thoracic, and lumbar vertebrae and the spinal muscles that indicate damage which could weaken these tissues.<br><br>Our unique engineering approach will measure the loss of vertebral strength during spaceflight conditions and predict the risk of failure during traumatic, dynamic loading conditions such as launch or landing. Vertebral strength and risk for vertebral fracture and injury will be quantified in 900 dynamic simulations using a full human body model that is constructed using structural and material data gathered from the pre- and post-flight medical images for each astronaut.<br><br>This study has significance in quantifying and addressing risks of long-duration spaceflight, including vertebral injury from dynamic loads, vertebral fracture, early onset vertebral osteoporosis due to spaceflight, and impaired performance due to reduced spinal muscle mass, strength, and endurance. |
| **Rationale for HRP Directed Research:** | |
| **Research Impact/Earth Benefits:** | |
| **Task Progress:** | New project for FY2017. |
| **Bibliography Type:** | Description: (Last Updated: 08/02/2022) |