Improved Insulin Resistance, Adiponectin and Liver Enzymes without Change in Plasma Vaspin Level after 12 Weeks of Exercise Training among Obese Male Adolescents

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ABSTRACT

Background: The purpose of this study was to investigate (1) the association among anthropometric measurements, cardiopulmonary fitness, liver enzymes and inflammatory markers including vaspin levels among male adolescents, and (2) the effects of a 12 week aerobic exercise training on insulin resistance, liver enzymes and inflammatory markers including vaspin levels among obese male adolescents were also studied.

Methods: We compared anthropometric and metabolic parameters between thirty obese (BMI \(\geq 25\)) and fifteen lean (BMI < 23) male high school students (17.0 ± 0.1 y). Obese male subjects were randomly assigned to either exercise intervention group (OIG, n = 18) or control group (OCG, n = 12). OIG participated in aerobic exercise (5 days/wk) for 12 weeks, while the OCG participated only in regular physical education class.

Results: Partial correlation coefficient analysis showed no association between vaspin levels and metabolic parameters including insulin resistance. However, vaspin levels have significantly correlated with intima-media thickness (IMT). Parameters which were significantly associated with insulin resistance were gamma-glutamyltransferase (GGT) and VO2max, while adiponectin levels showed significant association with VO2max and fasting insulin levels. Twelve weeks of exercise training significantly improved insulin resistance with concurrent improvement in adiponectin and GGT without affecting the vaspin levels.

Conclusion: Our findings suggest that 12 week of aerobic exercise training significantly improved insulin resistance and metabolic parameters. However, it did not affect the plasma vaspin levels.

Key words: Adolescents, Aerobic exercise, Insulin resistance, Vaspin, liver Enzymes, obesity

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Introduction

The incidence of obesity and the risk of metabolic disorders including type 2 diabetes and cardiovascular disease have dramatically increased among children and adolescents. Recent studies show that being overweight or obese during adolescence increases the risk of obesity and obesity-associated metabolic disorders during adulthood. Therefore, the prevention of adolescent obesity is an important issue in public health improvement.

The association between obesity and metabolic disorders have long been identified, however, the mechanism of obesity-associated insulin resistance and metabolic disorders have recently been understood since the discovery of leptin and other adipokines such as interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α) and adiponectin. Among these adipokines, visceral adipose tissue-derived serpin (vaspin) was identified as a potential insulin sensitizing adipokine. Vaspin was identified as a member of serine protease inhibitor family, which was secreted from visceral adipose tissue in Otsuka Long-Evans Tokushima Fatty (OLETF) rats, animal model of abdominal obesity with type 2 diabetes.

Since the identification of vaspin and its potential roles, factors which influence the vaspin regulation have been studied. Youn et al. investigated the effects of four week of exercise training has on vaspin level and found significantly increased level of vaspin after the training. Whereas, Lee et al. reported a significant reduction in serum vaspin level with concurrent improvement in insulin resistance among obese children following a short-term lifestyle modification, including exercise training. The discrepancies between these two studies could be due to the ages of their participants as well as the type of exercise training. Participants in Youn’s study were adults with and without type 2 diabetes, whereas, participants in Lee’s study were obese children. Furthermore, participants from Lee’s study were housed together for seven days and their diet and the level of physical activity were tightly controlled. Therefore, further studies are needed to elucidate what effects the different modes and durations of exercise have on vaspin level among different age groups.

Vaspin also plays a pivotal role in the pathogenesis of non-alcoholic fatty liver disease (NAFLD), not only as regulators of insulin sensitivity, but also as mediators of the inflammatory process. The incidence of NAFLD is constantly growing due to the increasing prevalence of obesity. Deivanayagam et al. measured insulin resistance from liver and muscle in both NAFLD adolescents and normal adolescents who had identical body weight and age. Consequently, they discovered that insulin resistance was increased among adolescents with NAFLD independent of their body mass index (BMI). Although the importance of NAFLD in the development of insulin resistance among adolescents has been identified, the effects of exercise on alanine-aminotransferase (ALT), alanine-aminotransferase (AST) and gamma-glutamyltransferase (GGT) have not been fully elucidated.

Therefore, the aims of this study were to investigate: (1) the association among anthropometric measurements, level of fitness, liver enzymes and circulating levels of inflammatory markers including vaspin levels among adolescents; and (2) the effect of 12 week aerobic exercise on insulin resistance, liver enzymes, and adipocytokines including vaspin and adiponectin levels among obese male adolescents.

Method

1. KAPHA Study

This study is a part of the “Korean Adolescents Physical Activity and Health (KAPHA) study”, and the purpose of the KAPHA study was to examine the effects of obesity, also the effects of physical activity and physical fitness levels on insulin resistance and cardiovascular disease risk factors among male high school students. Data from the third year of the KAPHA study was used for the current study.

2. Subject

Thirty obese (BMI ≥ 25) and fifteen lean (BMI < 23) male adolescents were recruited to compare the effects of adiposity on insulin resistance, metabolic parameters and adipocytokines. Obese participants were randomly assigned to either exercise intervention group (n = 18) or control group (n = 12). An institutional ethics review board at Yonsei University College of Medicine approved this study. Most subjects were not participating in any regular physical activity except for school physical education classes. We have collected the written consent forms from the parents of the participants.