Original Article

The Effect of Eight-Week Aerobic Training on Serum Angiotensin Converting Enzyme and Lipid Profile in Inactive Overweight Women

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Abstract

Background & Objective: At present, the prevalence of hypertension is growing and one of the contributing factors in the occurrence and development of hypertension and atherosclerosis is impaired renin–angiotensin system which in this system endothelium angiotensin converting enzyme is the main enzyme. The aim of this study was to investigate the effect of eight weeks aerobic training on serum angiotensin converting enzyme and lipid profile in inactive overweight women.

Materials & Methods: In this semi-experimental study, twenty healthy women (20-30 years old) with BMI>25 kg/m ^{2} were randomly divided into training group (n = 10) and control group (n = 10). The training group performed aerobic exercise for eight weeks, three sessions per week with 55-75% of maximum heart rate. The duration of each training session was increased from 40 to 60 minutes gradually. 48 hours before and after aerobic training program, anthropometric measurements, VO_2max, lipid profile, angiotensin-converting enzyme (ACE) of all subjects were measured. Data were analyzed with paired t-independent test and t-student test at a significance level of $P<0.05$.

Results: Results showed that eight weeks of aerobic training had a significant effect on weight (p=0/01) and BMI (p=0/01) in training group; While changes in angiotensin converting enzyme (p=0/543) and LDL(p=0/927), HDL(p=0/120), Triglyceride (p=0/788) and Cholesterol (p=0/324) during pre-test and post-test was not significant in between groups.

Conclusion: Eight weeks of training program have improved angiotensin converting enzyme, LDL, HDL, Triglyceride and Cholesterol in women, approximately. And it can be said that regular exercise may probably have a preventive effect on the prohibition of cardiovascular disease in overweight women.

Keywords: Angiotensin converting enzyme, Lipid profiles, Aerobic training, Inactive overweight women

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Introduction

Today, coronary artery disease is the leading cause of mortality in the developing countries. As shown by the epidemiologic studies, the prevalence of hypertension is increasing in the industrialized societies, in a way that 10-15% of the adults are diagnosed with this condition (1). In Iran, the improper lifestyle has increased the possibility of hypertension to more than 18%. Accordingly, the Isfahan Cardiovascular Research Center has reported (2012) that one out of five Iranians has hypertension (2). More than 12 million adults aged ≥ 20 years are diagnosed with systolic blood pressure higher than 140 mm Hg or diastolic blood pressure greater than 90 mm Hg (2).

Lipid profile has been considered as an indicator of cardiovascular diseases for a long time. Nevertheless, evidence suggests that some

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individuals were diagnosed with cardiovascular diseases regardless of having appropriate levels of high- and low-density lipoprotein levels (3, 4). Therefore, the attention of the researchers has been shifted towards the indicators, which predict the risk of cardiovascular diseases with more accuracy and sensitivity. In this regard, some previous studies have indicated that some of these indicators, such as angiotensin-converting enzyme (ACE), are associated with the development of cardiovascular diseases (5-7).

The impairment of renin angiotensin system is one of the influential factors for the occurrence and development of hypertension and atherosclerosis. In the renin angiotensin system, the endothelial ACE is considered as the main enzyme and affects the physiological function of heart and vasculature (8, 9). Endothelial ACE, which plays a catalytic role in the conversion of angiotensin type 1 (AT1) to angiotensin type 2 (AT2), is a decapeptidyl peptidase secreted from the renal and pulmonary endothelial cells and abundantly found in vascular beds (10, 11). This enzyme creates the condition for vasoconstriction due to substrate concentration in the blood vessels. The increased localized activity of this enzyme in the cardiac and aorta could be associated with hypertrophy and cardiovascular disorders (12).

Moreover, ACE is able to inactivate the bradykinin vessel opening peak and has an unfavorable impact on the dilation of vessels (13, 14). Given the dual effect of ACE on the maintenance of blood pressure and homeostasis of water and electrolytes, the inhibition of ACE has earned a successful position in the treatment of hypertension and congestive heart failure (15, 16).

Conflicting results have been obtained regarding the effect of physical activity on the levels of ACE. In this regard, Teixeria et al. (2013) evaluated the effect of eight weeks of aerobic exercise at 50-65% of maximum heart rate on 20 sedentary middle-aged men. According to the results of this study, four weeks of training significantly decreased the level of ACE (17,18).

On the other hand, Fernandes et al. (2011) assessed the impacts of two different exercise programs (one program with low volume and intensity and the other one with low intensity but high volume) on the amount of ACE of the trained mice for 10 weeks. The results of the mentioned study were indicative of a significant increase in the amount of ACE in the group with high volume exercise (19).

Currently, hypertension is highly prevalent, which is mostly accompanied with various complications and high expenses. Therefore, the evaluation of the influential factors in hypertension, such as changes in ACE, in response to the physical activity as a non-pharmacological approach for the possible prevention of hypertension in Iranian population is of paramount importance. Today, there are few studies investigating the effective factors on hypertension. Specifically, there are limited studies examining the effect of physical activities on the influential factors in hypertension from the cellular and molecular perspective in Iranian population. The aim of this study was to investigate the effect of eight-week aerobic training on serum angiotensin converting enzyme and lipid profile in inactive overweight women.

Materials & Methods

This semi-experimental research (with a pretest-posttest design) was conducted on 20 healthy and inactive women with age range of 20-30 years old and body mass index (BMI) higher than 25 kg/m^2 with urban residence at the time of the study. Participants were selected through purposive and convenience sampling and randomly divided into two groups of intervention (n=10) and control (n=10). First, overall health of the samples was confirmed by a physician based on the demographic characteristics. All subjects were none-smokers and had no history of respiratory, metabolic, cardiovascular, renal and liver diseases.

