INTERACTION OF DIET AND EXERCISE ON SKELETAL MUSCLE ADAPTATIONS AND EXERCISE PERFORMANCE IN RATS

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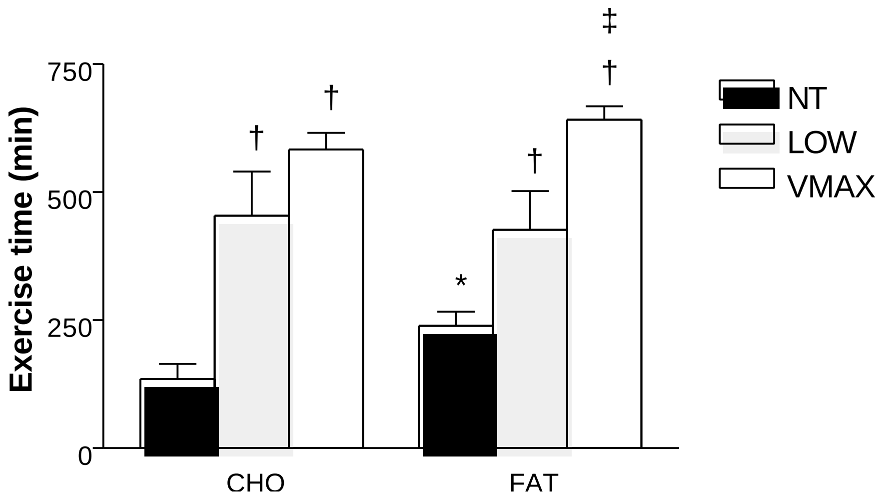
We determined the interaction of different exercise (low- and high-intensity) and diet (high-fat and high-carbohydrate) regimens on selected skeletal muscle and liver adaptations and their metabolic consequences for endurance performance in rats. We hypothesised that a high-fat diet in combination with low-intensity training would evoke the greatest metabolic adaptations for fat metabolism in skeletal muscle and subsequently improve endurance running capacity to a greater extent than when either low or high-intensity training was undertaken on a high-carbohydrate diet.

Sixty-four female Sprague-Dawley rats undertook a baseline treadmill run to exhaustion at 16 m min^{-1} (RUN1) and were then divided into one of two dietary conditions: high-carbohydrate (CHO) or high-fat (FAT). Each dietary group was then divided into one of 3 subgroups: sedentary control that performed no training (NT); low-intensity running (8 m min^{-1}; LOW) and maximal voluntary running speed without electrical stimulation (28 m min^{-1}; VMAX). Training volume was the same for LOW and VMAX (1,000 m $session^{-1}$) and animals ran 4 d wk^{-1} for 6 wk. In order to assess the interaction of the higher intensity training with diet, a second endurance test (RUN2) was undertaken after 6 wk at either 16 m min^{-1} or 28 m min^{-1}. At the completion of the training programme, all animals were anesthetised by intraperitoneal injection of pentobarbital sodium (60 mg kg^{-1} BM). Once the anesthesia took effect, hindlimb muscles from the right leg were exposed and the soleus, the red vastus lateralis and the white vastus lateralis were dissected out, rapidly frozen and stored in liquid nitrogen. The abdomen was then opened and a portion of liver was excised and frozen. All animals were killed by heart removal.



NT ran 77% longer at 16 m min^{-1} after FAT than CHO (239 ±28 vs. 135 ±30 min, P<0.05). There were no differences for LOW when rats ran at 16 m min^{-1} (454 ±86 vs. 427 ±75 min for CHO and FAT), but VMAX rats fed fat ran longer than CHO when tested at 28 m min^{-1} (100 ±28 vs. 58 ±11 min, P<0.05). There were significant main effects for both diet and training on liver glycogen concentration (P<0.01) and main effects of diet (P<0.01) on citrate synthase and *b*-hydroxy-acyl-CoA dehydrogenase activity in selected skeletal muscles.

In conclusion, significant metabolic adaptations in skeletal muscle and liver occurred in response to both diet and exercise. However, training intensity rather than volume exerted a stronger influence on subsequent endurance running capacity.