BODY UNLOADING ASSOCIATED WITH SPACE FLIGHT AND BED-REST IMPACTS FUNCTIONAL PERFORMANCE

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INTRODUCTION: The goal of the Functional Task Test study is to determine the effects of space flight on functional tests that are representative of high priority exploration mission tasks and to identify the key underlying physiological factors that contribute to decrements in performance. Ultimately this information will be used to assess performance risks and inform the design of countermeasures for exploration class missions. We are currently conducting studies on both ISS crewmembers and subjects experiencing 70 days of 6° head-down bed-rest as an analog for space flight. Bed-rest provides the opportunity for us to investigate the role of prolonged axial body unloading in isolation from the other physiological effects produced by exposure to the microgravity environment of space flight. This allows us to parse out the contribution of the body unloading component on functional performance.

METHODS: In this on-going study both ISS crewmembers and bed-rest subjects were tested using an interdisciplinary protocol that evaluated functional performance and related physiological changes before and after 6 months in space and 70 days of 6° head-down bed-rest, respectively. Functional tests included ladder climbing, hatch opening, jump down, manual manipulation of objects and tool use, seat egress and obstacle avoidance, recovery from a fall, and object translation tasks. Crewmembers were tested three times before flight, and on 1, 6, and 30 days after landing. Bed-rest subjects were tested three times before bed-rest and immediately after getting up from bed-rest as well as 1, 6, and 12 days after reambulation.

RESULTS: A comparison of bed-rest and space flight data showed a significant concordance in performance changes across all functional tests. Tasks requiring a greater demand for dynamic control of postural equilibrium (i.e. fall recovery, seat egress/obstacle avoidance during walking, object translation, jump down) showed the greatest decrement in performance. Functional tests with reduced requirements for postural stability (i.e. hatch opening, ladder climb, manual manipulation of objects and tool use) showed little reduction in performance.

DISCUSSION: Results indicate that body unloading resulting from prolonged bed-rest impacts functional performance particularly for tests with a greater requirement for postural equilibrium control. These results indicate that body support unloading experienced during space flight plays a central role in postflight alteration of functional task performance. These data point to the importance of providing axial body loading as a central component of an inflight training system that will integrate cardiovascular, resistance and sensorimotor adaptability training modalities into a single interdisciplinary countermeasure system.