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Anti-inflammatory property of short-term regular exercise training in the absence of weight loss

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Abstract

To evaluate the effect of short-term aerobic training on serum C reactive protein as a proinflammatory cytokine, thirty four sedentary healthy obese or overweight women matched for age (38.06 ± 4.83 years of old) and BMI (26 ≤ BMI ≤ 35) participated in this study by accidentally samples and were randomly divided into control and exercise group. For this purpose, fasting serum C reactive protein (CRP) and all anthropometrical markers were measured before and after a aerobic exercise program (6 weeks/3 times weekly) in two groups. Student's paired 't' test was applied to compare the pre and post training values. Aerobic training led to decrease in body weight and body mass index but insignificantly. Serum CRP decreased significantly after exercise program when compared to pre-training in exercise group. All variables remained without change in control subjects. Based on these data, we can say that aerobic training for short-time improves serum CRP independent of each change in anthropometrical markers in obese or overweight women.

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Introduction

There is considerable evidence that obesity is associated with systemic inflammation and metabolic syndrome. Obesity or overweight are chronic inflammatory disease where various cytokines/adipocytokines play a key role. Accumulating evidence indicates that adipose tissue secretes a variety of pro or anti-inflammatory mediators including adipocytokines such as adiponectin, leptin, resistin, or classical cytokines such as the pro-inflammatory mediators C reactive protein (CRP) and interleukin 6 (Hotamisligil *et al.,* 2006; Tilg *et al.,* 2006).

The cytokines produced by the adipose tissue have a key role in promoting atherosclerosis and cardiovascular related diseases (Ekmekci *et al.,* 2006). Among them, C reactive protein as a pro-inflammatory cytokine has emerged as one of the most powerful independent predictors of cardiovascular disease risk and cardiovascular death (Takemura *et al.,* 2006). This inflammatory cytokine is a key inflammatory factor that produced by the liver in response to an acute infection or inflammation and its concentration in plasma can increase as much as 1000-fold during injury and infection (Schultz *et al.,* 1990). Review of research findings show that CRP can be predicts CVD more so than other cytokines (Nicklas *et al.,* 2005). Recent epidemiologic studies have demonstrated that CRP in combination with age, hypertension, and diabetes were the most outstanding risk factors associated with CVD in this population (Panagiotakos *et al.,* 2008).

Previous investigations have described a positive association between plasma C-reactive protein (CRP) concentrations, an excellent marker of inflammation, and cardiovascular disease in both men and women (Bermudez *et al.,* 2002; Ridker *et al.,* 2002). There are Contradictory findings about inflammatory cytokines responses to the kind of exercise training in obese, obesity related diseases of healthy population. In this area, some previous study confirmed beneficial role or exercise training on CRP (Campbell *et al.,* 2008), while other studies Have denied CRP response to exercise training following long term exercise training (Kim *et al.,* 2008). Given these contradictory findings, this study was evaluated the effect of 6 weeks regular exercise training on serum CRP and anthropometrical indexes in overweight or obese middle-aged women.

Materials and methods

Subjects

In this study, we evaluate the effect of short term aerobic training on serum CRP in middle-aged women who did not perform regular exercise and were sedentary. Sedentary lifestyle was defined; as no leisure time physical activity or activities done for less than 20 minutes or fewer than 3 times per week (Richa *et al.,* 2010). For this purpose, thirty four non-trained healthy women matched for age (38.06 ± 4.83 years of old) and BMI (26 ≤ BMI ≤ 35) participated in this study by accidentally samples. The subjects chosen for the study was divided into two groups by accidently as follows: Exercise group: It included 17 healthy that participated in aerobic program (6 weeks/3 times per week). Control group: It included the same 17 healthy without participation in exercise program in this period.

The study was approved by the Ethics Committees of Islamic Azad University, Iran. Written consent was obtained from each subject after the experimental procedures and possible risks and benefits were clearly explained.

