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Effect of Exercise Therapy on the Body Composition and Blood Components of Obese Men

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Abstract. [Purpose] The purpose of this study was to examine the effects of an eight-week exercise program on body composition, blood lipids, and hormone levels of 16 obese adult males. [Subjects and Methods] After an experimental group (n=8) and a control group (n=8) were organized, subject were examined: then, the experimental group performed endurance exercises for 8 weeks. At the end of the eight weeks, the two groups were examined again for weight, % body fat, and body fat mass via a bioelectrical impedance analysis (BIA). A blood sample was collected the day before the exercise program. Right after the exercise program, 5 ml of blood was collected and then centrifuged for 10 min at 3000 rpm. The centrifuged samples were stored at −73°C and sent to Green Cross for analysis; TC, TG, leptin, and insulin were analyzed. [Results] The experimental group showed a statistically significant decrease in % body fat and body fat mass as well as significant reductions in TC and TG and leptin concentrations. There was also a decrease in the exercise group's insulin concentration but is was not significant. [Conclusion] Eight weeks of exercise therapy increased energy consumption resulting in favorable changes in the body composition, blood lipid metabolism, and hormone levels in obese adult males.

Key words: Body composition, Blood lipid metabolism, Hormone

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INTRODUCTION

Research in 2007 conducted by the Korea Center for Disease Control and Prevention (KCDC) shown that the prevalence rate of obesity among Korean adults aged over 19 had increased by 5.1% over the prior decade. The prevalence rate of obesity of 32.1% was lower than American levels (34.3%), but was higher than Japanese levels (24%)[1)].

It has been reported that regular endurance exercise has a positive effect on several cardiovascular risk factors, such as increasing high density lipoprotein (HDL), total cholesterol (TC), and triglyceride (TD) and decreasing low density lipoprotein (LDL) and TC/HDL-C2[2,3)]. Moreover, exercise training is beneficial not only for decrease of body weight and body fat, which normalize metabolic diseases associated with obesity, but also for increase of muscle mass, mineral levels, and lean body mass, contributing to improved health[4)]. Thus, endurance exercise can be beneficial for a number of factors.

Long-term endurance exercise increases muscle mass by muscle fiber hypertrophy, increases the volume of oxidative enzymes in muscle cells and strengthens connective tissue, and decreases the accumulation of body fat by increasing fat combustion and increasing total blood volume[4,5)]. Increased body fat causes an increase in the production of leptin in the blood. If appetite is not able to control this increase it can lead to leptin resistance. The amount of fat tissue is maintained because sensitivity to leptin is reduced in obese people. A study dealing with leptin[6)] showed that leptin levels in the blood were positively correlated to the amount of fat tissue and body fat index[7)]. The plasma levels of leptin and mRNA in fat cells are higher in obese people, with a high correlation between body fat and % body fat, and obese people have a higher level of leptin than lean people.

Regular exercise decreases the plasma leptin level without controlling for diet associated with body mass index (BMI), lipid levels in blood, body fat, insulin levels, fatty acids, and growth hormone[8,9)]. It has been clearly shown that metabolic and hormonal impairments observed in obese people affect antioxidative systems causing an increased risk of adult diseases including atherosclerosis[9)].

Little research has been conducted on the changes of blood lipids and hormones in obese subjects. Thus, the purpose of this investigation was to identify the effects of endurance exercise on body composition, blood lipids, and hormones in male adults with obesity and to provide the information on how obese people should exercise to realize the exercise effects.

SUBJECTS AND METHODS

Sixteen obese adults males (body fat>25%) participated in this study. Subjects did not have any experience of

Table 1. The physical characteristics of the subjects

Group	Age (yrs)	Height (cm)	Weight (kg)	HRrest (beats/min)	BMI
Exercise (n=8)	27.3 ± 2.28	175.2 ± 2.26	81.3 ± 4.23	70.3 ± 6.34	26.5 ± 2.56
Control (n=8)	28.1 ± 3.11	174.9 ± 1.29	81 ± 3.32	73.4 ± 2.64	26.9 ± 1.74

exercise participation and were randomly assigned to two groups (8 = exercise group, 8 = control). Informed consent was obtained from the subjects prior to their participation in the study. Table 1 shows the physical characteristics of the subjects.

