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DO RESPIRATORY MUSCLES EXHIBIT SIMILAR ADAPTIVE PROPERTIES TO LOWER LIMB MUSCLES IN RESPONSE TO CHRONIC TRAINING? A CROSS-SECTIONAL COMPARISON BETWEEN BASKETBALL PLAYERS AND CYCLISTS

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Introduction. Previous studies have shown that elite athletes who undergo intensive exercise training have distinct morphological and mechanical qualities in their muscle-tendon units (MTUs). Changes in musculotendinous morphology affect muscle contraction and, in turn, physical performance. Therefore, repeated exposure to specific exercise training can alter the structure of the MTUs, leading to specific functional adaptations.

The main goal of the study was to investigate whether different types of chronic training, like basketball and cycling, can induce not only specific adaptations in the lower limb MTUs but also in the structural and functional characteristics of the respiratory muscles.

Methods. Thirty-two male athletes (cyclists n=16, and basketball players n=16) voluntarily participated in the study. First, anthropometric parameters were measured, followed by musculoskeletal ultrasound images of specific muscles taken one at a time: vastus lateralis (VL), gastrocnemius medialis/lateralis (GM/GL), and different breathing phases of the diaphragm. Next, participants underwent maximal voluntary isometric contraction (MVIC) and passive resistive torque tests for the knee extensors and plantar flexors. Finally, subjects completed a respiratory muscles strength protocol, which included maximum inspiratory/expiratory tests (MIP/MEP) and spirometry.

Results. Basketball players (BP) compared to cyclists (CYC) displayed significantly greater diaphragm, GM, and GL muscle thickness (MT) ($p<0.05$), and fascicle length (FL) of GM and GL. In addition, BP showed a greater rate of peak torque (PT) and rate torque development (RTD) in plantar flexors, and a rate of inspiratory/expiratory pressure development (RIPD/REPD) ($p<0.05$). No significant differences emerged between the groups for VL FL and MT, as well as knee extensors' PT and RTD ($p>0.05$). Moreover, forced vital capacity (FVC) did not differ significantly.

Discussion. Overall, our results showed significant differences in morphological and contractile properties, as well as respiratory function parameters between the groups. BP demonstrated a greater RTD in the lower limb and RIPD/REPD of respiratory muscles compared to CYC, but similar PT of the knee extensors. Additionally, BP had greater MT of the plantar flexors, leading to a higher PT. Interestingly, the respiratory muscles showed similar adaptive traits with significantly greater diaphragm MT in BP. This may be due to the anaerobic repetitive loading to which the respiratory muscles are exposed, and specific diaphragm operating lengths during the process.

In conclusion, the study investigated whether chronic exposure to different sports leads to differences in muscle architecture, including greater pennation angle and lower fascicle length in CYC compared to BP. Additionally, the study hypothesized that cyclists' respiratory muscles would show similar trends in structural and functional differences, such as diaphragm morphology and respiratory muscle strength. The present findings confirm the hypothesis and demonstrate how chronic exercise can influence not only the primary muscles directly involved in the exercise but accessory ones such as the respiratory muscles also.

Keywords: performance analysis, muscle architecture, respiratory muscle strength, muscle thickness.

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