

## CENTRAL FATIGUE AFTER PROLONGED RUNNING

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**KEY WORDS:** running, fatigue, twitch interpolation

**INTRODUCTION:** Fatigue can be caused by a failure in neural activation (central) and/or in force generating capacity of the muscle (peripheral). Using the twitch interpolation technique, central fatigue was demonstrated after prolonged running in the knee extensors (Millet et al., 2003), but not in the plantar flexor muscle group (Finni et al., 2003; Racinais et al., 2006) despite marked involvement in running propulsion. However, the paradigm in the latter studies appears to have limited the testing only to parts of the triceps surae. Therefore, the aim of this study was to use the twitch interpolation technique to investigate central and peripheral fatigue in the entire plantar flexor muscle group after prolonged running.

**METHOD:** Eight male subjects [mean age  $27.6 \pm 2.4$  (SD) yr, height  $1.82 \pm 0.87$  m, body mass  $74.5 \pm 0.7$  kg, and  $VO_{2peak}$   $5.16 \pm 0.61$  l · min<sup>-1</sup>] ran on a motorized treadmill during 2 h at a speed corresponding to 75% of  $VO_{2peak}$ . Isometric maximal voluntary contraction (MVC) of the plantar flexors as well as the electrically induced twitch produced during the MVC (IT) and with the muscles at rest (RT) were measured. The RT and IT were evoked by two 0,5 ms supramaximal electrical pulses delivered at 50 Hz in the popliteal fossa to stimulate the tibial nerve. The level of activation (LOA) during each MVC was calculated as  $LOA (\%) = 100 \cdot (1 - IT \cdot RT^{-1})$ . Fatigue was defined as a decrease in MVC, central fatigue as a decrease in LOA, and peripheral fatigue as a decrease in RT.

**RESULTS:** After 2 h of running, MVC of the plantar flexors decreased significantly ( $p < 0.05$ ) (from  $148.5 \pm 15.8$  to  $122.6 \pm 26.9$  Nm) and so did LOA (from  $83 \pm 16$  to  $68 \pm 20$  %). There was no significant change in RT ( $61.2 \pm 10.0$  vs  $57.3 \pm 8.9$  Nm). The changes in MVC were significantly correlated to the changes in LOA ( $r = 0.866$ ).

**DISCUSSION:** The main finding of this study was that central, but not peripheral, fatigue occurred during voluntary isometric plantar flexion after prolonged running. It could be speculated that central fatigue mainly affected the gastrocnemius muscle, since previous studies involving mainly the soleus muscle failed to show significant central fatigue after similar fatigue protocols. The absence of peripheral fatigue may have been caused by post activation potentiation occurring in parallel with the fatigue process.

**CONCLUSION:** The results demonstrate that prolonged running leads to a reduction in maximal voluntary plantar flexor muscle strength, which was strongly related to central fatigue. This may have practical implications, for example, for supplementation in connection with prolonged running in training and competition.

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