Body composition was measured. Subjects did not eat anything for two hours prior to the measurements and wore light clothes. Subjects' weight, % body fat, and body fat mass via a bioelectrical impedance analysis (BIA) were measured. Before the collection of blood samples, subjects were not allowed to eat, smoke, drink, or do strenuous exercise. On the collection day, 10 ml of blood was collected from the antecubital vein. The blood sample was removed the day before the exercise program began, and at the end of the program. 5 ml of blood was collected and centrifuged for 10 min at 3000 rpm. The centrifuged samples were stored at –73°C and sent to Green Cross for analysis. TC, TG, leptin, and insulin were analyzed.

In order to provide an appropriate exercise intensity, the exercise group underwent a treadmill test as suggested by the American College of Sports Medicine (2006). Based on the results of the treadmill test, the exercise type, frequency, intensity, and duration was individually prescribed. The exercise was a treadmill run, and the intensity of exercise was a long-term low intensity rather than a short-term high intensity. The intensity of the exercise was at 55–80% (HRmax). The intensity of exercise was determined by the exercise heart rate, measured with a polar heart rate checker, and the lactate acid level. The exercise group performed the exercise training, consisting of a warm-up, treadmill exercise, and cool down, five days per week.

Descriptive data are expressed as mean ± SD for all variables. The paired t-test was used to examine the difference between pre and post -intervention measurements. Differences were considered significant at values of $p<0.05$. The statistical analysis was conducted using SPSS for Windows^{TM} 13.0.

RESULTS

The results of pre- and post-intervention for the difference of body composition between the exercise and the control groups are shown in Table 2.

In the exercise group, pre-intervention body weight at rest was 81.34 kg, and body weight of at the end of the exercise training at rest was 79.91 kg. Although body weight decreased, the differences was not significant. There was not significant difference in the pre-and post-intervention body weights of the control group.

% body fat taken at rest in the exercise group was 28.31% and was 24.11% at the end of the exercise training. Pre-intervention % body fat taken at rest in the control group was 27.8% and 28.0% at post-intervention with no significant difference.

At the beginning of the experiment, the fat mass at rest was similar between groups (22.08 ± 2.86 vs 22.12 ± 2.35, exercise vs control). However, after the exercise training, fat mass was reduced to 18.50 kg in the exercise group, a statistically significant differences ($p<0.05$). No difference was noted in the fat mass of the control group.

The blood analysis of the exercise and control groups before and after the intervention are shown in Table 3. There was a significant difference for TC at rest (211.31 mg/d) in the exercise group ($p<0.05$). There was no significant difference for TC in the control. For TG, there was also a significant difference in the exercise group ($p<0.05$), and no difference in the control group.

As illustrated in Table 3, leptin levels in the blood at rest prior to beginning the exercise training was 5.18 ng/ml. After 8 weeks of exercise training, it was reduced to 4.51 ng/ml, a significant difference ($p<0.05$). There was no significant difference in the control. Only the exercise group showed a tendency of decrease in the insulin level ($p<0.05$).

Table 2. The changes of body composition following exercise

Variables	Group	Pre	Post
Body weight (kg)	Exercise	81.3 ± 4.23	79.9 ± 3.71
	Control	81.0 ± 3.32	81.8 ± 3.61
% body Fat	Exercise	28.3 ± 2.84	24.1 ± 3.51*
	Control	27.8 ± 2.19	28.0 ± 4.10
Fat mass (kg)	Exercise	22.1 ± 2.86	18.5 ± 3.45*
	Control	22.1 ± 2.35	21.0 ± 4.59

Note. * Significantly different between pre- and post-intervention ($p<0.05$).