Inclusion and exclusion criteria

A detailed history and physical examination of each subject was carried out. The range of Body mass index of the subjects was 26-36 kg/m2. Neither the control or exercise subjects had participated in regular exercise for the preceding 6 months, nor did all subjects have stable body weight. Subjects with any history of smoking, chronic cough, recurrent respiratory tract infection, history of chest or spinal deformity, personal history of asthma, chronic obstructive lung diseases were excluded from the study.

Anthropometric measurements

All anthropometric measurements were made by the same trained general physician and under the supervision of the same pediatrician following standard protocols. Anthropometric measurements of participants were performed while they stood in light clothing without shoes. Height was measured to the nearest 0.1 cm using a free-standing stadiometer. Body weight was measured in duplicate in the morning following a 12-h fast. Visceral fat and body fat percentage was determined using body composition monitor. Body mass index was calculated as weight (kg) divided by squared height (m).

Table 1. Mean and standard deviation of anthropometrical and biochemical parameters before and after intervention in studied groups.

Variables	Exercise group		Control group	
	Pretest	post-test	Pretest	post-test
Age (year)	38.06 ± 4.83	38.06 ± 4.83	38.3 ± 4.14	38.3 ± 4.14
Height (cm)	161.2 ± 5.62	161.2 ± 5.62	161.8 ± 6.3	161.8 ± 6.3
Weight (kg)	82.48 ± 7.19	82.29 ± 7.17	82.70 ± 6.21	82.49 ± 5.6
Waist circumference (cm)	109 ± 8.3	108.6 ± 8.77	110.1 ± 7.6	110.14 ± 5.9
Hip circumference (cm)	113.1 ± 7.1	112.7 ± 7.24	114.1 ± 8.3	113.8 ± 7.13
Abdiminal to hip ratio	0.96 ± 0.07	0.97 ± 0.07	0.97 ± 0.06	0.97 ± 0.08
BMI (kg/m2)	31.76 ± 2.73	31.69 ± 2.74	31.59 ± 3.8	31.51 ± 2.8
Body fat (%)	44.86 ± 3.7	44.76 ± 3.70	45.2 ± 4.21	45.8 ± 3.41
C-reactive protein (ng/ml)	6561 ± 2747	6561 ± 2747	6470 ± 1974	6533 ± 2112

Blood measurement and Exercise protocol

After physical examination, all subjects in the experimental and control groups were asked to attend Hematology Lab following 12 hours of overnight fasting, between the hours of 8 to 9 am for blood sampling in order to measuring serum CRP. The subjects were advised to avoid any heavy physical activity 48 hours before the blood sampling. Then the subjects of exercise group were completed an aerobic exercise program (6 weeks/3 times per week). Each session lasted 60-90 min at intensity in 60-80 of maximal heart rate. During their training period they performed different types of exercises included running on a flat surface and Kick pedal on a stationary bicycle for 3 times weekly. All anthropometrical and biochemical measurements were repeated 48 after last exercise session in two groups.

Statistical analysis

Statistical analysis was performed with the SPSS software version 15.0. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Independent student t test was used for between groups comparison at baseline. Student's paired 't' test was applied to compare the pre and post training values. A p-value of less than 0.05 was considered to be statistically significant.

Results

Anthropometric and metabolic characteristics of the study participants in the exercise and control groups are shown in Table 1. The finding of independent T test showed no significant differences in serum CRP and all anthropometrical markers between exercise and control group at baseline ($p \geq 0.05$). All values are given as mean and standard deviation in table 1.

Data of Paired T test showed that aerobic training was not associated in anthropometrical markers in exercise group ($p \geq 0.05$). On the other hand, there were not significant changes in anthropometrical markers as body weight or body mass index in response to exercise training in exercise group.

Compared to pre-training, the serum CRP levels decreased (P=0.035) significantly after exercise program in the exercise but not in the control groups ($p \geq 0.05$, Fig. 1).

