Extended abstract | Reports in Cancer and Treatment | 2021
Vol.5 No.1

The effects of 12 weeks of functional strength training on muscle strength, volume and activity upon exposure to elevated G_z forces in high performance aircraft personnel

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Background: Technological advancements in modern military and acrobatic jet planes have resulted in extraordinary psychophysiological loads being exerted upon flying personnel, including inducing neck and back pain. The purpose of this study was to examine the effects of 12 weeks of functional strength training on 1) the volume and strength of the neck and shoulder muscles and 2) muscular activity upon exposure to helmets of different masses and elevated G_z forces in a long-arm centrifuge in high-performance aircraft personnel.

Methods: 18 participants underwent 12 weeks of functional strength training (n = 12) or the control protocol (n = 6) without additional strength training. Pre- and post-intervention tests included evaluations of isometric strength of the head extensor muscles, flexion, and lateral flexion and rotation, as well as magnetic MRI to measure the volume of the m. sternocleidomastoideus, m. trapezius, and deep neck muscles. Furthermore, during a long-arm centrifuge (+ 1.4 and + 3 G_z) protocol, the muscular activity levels of the muscles were assessed with different head worn equipment. Each participant's perception of muscular strain was noted immediately after the long-arm centrifuge protocol.

Results: The maximal isometric strength in all exercises and muscle volumes increased in the training group but not the control group ($P < 0.05$). Relative muscle activity (%MVC) with a helmet decreased after the intervention in the training but not the control group ($P = 0.01$). The perceived muscular strain of the neck muscles induced by the long-arm centrifuge did not differ between the groups.

Conclusion: This study clearly shows the potential of an approach that supports the preservation of the flying personnel's health by means of functional whole-body training focused on muscular strength in the neck and shoulder areas. When developing modern combat aircraft the physical performance of flying personnel must also be adapted to the ongoing technological progress to ensure that the system performance remains balanced.

This work is partly presented at Merge Conference: 51st World Congress on Advanced Nursing Research & 17th World Congress on Healthcare & Technologies
April 26-27, 2021