Fructose-induced Metabolic Changes in Mice with Regular Exercise in Intrinsic High- or Low-Aerobic Exercise Capacity in Mice

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Abstract

Introduction: Excessive fructose intake leads to metabolic disorders such as hyperglycemia, hypertriglyceridemia, and accumulation of body fat. Also, fructose-rich sweeteners have a higher incidence of diabetes and obesity in humans. Regular physical exercise has been indicated for the treatment of several metabolic syndromes or chronic diseases. However, response to exercise intervention is often highly variable among individuals. We propose that differential intrinsic aerobic capacity may be one of the underlying etiologies of fructose-induced metabolic disorders and obesity.

Methods: We selected high- and low- intrinsic aerobic exercise capacity mice by using an endurance swimming test. We investigated the effects of a 8-week swim training program (initial 15 min/day, 5 days/week; 2 min/each day to 30 min/day at the end) on the HFD-fed mice. All animals were divided into 4 groups (n=8/group): high-exercise capacity with normal chow diet (HC-ND), high-exercise capacity with high- fructose diet (HC-FD), low-exercise capacity with normal chow diet (LC-ND), low-exercise capacity with high-fructose diet (LC-FD). Exercise performance will be evaluated by forelimb grip strength and exhaustive swimming time. The blood biochemical markers and tissue damage markers were determined. Other organs such as heart, lung and liver will be examined by histopathology.

Results: The high-fructose-fed mice consumed significantly more calories than control-fed mice. The mean final body weight of HC-FD group was significantly higher by 1.07-folds as compared with that of the HC-ND group, and LC-FD group was also higher by 1.08-folds as compared with that of the LC-ND group. The grip strength of the HC-ND group was significantly higher by 1.08- and 1.09-fold than HC-FD and LC-FD groups, respectively. The total body fat weights including mesenteric, epididymal and perirenal fat pads, were all significantly increased in both HC-FD and LC-FD groups. Serum levels of total cholesterol, triacylglycerol, uric acid and glucose in HC-FD and LC-FD groups were all significantly higher than those of HC-ND and LC-ND groups. Four classic serum markers in LC-FD group were worsen than in HC-FD group. We also found the levels of glycogen in liver and muscle in the LC-FD group was higher than other three groups.

Conclusions: The poor efficiency of energy metabolism and deposition of glycogen and lipid in tissues were found LC-FD mice. Therefore, it is concluded that the aerobic exercise capacity is essential for attenuating the complications developed by the consumption of fructose.

Keywords: Intrinsic exercise capacity, High fructose diet, Obesity, Energy utilization