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MUSCLE-SPECIFIC ATROPHY AFTER 6 WEEKS OF OVERTRAINING WITH ECCENTRIC MUSCLE ACTIONS IN RATS

Stauber, W T. FACSM[1]; Willems, M E.[1]

Author Information

[1]Department of Physiology and Pharmacology, West Virginia University, Morgantown, WV 26506
e-mail: mwillems@hsc.wvu.edu

PURPOSE

To examine adaptations for slow- and fast-twitch muscles after overtraining with eccentric muscle actions.

METHODS

Using subcutaneous electrical stimulation (70 Hz, 0.2 ms pulse duration, 20-40 V), plantar flexor muscles (i.e., slow-twitch soleus and fast-twitch plantaris and gastrocnemius muscles) of female Sprague Dawley rats (4-5 mo) were trained (5 d/wk for 6 wks) with eccentric muscle actions (5x10). Eccentric muscle actions occurred between ankle positions of 140° to 40° (velocity ~ 400° $\cdot s^{-1}$) and were followed by unresisted concentric muscle actions. Rats limited to cage activity served as control. Weights of adrenal glands and plantar flexor muscles were taken. Fiber size distributions and mean fiber areas were determined using serial cross-sections (thickness 8 µm) and image analysis. Fiber type shifts were documented for the soleus muscle using immunohistochemistry.

RESULTS

Adrenal glands were enlarged by 17% (overtraining: 72±3 mg (mean±SE), control: 62±1 mg (n = 16 in each group), $p < 0.05$). Mass of the soleus muscle was decreased by 19% (overtraining: 116±3 mg (n = 16), control: 130±3 mg (n = 10), $p < 0.05$). After overtraining, smaller fiber sizes were present in the gastrocnemius medialis and soleus muscles resulting in a decrease of the mean fiber areas by 26% and 13%, respectively ($p < 0.05$). An atrophic response was not observed for the plantaris muscle. In the soleus muscle, the number of fast fibers increased from 17.4±0.9% (control) to 22.0±1.5% (overtraining) - an increase by 26% ($p < 0.05$).

CONCLUSIONS

Overtraining with eccentric muscle actions resulted in atrophy in the soleus and gastrocnemius muscles but not in the plantaris muscle. Adaptation to overtraining with eccentric muscle actions appears to be muscle-specific and was largest for slow-twitch muscles. Supported by NIOSH R01-OH-02918.