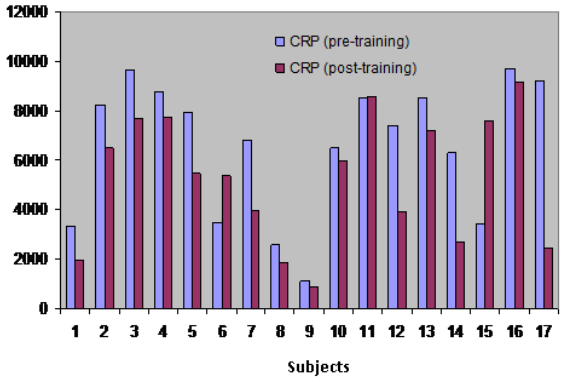

Fig. 2. The change pattern of serum CRP before and after aerobic exercise training in exercise group. Each pair of vertical columns represents one subject.

Discussion and conclusion

In present study, we investigated the effect of 6 weeks regular exercise training including aerobic program on C reactive protein and it's related with the change in anthropometrical parameters. The main finding was significantly decreased in serum CRP in studied subjects. As mentioned in the previous section the subjects were healthy overweight or obese women.

Relationship between obesity and systemic inflammation has been reported by many previous studies. A growing body of literature suggests the possibility that local and systemic inflammation may be important mediators in the development of insulin resistance and type 2 diabetes in many individuals (Yudkin *et al.,* 2000; Festa *et al.,* 2000)

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Review of research evidence shows that adipocytes, particularly those located within the visceral fat, are major secretors of both pro and anti-inflammatory factors, often referred to as adipokines (Havel, 2002).

Clear evidence has established that inflammatory cytokines may cause vascular dysfunction through progression of atherosclerosis, oxidative stress, NO impairment, vasoconstriction, endothelial cell apoptosis and adverse vascular remodeling (Anker *et al.,* 2004).

A number of independent studies have indicated numerous mechanisms by which CRP may directly contribute to vascular inflammation and atherosclerosis (Pue *et al.,* 1996, Zwaka *et al.,* 2001). Animal and preliminary human research has also suggested that that C-reactive protein (CRP) as an inflammatory cytokine, a sensitive physiological marker of subclinical systemic inflammation, is associated with hyperglycemia, insulin resistance, and overt type 2DM (Hong *et al.,* 2007; Utzschneider *et al.,* 2006).

Because many of obesity induced diseases are associated with increased adiposity, it is not clear whether these differences in CRP would remain after adjustment for visceral adiposity or physical activity levels. Regular exercise training as a non-pharmological treatment has been demonstrated as one of the factors determining long-term weight maintenance in weight-reduction programs (Eizadi[b] *et al* 2011; Eizadi[b] *et al.,* 2011). Beside the effects on body weight or the other anthropometrical parameters, exercise training is associated with improvement health benefits such as improved insulin sensitivity, lipid or cytokines profile.

Although a growing body of literature suggests that exercise in combination with weight loss diets can be affect inflammatory and anti-inflammatory cytokines, it is not clear whether exercise in the absence of weight loss or dietary interventions can modify their levels. In present study, we observed significant decrease in serum CRP in response to 6 weeks aerobic training in studied subjects while anthropometrical markers remained unchanged. In fact, although in our study, some anthropometrical parameters as body weight or body fat percentage were decreased after exercise program, but were insignificantly for statistical perspective. The finding of a recent study showed that the changes in serum CRP or adiponectin in response to exercise training are not associated with the changes in body fat percentage or some other anthropometrical markers (Marcell *et al.,* 2005).

On the other hand, some previous studies have pointed out that a minimum weight loss of 5% is

required to improve adipokine profile and decrease fat cell size in obese men (Varady *et al.,* 2009). But despite these statements, in present study, we observed a decrease in serum CRP Despite the lack of significant weight loss in studied subjects. Based on these data, we conclude that the change in serum CRP as a pro-inflammatory cytokine after aerobic training is independent of any change in anthropometrical markers in overweight or obese women. To support these findings some recent evidence also support that Regular physical activity, independently of BMI, is associated with lower risk of all cause mortality (Hu *et al.,* 2005).

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