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Investigating the Protective Effects of Endurance and Resistance Trainings on Serum level of Cellular and Vascular Adhesive Molecules in Obese Men

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ABSTRACT

Background and objectives: Obesity, particularly abdominal obesity, is the most common cause of metabolic abnormalities, such as metabolic syndrome. The aim of this study was to compare effects of eight weeks of endurance and strength trainings on serum levels of cellular and vascular adhesion molecules in obese men.

Methods: Twenty-four obese men were randomly assigned to control, endurance training and strength training groups. The endurance training group performed a modified treadmill running protocol with an intensity of 50-70% of maximum heart rate. The resistance training included chest press, armpit stretch and leg and crus presses at intensity of 50-80% of one-repetition maximum. Serum levels of intercellular adhesion molecule-1 (ICAM-1) and vascular cell adhesion protein 1 (VCAM--1) were measured using commercial ELISA kits. Data were analyzed by one-way ANOVA and post hoc Tukey test at significance of 0.05.

Results: Serum VCAM-1 and ICAM-1 levels decreased significantly in both training groups compared to the control group (P=0.0001). The reduction of serum VCAM-1 and ICAM-1 levels was more significant in the endurance training group than in the resistance training group.

Conclusion: Given the favorable effects of endurance and resistance trainings on serum levels of VCAM-1 and ICAM-1, the eight-week training could be performed as a protective intervention in obese people.

Keywords: Endurance Training, Resistance Training, Intercellular Adhesion Molecule-1, Vascular Cell Adhesion Molecule-1, Obesity

INTRODUCTION

The prevalence of obesity is growing rapidly worldwide, not only in industrial societies but also in developing countries. Nowadays, adipose tissue is considered as a very active endocrine organ that plays a role in the regulation of metabolism by secreting multiple hormones (1). According to the council of National Cholesterol Education Program (NCEP), obesity, particularly abdominal obesity, is the most common cause of metabolic abnormalities, such as metabolic syndrome (2, 3). Older individuals are more susceptible to this condition due to the coincidence of inactivity, increased visceral abdominal fat and decreased muscle mass (3, 4). Recent findings have demonstrated that obesity and metabolic syndrome components such as type II diabetes, insulin resistance, blood lipid anomalies and hypertension are closely associated with the secretory function of adipose tissue (5, 6).

Obesity is a risk factor for atherosclerosis. Obese individuals have higher levels of inflammatory cytokines and vascular cellular adhesion molecules (VCAM) and intercellular adhesion molecules-1 (ICAM-1) compared to healthy individuals (7).

Measuring adhesion molecules appears to be a useful tool for the effective diagnosis of various environmental factors in vascular disorders (8). Obese people are exposed to metabolic diseases due to their sedentary lifestyle and improper feeding patterns. In these people, many metabolic syndrome criteria such as low-density lipoprotein, high-density lipoprotein (HDL), triglycerides and cholesterol have high fluctuations that can result in inflammation and cardiovascular disease (CVD). Increased obesity leads to atherosclerosis, partly through the progression of chronic low-grade inflammatory conditions and endothelial dysfunction (9). Increased levels of inflammatory indices, such as ICAM-1 and VCAM-1, in obese patients play an important role in the development of endothelial disorders or atherosclerosis. These inflammatory indices have been considered as strong predictors of CVD events in obese and overweight people (10). Recently, researchers have focused on the impact of interventions, such as diet, weight loss, and exercise, on vascular inflammation factors. It hasbeen reported that plasma concentrations of ICAM-1 decrease significantly in obese diabetic subjects after six months of moderate-intensity endurance activity two sessions per week for (11). Evidence concerning the effect of exercise on the level of ICAM-1 and VCAM-1 has been contradictory (12, 13). An increase in adhesion molecules causes monocyte invasion in endothelial vessels and increases the permeability and activation of platelets (10). Increased levels of adhesion molecules have been shown to induce vascular endothelial activation and inflammation. Researchers believe that these molecules are directly involved in various stages of atherosclerosis and other chronic diseases such as dyslipidemia, connective tissue disorders and some cancers (14) . Hence, increased levels of adhesion molecules can be used as a sign of primary atherosclerosis and coronary heart disease. The present study aimed to investigate the effects of endurance and resistance training on cellular and molecular adhesion inflammatory indices.