Table 3. The changes of blood components following exercise

Variables	Group	Pre	Post
TC (mg/dl)	Exercise	211.3 ± 28.91	159.1 ± 25.37*
	control	216.2 ± 30.15	211.8 ± 34.21
TG (mg/dl)	Exercise	161.1 ± 31.23	129.3 ± 31.16*
	Control	162.2 ± 28.91	163.2 ± 27.91
Leptin (ng/ml)	Exercise	5.2 ± 6.01	4.5 ± 4.14*
	Control	5.2 ± 3.94	5.0 ± 4.65
Insulin (μIU/ml)	Exercise	23.1 ± 3.87	22.2 ± 4.97
	Control	23.5 ± 3.87	23.4 ± 5.64

Note. * Significantly different between pre- and post-intervention ($p<0.05$); TC = Total cholesterol, and TG = Triglycerides.

DISCUSSION

In this study, % body fat was not significantly different between the exercise and the control groups. The results of this study are not consistent with the results of Owens et al.[10] and Seung et al.[11]. The reason for this is that the endurance exercise increased the enzyme activity of lipase, decomposing triglyceride into free fatty acids, and increased the energy supply by promoting fat metabolism and fat consumption, creating an makes energy imbalance which reduced proliferating fat cells.

Owens et al. (1999) [10] found % body fat was decreased in obese children following exercise for five days a week at an intensity of 150–160 HR/min. Changes were seen for obese male middle school students after swimming exercise at three days a week for eight weeks[11]. On the other hand, 10 weeks of aerobic dance at an intensity of 60–85 VO_2max decreased % body fat in collegiate students, though not significantly[14]. Also, % body fat was not significantly different after exercise for four days a week for six weeks. In a study conducted by Flanklin et al.[12], body fat mass in middle-aged women decreased by 2.9 kg following 12 weeks of endurance exercise. Nindle et al.[13] examined the effects of endurance and resistance exercise on the body fat mass of women. The participants exercised five days a week for 24 weeks and reduced their body fat mass during the intervention.

Regarding the relationship between endurance exercise and TC, decreased TC concentration was detected in two studies[14,15]. There are several reasons for the resultant decrement in TC concentration. First, exercise increases the synthesis of apolipoprotein A-1 from the mucous membrane of the small intestine. The increased apolipoprotein A-1 promotes enables the activity of lecithin cholesterol acyltransferase activity (LCATA) that increaseing cholesterol levels in the blood. As a result, the increased cholesterol is transferred to where it is excreted, lowering the TC blood concentration. Second, exercise activates the lipase and deactivates hepatic triglycerides in the liver which induces the synthesis of TG in liver. TG increases cholesterol catabolic mechanisms and decreases the rate of TC synthesis, lowering TC levels in the body. In this study, TC levels in the exercise group were significantly decreased compared to the control. The results are consistent with the results of George et al.[15], Schuit et al.[16]. However, it has been reported that TG concentration was not changed following endurance exercise[17]. Although controversial, most studies have shown that regular exercise reduces TG concentration due to a decline in TG flow rate, the fast use of TG for energy, and increases in the activity of decomposition of skeletal muscles and fat tissues[18].

A study by Gutin et al.[8] examined the effects of endurance exercise on blood leptin concentration in obese children. The obese children exercised four days a week for four months at an intensity of 60% VO_2max. Gutin et al. found that blood leptin concentration was dramatically reduced in the exercise group. Halluzik[19] also found that leptin concentration was decreased after endurance exercise. The mechanism was not clearly explained, but the decrease in leptin concentration was due to % body fat, the size of fat cells, adrenal cortex, body fat mass, resistance of leptin, insulin, thyroid gland, and changes of growth hormone, and how these factors were affected by exercise. In agreement with Gutin et al.[18] and Haluzik et al.[19], in the present study there was a significant decrease in blood leptin concentration in the exercise group compared to the control.

Moderate exercise intensity for 12 weeks has been shown to decrease insulin levels by 8.2%[20], and a 60% lower insulin level was shown in the people who have exercised regularly[21]. In this study, there was not a significant decrease in insulin concentration in the exercise group compared to the control. It is consistent with the results of Erikson et al. and Engdahl et al.[20,21]. Insulin concentration increases following exercise because exercise suppresses the secretion of insulin from the pancreas by stimulating the sympathetic nervous system[9], and by restricting the synthesis of cholesterol by increasing the permeability of the cell membrane to insulin receptors. This allows exercise to affect the blood glucose level in skeletal muscle by increasing insulin sensitivity.

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