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A Single Circuit-Resistance Exercise Effects on Inflammatory Markers of Atherosclerosis; hs-CRP and Homocysteine in Women

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Keywords

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Abstract

Cardiovascular diseases such as atherosclerosis are considered as the main causes of mortality in today's industrial world. Increase of the basal level of high sensitive C-reactive protein (hs-CRP) and Homocysteine have been introduced as the main and independent next major risk factors for cardiovascular disease. The purpose of this study was to investigate the effect of a single circuit-resistance on blood levels of these inflammatory markers in overweight women. Twenty one subjects were randomly assigned into experimental and control group. The exercise program included nine stations whit 40% one-repetition maximum subjects. Blood levels of hs-CRP and Homocysteine were measured before and immediately after exercises. Dependent t and independent t were used in the two groups and between the groups respectively to compare pre-test and post-test data. The findings indicated that, the levels of hs-CRP and Homocysteine after exercise had a significant increase compared to before the exercise ($P<0.05$). The variations were also significant compared to the control group, hs-CRP and Homocysteine respectively ($P=0.003$, $P=0.001$). The results of correlation coefficient in the present study showed no significant statistical relationship between hs-CRP and Homocysteine ($P=0.587$, $r=0.175$). A single circuit-resistance exercise with 40% of 1RM causes to increase of the levels of hs-CRP and Homocysteine in overweight women. Considering the different achieved results in different studies, more researches are needed on the impact of acute physical activities as well as long-term periods on the levels of risk factors for atherosclerosis.

1. Introduction

Atherosclerosis is a cause of disability and mortality in the advanced world which leads to thickening of the vessel wall and lipid accumulation (1). The initial symptoms of the disease is to increase the thickness of the inner layer of the arterial in which progress, fat deposits, plaque formation, reducing the diameter of the artery and the vein thrombosis are observed (2). By the start of process of the mentioned disease, the destruction resulted by internal pressure on the vessel wall is increased and dilation of the arteries is decreased due to thickening of the arteries. High-fat fed and reduced mobility is the most important cause of this disease (3). Atherosclerosis is a slow and progressive process which begins since childhood and leads to clinical symptoms in adulthood (4). Past studies and recent findings have classified the cardiovascular diseases into two classes: 1- Traditional risk factors include Hyperinsulinemia, hyperlipidemia, obesity, sedentary lifestyle, and hypertension. 2- The pathogenesis of multiple confounding risk factors, such as changes in homocysteine concentration, C - reactive protein and inflammatory mediators (5).

C reactive protein is a spherical protein among plasma soluble glycoproteins which is made in the liver, and act after tissue damage, infection, inflammation, burns and a series of acute phase reaction. Hs-CRP is related to obesity, metabolic syndrome (6, 7) and insulin resistance (8, 9).

Homocysteine (2-amino-4-mercapto butyric acid) is a Sulfur amino acid which is produced by animal proteins. Increase of homocysteine in blood is known as Hyperhomocysteinemia which has several effects such as atherosclerosis, venous thrombosis, and increase growth of vascular smooth muscle cells and inhibits the growth of endothelial cells (10). Increased serum levels of homocystein and CRP is related to increased incidence of cardiovascular disease (11, 12) so that, increased hs-CRP index predicts future risk of plaque rupture (13). Exercise and physical activity is a factor affecting the concentration of homocysteine and CRP. Some of researchers have reported an inverse relationship between hs-CRP and cardiovascular fitness (8, 14, 15). Some studies also, have reported the lack of association between physical activity and hs-CRP (16, 17) and a negative relationship between homocysteine and physical activity (18). Conflicting results have been reported on the effects of acute exercise training on CRP and homocysteine by the researchers. In some of the mentioned studies, acute exercise caused to increase homocysteine and hs-CRP levels (19, 20); while, some other studies showed that, acute exercise has no impact on homocysteine and hs-CRP levels (21, 22). Among various forms of physical activities and exercises, circular progressive resistive exercise is used for simultaneous increase in muscle strength and cardiovascular endurance, and the exercise makes large muscle groups (upper and lower extremities) involved, and different muscles are used in different times that may not to be possible in many aerobic activities such as walking and cycling (13-15), and these exercise can be planned in accordance to physical conditions of any person. In this type of exercise, a lively and interesting environment is generated in terms of competition for the people that increases their tendency for doing exercise. Therefore, the objective of the present study is to investigate the response of homocysteine and hs-CRP atherosclerosis inflammatory markers to circular power exercise.

Hard exercises reduce capacity of the body to fight free radicals and active oxygen and can cause oxidative stress (23, 24). Lack of physical activity or restricting it causes to increase oxidative stress significantly, and more tissues are exposed to damages (23). Therefore, inconsistent scientific findings on the role of various types of physical activities and its components (frequency, volume and intensity) on cardiovascular inflammatory markers, especially confounders made the effect of acute power exercise to predictive inflammatory markers of the risk of atherosclerosis, homocysteine and hs-CRP on the 30-40 years old healthy and inactive women possible.