MATERIALS AND METHODS

In this quasi-experimental and applied research, 24 obese volunteer men with a body mass index (BMI) of > 25 kg/cm2 were selected from Tehran, Iran (Table 1). The participants were randomly assigned to three groups of control, endurance training and resistance training. The subjects had no history of disease and hormonal disorders and were not under medication during the study. They also had no athletic background and did not participate in other training programs for at least six months before participating in our training program. The health status of the subjects was assessed with a standardized health questionnaire with emphasis on consumption of alcohol, soft drinks, cigarettes, etc.

The endurance training group performed a modified treadmill running protocol with intensity of 50% of maximum heart rate (HRmax) for 16 min/day in the first week. The intensity gradually increased to 70% of HRmax for 30 min/day in the eighth week. Resistance exercises included chest press, armpit stretches and leg and crus presses. In the first week, the training intensity was performed at 50% of one maximum repetition (1-RM), two sessions a week. Each session included three sets of 10 repetitions and a 1-min rest between the sets with 1-3 min rests between each movement.

The training intensity doubled every week, so that it increased to 80% of 1-RM in the eighth week as three sessions a week, and each session included three sets of six repetitions and the same resting times between the sets and movements (15). In order to measure serum levels of VCAM-1 and ICAM-1, fasting blood samples were collected at baseline and 48 hours after the last training session. Serum levels of VCAM-1 and ICAM-1 were measured using commercial ELISA kits (Pars Azmoon Co., Iran). Differences between groups were examined using one-way analysis of variance (ANOVA) and Tukey's post hoc test at a significance level of ≤0.05. All statistical analyses were performed using SPSS 23 software. The Kolmogorov-Smirnov test confirmed normality of data distribution.

Table 1- Anthropometric characteristics of the subjects

Group	Age (year)	Weight (kg)	Height (cm)	BMI (kg/cm^2)
Control	33.8 ± 2.11	79.01 ± 2.6	173 ± 7.14	26.4
Endurance training	33.4 ± 2.83	78.69 ± 2.4	172 ± 7.25	26.6
Resistance training	33.9 ± 2.52	79.44 ± 2.8	172 ± 7.12	26.9

Table 2- Mean serum level of ICAM-1 (ng/mL) in the study groups

Group	Mean	Standard deviation	Minimum	Maximum
Control	762.29	11.26	722.20	819.23
Endurance training	411.34	16.62	384.27	460.23
Resistance training	562.11	14.19	539.87	599.14

Table 3-Mean serum level of VCAM-1 (ng/ml) in the study groups

Group	Mean	Standard deviation	Minimum	Maximum
Control	1211.93	44.72	112.22	1287.23
Endurance training	614.12	22.69	584.21	660.24
Resistance training	826.62	30.19	889.87	784.19

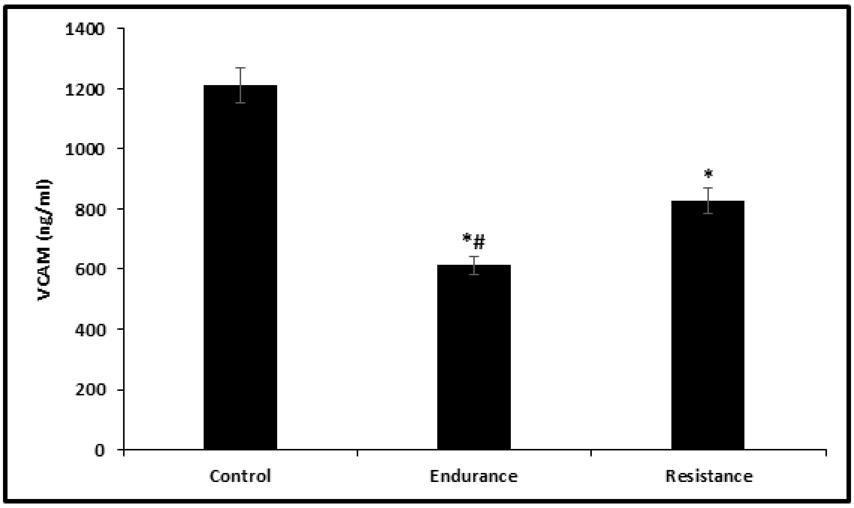

Figure 1- ICAM-1 changes (ng/mL) in the study groups. * and # indicate significant differences with the control and endurance training group, respectively

