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MRI INVESTIGATION ON THE EFFECTIVENESS OF HIGH-INTENSITY JUMP TRAINING IN PRESERVING LUMBAR PARASPINAL MUSCLE MASS DURING 60 DAYS OF BED REST: RESULTS FROM THE COLOGNE RSL STUDY

Abstract

Background: An astronaut's body is exposed during spaceflight to the peculiar condition of weightlessness, and consequently experiences various adaptive changes, among which bone and muscle loss stand out. Although space agencies nowadays adopt numerous preventive measures against these pathologies, they are presently only able to reduce their entity but not entirely prevent their onset. Hence, alternative countermeasures are currently being investigated, in the hope that they may be more effective and efficient in this setting.

Objective: The purpose of this experimental study was to assess the usefulness of a novel form of high-intensity interval training (HIIT), based on the principle of jumping, which could be used aboard the International Space Station (ISS) to prevent musculoskeletal deconditioning in astronauts. The effectiveness of the training has been determined by evaluating its ability in preventing the onset of atrophy in lumbar paraspinal muscles, and chiefly in the multifidus, over the course of a bed-rest study.

Materials and Methods: Twenty-three healthy male participants, aged between 21 and 42, selected after an extensive screening procedure, were confined for ninety days in the facilities of the German Aerospace Centre in Cologne. The study was divided in three phases: a 15-day baseline measurement phase, a 60-day 6 head-down-tilt (HDT) bed-rest phase, and a 15-day recovery phase. Participants were

randomly allocated to the control group (CTRL, n=11) or the training group (JUMP, n=12). Subjects have been carefully monitored during the whole study, and the dimensions of their lumbar paraspinal muscles has been measured using magnetic resonance imaging at nine points in time, during and after the bed rest.

Results: Subjects have tolerated the exercise well, and adherence to the planned protocol has been perfect, despite a few deviations in intensity. No significant difference in lumbar paraspinal muscles atrophy between the training and the control group has emerged at any study-date ($p=0.210$), whereas a significant reduction in their thickness at the end of the bed rest has been demonstrated in both groups (-5,05%, $p<0.001$). No beneficial effect to single vertebral segments of the lumbar paraspinal muscles has been observed either.

Conclusions: The training has shown itself to be able neither to prevent the onset of lumbar paraspinal muscles disuse atrophy nor to reduce its severity compared to the controls. For future countermeasures, we recommend muscle-specific high-intensity exercise as being more likely to retain lumbar muscle mass.