SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (4)

Author: Dr. Elena Fomina
FSC RF-IMBP, Russian Federation

Mrs. Tatyana Kukoba
FSC RF-IMBP, Russian Federation
Mrs. Natalya Lysova
FSC RF-IMBP, Russian Federation
Ms. Alexandra Savinkina
FSC RF-IMBP, Russian Federation

MAJOR FACTORS OF THE PROPHYLACTIC EFFECTIVENESS OF LOCOMOTION AND RESISTANCE TRAINING IN LONG-DURATION SPACE FLIGHT

Abstract

Purpose of the investigation was to elicit major factors adverse to the prophylactic effectiveness of locomotion and resistance training of cosmonauts on long-duration missions. Physical performance of cosmonauts was assessed by the standard incremental locomotion test. The neuromuscular function evaluation prior to and after space flight included determination of the electromyographic cost of walking and isokinetic muscle testing. Comparative analysis showed that the best prophylactic effect can be achieved by interval locomotion training at high speed ($p<0.05$) when the vertical ground reaction force grows ($p<0.01$) with acceleration of the treadmill belt. Passive treadmill training more than 29 % of the overall session time is more favorable to physical shape maintenance than locomotion training with a short period on passive treadmill ($p<0.05$). However, maximal vertical ground reactions force were measured when they ran on passive but not active treadmill ($p<0.01$). Physical performance of cosmonauts who applied axial loading 65 % of body weight for locomotion training was not changed in flight in comparison with baseline test data ($p<0.05$); meanwhile, the choice of easy axial loading by others resulted in degradation of their physical performance. The investigation showed that high axial loading during locomotion stimulates support afferentation ($p<0.01$). In the group of cosmonauts where "weight" loads of resistance exercises in space flight made up 50-60% of repeated maximum, the torque of leg extensor muscles was decreased at all angular velocities ($p<0.01$); significant gain in flexor torques was observed at $30^o/s$ only ($p<0.01$). Strength endurance of femoral extensors decreased 30 % in comparison to preflight values. In the group of cosmonauts where "weight" load was 70-80% of repeated maximum, post-flight strength and velocity parameters ofleg extensors did not alter at $30^o/s$ and $90^o/s$ and neither did torques; on the contrary, strength endurance of femoral muscles increased ($p<0.001$). The validity of the concept about the crucial role of support afferentation in development of the microgravity-induced changes was demonstrated by analysis of vertical ground reactions during locomotion training, and level of physical performance before, in and after long-duration space flight. There are three factors of locomotion training that relate to support stimulation and influence training effectiveness in the course of long-duration space missions. They are running velocity, time of running on passive treadmill and level of axial loading. Effectiveness of resistance exercises is dependent on the "weight" load heaviness. The investigation was performed with support of RFFI grant 13-04-02182.