Department of Rehabilitation Medicine
Division of Physical Fitness

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General Summary

The research of our division has been focused on skeletal muscle plasticity, neuroscience, and exercise physiology.

Research Activities

Running training increases heat shock proteins in skeletal muscle

Heat shock proteins (HSPs) play important roles in protecting cells from stress by acting as molecular chaperons. Limited information is available about the responses of HSPs to training and whether the frequency of training affects changes in HSPs. We investigated the effects of training frequency on the expression of several HSPs in the gastrocnemius muscle of rats. The trained rats ran (30 m/minute) on a motor-driven treadmill for 3 days per week (T3 group) or 6 days per week (T6 group) for 6 weeks. The total running duration was 60 minutes for the T3 group and 30 minutes for the T6 group. The expression levels of HSPs of 73, 72, 60, 40, and 25 kD and of αB crystallin were determined in the white and red regions of the lateral gastrocnemius muscles using the Western blotting method. No significant increase in expression of any of the HSPs was evident in the red region after training in either the T3 or T6 group. In contrast, the expression levels of all HSPs except for HSP73 and HSP60 increased in the white region after training in both groups without a difference between the groups. The lack of significant difference between the T3 and T6 group suggests that the total training load rather than the training frequency contributes to the increases in HSPs. We conclude that the increases in HSP expression after endurance training are region-specific and are not affected by training frequency.

Relationship between eating and hoarding behavior and neuropeptide Y mRNA in the arcuate nucleus of the hypothalamus of exercising Syrian golden hamsters

Syrian golden hamsters more actively perform wheel-running exercise than do rats and have a strictly defined circadian rhythm for running activity. For these reasons, we hypothesized that the factors regulating appetite behavior would be changed in exercising Syrian golden hamsters compared with those in ad libitum controls. Moreover, Syrian golden hamsters have a hoarding habit, which reflects their long-term appetite. Therefore, we used Syrian golden hamsters to evaluate the relationship between eating and hoarding behaviors and neuropeptide Y mRNA in the arcuate nucleus during wheel running exercise. We found that the low-appetite condition was indicated by decreases in the eating and hoarding volumes of food in exercised hamsters. Serum leptin levels were markedly lower in exercising hamsters than in ad libitum controls. No significant

difference was found in leptin receptor mRNA levels in the arcuate nucleus of the hypothalamus. Also, as we had hypothesized, neuropeptide Y mRNA levels in the arcuate nucleus of the hypothalamus were significantly lower in exercising hamsters than in ad libitum controls. Therefore, we speculate that a mechanism of exercise-induced appetite inhibition is a decrease in neuropeptide Y in the arcuate nucleus of the hypothalamus.

Exercise intensity affects plasma concentrations of tumor necrosis factor alpha in response to lipopolysaccharide in rats

Moderate exercise can reduce the risk of infectious disease. In contrast, strenuous exercise transiently increases the risk of infection. We examined the mechanisms underlying these observations. Ten-week-old female F344 rats were randomly assigned to 1 of 4 groups: rest (R) and low (LE)-, middle (ME)-, and high (HE)-intensity running exercise. Immediately after the exercise or resting period, rats were given intravenous injections of lipopolysaccharide (LPS) (1 mg/kg). Blood samples were obtained immediately after exercise or rest and 1 hour after the LPS injection. Plasma concentrations of tumor necrosis factor (TNF)-alpha in both the ME and HE groups were significantly lower than those in the R and LE groups, respectively. Exercise intensity did not affect plasma corticosterone concentrations. In contrast, plasma epinephrine concentrations in the ME and HE groups were significantly higher than those in R and LE groups, respectively. In addition, plasma norepinephrine concentrations in the HE group were higher than those in the other 3 groups. Responses of TNF-alpha to LPS were suppressed in the ME and HE groups but not in the LE group. This immunosuppression might be regulated by changing catecholamine concentrations, which depend on exercise intensity.