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FOOT-GROUND REACTION FORCE DURING SHORT-RADIUS CENTRIFUGATION

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The creation of artificial gravity onboard the space station using a short-radius centrifuge (SRC) is a potential countermeasure for long-term space flights. Our goal was to evaluate the foot-ground reaction forces (GRF) while arbitrary walking at least 20 steps before and after centrifugation, as well as during centrifugation. Nine healthy male volunteers aged from 24 to 41, height 165-185 cm, weight 69-96 kg have been observed under three SRC rotation modes with a maximum acceleration of 2.05 g, 2.47 g and 2.98 g along the body vertical axis towards the legs with a rotation radius of 235 cm. The foot-ground reaction force was recorded by 190-197 pressure sensors of measuring insoles under the soles of participants. The average GRF values during rotation in SRC were always higher than those when walking before rotation: in the 1st mode – by 5.06±0.2%, in the 2nd mode – by 37.14±3.2% and in the 3rd mode – by 96.19±5.2%. Also the analysis of GRF during rotation in the 1st SRC mode showed that the GRF distribution on the structural and functional zones of the sole is closer to the nature GRF distribution in a vertical position on the Earth: most of the support load was on the metatarsal and calcaneal zones, while the longitudinal arch of the foot was slightly loaded. During rotation in the 2nd and 3rd SRC modes, the support load on the longitudinal arch of the foot increased sharply by 68.3±3.2 % and by 189.2±6.2 %, respectively. Selected rotation mode significantly affected the walking stability: the speed of displacement of the center of pressure during walking increased after SRC rotation in the 1st mode by 8.4±0.3 %, after the 2nd mode – by 19.6±1.7 %, after the 3rd mode – by 133.6±4.4 %. The results obtained in the study allow us to determine for the first time the effectiveness of different SRC rotation modes by analyzing the dynamics of GRF distribution on the structural and functional zones of the sole and the degree of asymmetry of GRF distribution between the right and left soles, as well as the SRC effect on sensory-motor system by analyzing the parameters that characterize the walking stability. The study is supported by the Russian Academy of Sciences (63.1).