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COSMONAUTS WITH ORBITAL FLIGHT EXPERIENCE WILL BE MORE SUCCESSFUL IN PERFORMING MARS MISSION TASKS

Abstract

The ISS is a scientific laboratory for accumulating the knowledge necessary to complete the interplanetary missions tasks. The mechanisms of negative effects of weightlessness on human health, its prevention methods and the ability to perform model tasks of extravehicular activity (EVA) on the planet surface can be studied in orbital flights. Changes in physiological systems functioning develop during the body's adaptation to weightlessness, forming structural traces and vegetative memory, which allows for accelerated adaptation and readaptation in repeated flights. Changes in afferent synthesis during adaptation to weightlessness and readaptation to Earth conditions are primarily due to the emergence of a new configuration of sensory systems interactions. Signalling the absence of stretching and support, the information from muscles proprioceptors and feet receptor zones cause perturbations in the sensory input. The hypothesis of our study was the assumption that the previous orbital flight experience contributes to a favourable course of readaptation to gravity and successful performance of model tasks of an interplanetary mission.

Methods The cosmonauts who made repeated flights to the ISS were examined. The cosmonauts' strength capacity was evaluated by means of isokinetic knee extension (IKKE) dynamometry ("Cybex") and calculation of strength-to-weight ratio (STW) on 30 and 60 days before the space flight and on the 4th and 15th days after its completion. Planetary activity simulation tasks were performed in conditions of simulated Martian gravity (0.38 of Earth g) at the Exit-2 stand and included: airlock operations, relocation to EVA position, relocation up to the container, antenna installation, electrical plugs connection, movement with the container, exit hatch closure. At all stages heart rate, respiratory rate, and temperature were recorded, tasks energy costs were calculated.

Results Mean IKKE STW was 2,00 N·m/kg after the first ISS mission and 2.14 N·m/kg after the second flight, which exceeds the minimum IKKE STW threshold required to successfully perform model tasks on planet surface during EVA. (Dos'Santos T, et. all., 2017; Ryder JW, et. all., 2013; 2019; Kirk L. English, et. all. 2020) The task type determined time and energy costs changes after the flight. The

mission duration did not affect the performance of the model tasks. Extrapolation of the obtained data to the tasks of interplanetary flights suggests the selection of experienced cosmonauts for interplanetary flights.

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