2. Material & Method

This study included 21 overweight and inactive women who were randomly divided into experimental group (n=12) and control group (n=9). experimental group with the mean age of the 33.83 ± 5.383 years, height of 161.49 ± 5.547 cm, weight of 71.39 ± 8.55 kg, and the control group with the mean age of the 35.56 ± 3.71 years, Height 161.15 ± 3.5 cm, weight 71.21 ± 8.88 kg, BMI of 27.56±2.55 kg/m^2 and the control group with the mean age of the 35.56 ± 3.71 years, Height 161.15 ± 3.5 cm, weight 71.21 ± 8.88 kg, BMI of 27.17±1.55 kg/m^2. Health situation of the objects was investigated by examination and diagnostic tests, electrocardiogram and blood pressure by doctor, and their physical activity level was determined the questionnaire of physical activity. The criterion for selection of participants included no liver disease, heart disease, diabetes, high blood pressure and they were not taking any medication and special food affecting the concentration of homocysteine and hs-CRP and dietary supplements. Also, they have not participated in any regular exercise program during the recent three months.

Body composition measurements were conducted after filling the consent form by the participants. The participants' height was measured without shoes and their weight was measured without shoes and clothes. Body mass index was calculated by the body weight (kg) divided by squared height (m). The control group did no exercise. A briefing meeting was held for all participants a week before conducting the main protocol. Also, the values of a maximum repetition (1-RM) of nine used motions for the experimental group was determined using the following equation:

A maximum repetition = the moved weight / 1.0278 (Number of repetitions to fatigue*0.0278) (25).

The exercise program included nine stations of shoulder press, leg press, press both ends of the arm, knee extension, bench press, knee flexion, extension Triceps, standing heel, wiring boat (rowing) (26). The collection of the stations activities was carried out for three rounds and there was one minute rest after each round, but, there was no rest between the stations. Each station took 25 seconds. The participants were asked to do the motions with their maximum speed and ability, and they went to the next station without any rest after each station. Work pressure in each station was equal to 40% of 1RM of the participants in the same station. All the participants were fasted at least for 12 hours while performing the exercise program. A blood sample was taken from the arm vein of each person 30 minutes before and just after the exercise in the interval of 7:30-9:30 AM for measurement of serum levels of hs-CRP and homocysteine, and then, the collected samples were transmitted to the medical laboratory. For quantitative determination of the amount of hs-CRP and homocysteine, specific kits were applied using immunoturbidimetry method with high sensitivity and ELISA method respectively.

For data analysis, descriptive statistics was used to calculate central indices and drawing the tables. In the section of inferential statistics, Kolmogorov-Smirnov test was used to observe natural distribution of the data, and also, Levine's test was pre-test and post-test. According to the results of serum homocysteine concentration was higher after the exercise than before exercise in the experimental group ($p<0.05$). The mentioned variations was also significant compared to the control group. In comparison between the control

used to test homogeneity of data variances. Dependent t-test and independent t-test were used to investigate intragroup and intergroup significance in pre-test and post-test respectively. Also, Pearson correlation coefficient test was used to investigate the relationships among the variables. All statistical operations were conducted by SPSS software version 18. Significance level was $p<0.05$.

3. Results

The results of Kolmogorov–Smirnov test in both groups showed that the distribution of data was normal. Objective of the present study is to investigate the impact of acute power exercise on the blood levels of inflammatory markers of hs-CRP and homocysteine in the overweight women. Table 1, shows the values of serum indices in the experimental and control groups at two stages of

and experimental group also, CRP values showed a significant increase after an exercise session compared to the before ($p<0.05$). The results of Pearson correlation coefficient showed no significant statistical relationship between hs-CRP and homocysteine ($p<0.05$).

Table 1. Variations of hs-CRP and homocysteine

Variable	Control group			Exercise group			(Independent) T
	Pre-test	Post-test	P	Pre-test	Post-test	P	P**
hs-CRP	0.57±0.1	0.5±0.08	0.743	0.58±0.14	0.97±0.08	0.002	0.003
H Homocysteine	4.08±0.41	4.23±0.42	0.820	4.75±0.47	5.84±0.62	0.001	0.001

* Significant at $p<0.01$ according to the results of paired sample t-test

** Significant at $p<0.01$ according to the results of paired sample t-test

4. Discussion

The present study investigated the impact of one session of acute power exercise with 40% IRM intensity on healthy and inactive women. Also, this study was conducted to investigate hs-CRP and homocysteine variations.