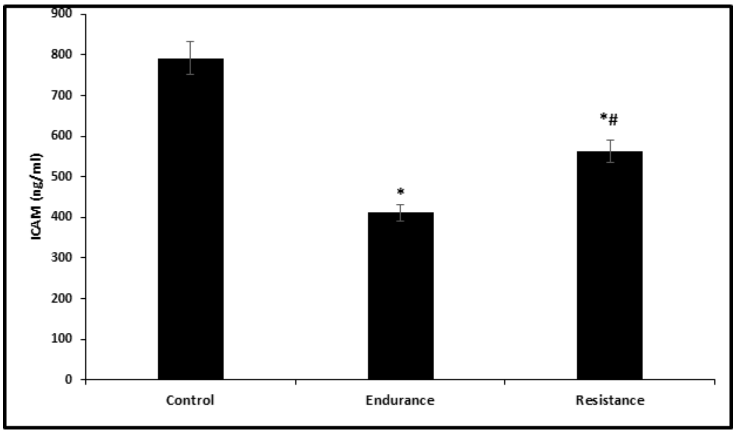

Figure 2- VCAM-1 changes (ng/ml) in the study groups. * and # indicate significant differences with the control and endurance training group, respectively.

RESULTS

The level of ICAM-1 decreased significantly in the training groups compared with the control group (P=0.0001) (Table 2). Moreover, the decrease in the level of ICAM-1 was more significant in the endurance training group than in the resistance training group (P=0.0001) (Figure 1).

Serum VCAM-1 level also decreased significantly in both training groups compared to the control group (P=0.0001) (Table 3). However, the decrease was more profound in the endurance training group compared to the resistance training group (P=0.0001) (Figure 2).

DISCUSSION

In the present study, we aimed to investigate the effects of endurance and resistance trainings on serum level of adhesion molecules as the most important risk factor for sudden death in obese people. Our findings demonstrated significant reductions in serum levels of VCAM-1 and ICAM-1 in obese men after eight weeks of endurance and resistance training intervention. However, further analysis of data revealed that endurance training was more effective than resistance training in reduction of serum VCAM-1 and ICAM-1 levels in obese people. In line with the present study, Tofighi et al. examined the effect of eight weeks of aerobic activities on circulatory adhesion molecules in obese women. They reported that serum VCAM-1 levels decreased significantly only in the exercise-supplement (combination) group (16). Silva et al. presented evidence of reduced VCAM-1 expression and inflammatory mediators as a result of aerobic exercise (17).

A beneficial effect of exercise on vascular endothelial function is an increase in plasma HDL-cholesterol levels, which results in the release of prostacyclin from smooth muscle cells, preventing plaque accumulation and reducing adhesion molecules. In obese people, not only more cytokines are produced due to higher adipose tissue content, but there are also higher levels of intramuscular cytokines (myocaines) (15). Increased physical activity along with weight loss and medication can effectively reduce levels of these cytokines and the overall risk of inflammation. Therefore, the reduction of cellular and vascular inflammatory indices observed in the present study can be associated with reduced fat mass. Exercise lowers blood inflammatory indices and pre-inflammatory conditions and improve endothelial function. This is achieved by reduction of anti-inflammatory cytokine production, weight loss, reduction of anti-inflammatory intermediate production and increased production of anti-inflammatory mediators in adipose tissue (18).

Therefore, it can be assumed that a reason for the decrease in inflammatory indices in the present study is related to the control of CRP levels and an improvement in insulin sensitivity. Zabet et al. also evaluated the effect of regular aerobic activity on CVD risk factors (ICAM-1, VCAM-1, and lipid profile) in sedentary obese men. The waist-to-pelvis ratio, weight and BMI of their subjects reduced significantly in the experimental group. They reported a significant relationship between waist-to-pelvic circumference ratio and ICAM-1 and VCAM-1 resting levels.

They concluded that changes in ICAM-1 and

VCAM-1 levels were possible if the training was performed at an intensity of 60-65% of reserve heart rate. On the other hand, although changes in the fat percentage, weight and central obesity of subjects occur in parallel with reduction of VCAM-1 levels, these two may not be significantly correlated in young men. In this regard, Rosetti et al. observed no change in VCAM-1 levels after 12 weeks of circular resistance training (19).

Rayan et al. found that aerobic exercise and weight loss could reduce vascular inflammation indices and improve insulin sensitivity in obese women (20).

CONCLUSION

Overall, the results showed that serum levels of VCAM-1 and ICAM-1 decreased significantly following eight weeks of training intervention. This decrease was more significant in the endurance training group. Given the association of VCAM-1 and ICAM-1 with risk of CVD, performing exercise, particularly endurance training, can be a protective and therapeutic approach for obese people.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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