

PRELIMINARY SENSORIMOTOR AND CARDIOVASCULAR RESULTS FROM THE JOINT RUSSIAN AND U.S. PILOT FIELD TEST WITH PLANNING FOR THE FULL FIELD TEST BEGINNING WITH THE YEAR LONG INTERNATIONAL SPACE STATION MISSION

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Ongoing collaborative research efforts between NASA's Neuroscience and Cardiovascular Laboratories, and the Institute of Biomedical Problems' (IBMP) Sensory-Motor and Countermeasures Laboratories have been measuring functional sensorimotor, cardiovascular and strength responses following bed rest, dry immersion, short duration (Space Shuttle) and long duration (Mir and International Space Station) space flights. While the unloading paradigms associated with dry immersion and bed rest does serve as acceptable flight analogs, testing of crew responses following the long duration flights previously has not been possible until a minimum of 24 hours after landing. As a result, it is not possible to estimate the nonlinear trend of the early (<24 hr) recovery process, nor is it possible to accurately assess the full impact of the decrements associated with long duration flight. To overcome these limitations, both the Russian and U.S. sides have implemented testing at landing site. By joint agreement, this research effort has been identified as the functional *Field Test* (FT). For practical reasons the FT has been divided into two phases: the full FT and a preliminary pilot version (PFT) of the FT that is reduced in both length and scope.

The primary goal of this research is to determine functional abilities in long duration space flight crews beginning as soon after landing as possible (< 2 hr) with one to three immediate follow-up measurements on the day of landing. This goal has both sensorimotor and cardiovascular elements, including evaluations of NASA's new anti-orthostatic compression garment and the Russian Kentavr garment. Functional sensorimotor measurements will include, but are not limited to, assessment of hand/eye coordination, ability to egress from a seated position, walk normally without falling, measurement of dynamic visual acuity, ability to discriminate different forces generated with both the hands and legs, recovery from a fall, a coordinated walk involving tandem heel-to-toe placement, and determination of postural ataxia while standing. The cardiovascular portion of the investigation includes blood pressure and heart rate measurements during a timed stand test in conjunction with postural ataxia testing (quiet stance sway) as well as cardiovascular responses during other functional tasks. In addition to the immediate post-landing collection of data for the full FT, postflight data will be acquired at a minimum of one to three more other times within the 24 hr following landing and continue until functional sensorimotor and cardiovascular responses have returned to preflight normative values.

The PFT represents a single trial run comprised of jointly agreed upon subset of tests from the full FT and relies heavily on IBMP's Sensory-Motor and Countermeasures Laboratories for content and implementation. The PFT was first conducted following the September 2013 landing of the Soyuz spacecraft (34S) and again following the landing of Soyuz 35S in November. Testing included: (1) a sit-to-stand test, (2) recovery from a fall where the crewmember began in the prone position on the ground and then stood for 3 min while cardiovascular stability was determined and postural ataxia data were acquired, and (3) a tandem heel-to-toe walk test to determine changes in the central locomotor program. Video, cardiovascular parameters (heart rate and blood pressure), data from body-worn inertial sensors and severity of postflight motion sickness were collected for analysis.

In summary, the level of functional deficit is expected to be most profound during the acquisition of gravity loads immediately after landing when the demands for crew intervention in response to emergency operations will be greatest. Clearly measurable performance parameters such as ability to perform a seat egress, recover from a fall or the ability to see clearly when walking, and related physiological data (orthostatic responses) are required to provide an evidence base for characterizing programmatic risks and the degree of variability among crewmembers for exploration missions where the crew will be unassisted after landing. Overall, these early functional and related physiological measurements will allow estimation of nonlinear sensorimotor and cardiovascular recovery trends to an accuracy that has not been previously captured in over 50 years of space flight.