Comparison of the findings indicated a significant increase in the amount of hs-CRP after one session of circular power exercise. Several studies examined the effects of exercise training on hs-CRP levels in healthy and inactive participants, but they were different from this study in their protocols or subjects. One study showed significantly increased of CRP after a session of acute resistance exercise in inactive elder men, Of course types of exersices were defferent from existence Research (20). Makovich et al. stated that, no significant variation was observed in hs-CRP levels after 30 minutes walking on treadmill with 50% VO_{2max} in 12 inactive 50-55 years old healthy men (21). Also, Murtaq et al. investigated the effect of 45 minutes walking with intensity of 60-70% VO_{2max} on CRP and IL-6 of 50 healthy inactive 45-55 years old men, and the results showed that, IL-6 level was reduced within 24 hours after exercise but, CRP level had no change (27).

Available findings and researches show a twofold nature for immune response to the physical activities. Exercise and hard activities having strong introvert with high mechanical stress cause muscle injury and can cause Cytokine release (28, 29). In low mechanical stress exercise, CRP level is decreased (30). In the present study, the applied exercise was circular power with high intensity. Generally, intensity, duration and type of the exercise, amount of muscle injury and volume of the involved muscles can affect CRP response to the physical activity (31). Although muscle injury (32) and local production of CRP can be as the causes of the increase of serum CRP after exercise (33). IL-6 is produced in many tissues and skeletal muscle (34), and adipose tissue (35). Production of interleukin increases from adipose tissue in overweight and obesity (36). One of the main effects of interleukin, is stimulate the production of CRP (37). The researchers have suggested that, muscle damage resulted from exercise is responsible to produce IL-6 by TNF- α and IL-1 and also, IL-6 that is produced at the beginning of inflammatory response to repair muscle damage, is the main stimulus of CRP hepatic production (33). Subjects of the study have overweight, Those with higher BMI, have higher CRP concentrations. This is due to the release of IL-6 from the adipose tissue, which causes to CRP secreted from the liver (38). In women who were taking estrogen, estrogen causes to increases IL-6 and CRP (38).

Also, the results of this results showed a significant increase in serum homocysteine after one session of circular power exercise which is consistent to the results of Bindini et al. and Herman et al. Bindini mentioned that, homocysteine levels of 5 marathon runner men showed a significant increase after 21 km running with high intensity (19). Herman conducted a study on 100 active men and women and showed that, acute endurance exercise causes to increase homocysteine level of the athletes (39). In contrast, Subesi et al. investigated the effects of acute resistance and aerobic exercises on homocysteine levels and lipid profile of 50 healthy students with mean age of 21 years. They found that, one session of moderate aerobic exercise causes to increase homocysteine levels of plasma but, one session of resistance exercise does not have such effect (22). Chen et al. also reported that, one session of cycling program with 80% VO_{2max} for 30 minutes has no impact on homocysteine level of the young men (40).

Kunig et al. reported that, intense acute exercise causes to increase homocysteine level of plasma in young men (41). In contrast, DiCarry et al. found that, homocysteine levels of plasma do not affected by under maximum acute exercises (42). The mentioned results were confirmed by Right et al. They stated that, 30 minutes of acute exercise with 70% of VO_{2max} has no impact on homocysteine level (43). Exercise program of this study had high intensity, so, it was an effective factor in significant increase of homocysteine level of serum after the exercise. Men (30 to 40 years old) have mainly higher homocysteine levels from women, Which this difference is attributed to estrogen, because the homocysteine level increases during menopause (10). Estrogen also reduced homocysteine in premenopausal and pregnant women (44).

Methionine is converted to homocysteine during its metabolism by some reactions. The produced homocysteine has three fates: 1) It is converted into Methionine consuming Betaine and production Dimethylglycine during some reactions. 2) It is converted into methionine along remethylation direction in which Folic acid and vitamin B12 participate as cofactor. 3) It is turned to amino acid cysteine during the reactions of trans-sulfuration direction. In the mentioned direction, existence of vitamin B6 is essential as cofactor (44). During a long and hard exercise, Glycogen resources is reduced dramatically; consequently, the need for the reactions dependent on vitamin B6 is increased. In these reactions, vitamin B6 as an enzyme as a coenzyme for Transaminase, decarboxylase and glycogen phosphorylase. Consequently, in such conditions, Vitamin B6 is not available enough to perform the reactions of trans-sulfuration direction properly. This is a cause to increase homocysteine. Also, during the demethylation direction, S-adenosylmethionine gives its methyl, and S-adenosyl homocysteine and keratin are produced. Since, hard exercise depends on ATP-PC, production of required keratin in the body causes to increase homocysteine (45). Generally, the results of this research showed that, doing a session of acute power exercise causes to increase hs-CRP and homocysteine levels in healthy and inactive 30-40 years old women. According to different achieved results in different studies, more researches are needed on the effect of acute physical activities as well as long-term periods on the risk factors for atherosclerosis.

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