Written informed consent was obtained from the participants, and they were allowed to withdraw from the research at any time. Exclusion criteria were use of medications (e.g., statins, ezetimibe and other lipid-lowering agents) and no training regularly for active group.

Before the intervention, subjects were referred to a medical laboratory, and initial blood samples were collected after 12 h of fasting and 24 h of no intense physical activity. Obtained samples were used to determine the levels of TG, TC, HDL-C and LDL-C, and levels of serum angiotensin converting enzyme (ACE) was measured by calorimetry method with ELISA kit

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(Cusabio, Biotech, China, Catalog number: CSB-E11269h). On each turn of blood sampling, 10 cc of blood was taken from a vein of anti-cubital arm and then the samples were frozen at -18 ° C and a maximum of 40 days after a blood test, all samples were measured in one day.

On the second day, anthropometric indices were measured through the electrical impedance method using Body Composition Analyzer (InBody720, South Korea) and tests to estimate the maximum oxygen uptake using the Bruce protocol on a treadmill (20) (Technogym, made in Italy) at Laboratory of Physiology (Ferdowsi University, Mashhad, Iran).

The training group performed aerobic exercise for eight weeks, three sessions per week with 50-70% of maximum heart rate. The duration of each training session was increased from 30 to 45 minutes gradually (20). During this period, the control group did not participate in any regular exercise program. At the end of training period, all measurements were repeated, just as they had been provided before the start of training.

Data Analysis

Data analysis was carried out using SPSS V.22, and after checking the normal distribution of data and homogeneity of variance by the Levene's test. Data analysis was performed using Student's t-test and independent t-test. P value of ≤0.05 was considered as significant.

Results

The subjects of the study were 23 healthy young women living in the city of Mashhad with an average age of 25/28 ± 2/98 years. Variations anthropometric measures of training subjects (n = 10) and control (n = 10) during the pre-test and post-test are shown in Table 1.

Table 1. Values for anthropometric measures of training subjects (n = 10) and control (n = 10) during the pre-test and post-test.

Variables	Training group		Control group	
	Pre-test Mean ± SD	Post-test Mean ± SD	Pre-test Mean ± SD	Post-test Mean ± SD
Weight (Kg)	68.76±8.31	66.87±7.45*	69.03±8.58	70.12±9.17*
Body mass index (kg/m^2)	25.67±2.75	24.95±2.86*	27.51±3.22	27.83±3.43
Body fat percentage	37.74±5.36	37.52±4.88	41.71±4.22	40.37±4.41
Waist-to-hip ratio(cm)	0.87±0.035	0.86±0.038	0.91±0.056	0.90±0.056

Student's t-test. *P-value: <0.05.

Results Table 1 showed that eight weeks of regular exercise significantly reduced amounts of weight and body mass index in training group (P<0.05). While in the control group, a significant increase in weight was observed, but in other anthropometric indicators no significant difference was found during the pre-test and post-test (P>0.05).

Changes in Vo2max, angiotensin-converting enzyme concentration and serum lipid profile indicators of training group (n = 10) and control (n = 10) subjects during the pre-test and post-test are shown in Table 2.

The results showed that after eight weeks of regular training, Vo2max increased significantly in training group (P=0.001). However, the results in Table 2 show that the between changes of angiotensin-converting enzyme and lipid profile

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Table 2. Changes in Vo2max, angiotensin-converting enzyme concentration and serum lipid profile indicators in training (n = 10) and control (n = 10) groups during the pre-test and post-test

Variables	Groups	Pre-tset Mean ± SD	Post-test Mean ± SD	Within Groups	
				t	P-value
VO2max (ml/Kg/min)	Exercise	22.46±3.83	34.54±3.72	-9.099	0.001*
	Control	27.87±9.09	31.50±8.33	-1.155	0.286
ACE (angiotensin-converting enzyme) (U/Lit)	Exercise	16.38±3.29	16.30±5.15	0.098	0.924
	Control	15.09±2.53	14.28±2.87	0.989	0.349
LDL (mg/dl)	Exercise	80.77±13.76	80.96±14.44	-0.028	0.979
	Control	84.90±11.88	85.58±14.55	-0.096	0.925
HDL (mg/dl)	Exercise	49.00±3.13	49.74±5.18	-0.357	0.728
	Control	47.20±3.73	47.56±3.89	0.251	0.808
Triglyceride (mg/dl)	Exercise	123.81±65.14	106.97±27.87	0.935	0.372
	Control	102.62±14.88	91.70±16.65	2.006	0.085
Cholesterol (mg/dl)	Exercise	162.01±65.14	151.42±26.87	0.979	0.356
	Control	160.60±24.88	167.64±31.38	-0.532	0.608

Student's t-test and independent t-test. *P-value: <0.05.

parameters were not significantly different (P>0.05).

Discussion

In the present study, eight weeks of aerobic exercise had no significant effect on the amount of ACE in the exercise group during the pretest and posttest. These findings are in congruence with the results obtained by Santos et al (2014); however, they are inconsistent with those obtained by Tartibian et al (2012) and Xu et al (2008) (2, 21, 22). Evaluations have indicated that the physical activities with medium intensity were the only form of exercise that led to decreased level of ACE.

Tartibian et al (2012) evaluated the effect of eight weeks of exercise with medium intensity on the gene expression of ACE among the middle-aged males. In total, 20 men within the age range of 40-55 years participated in the exercise program, who were divided into two groups of aerobic (n=10) and control (n=10). According to the results of the aforementioned study, ACE gene expression significantly decreased after four and eight weeks of aerobic exercise (2). Besides, they marked that aging was associated with the gradual process of oxidative stress indices. These findings are indicative of the fact that the increased oxidative stress occurs with aging, and these indicators stimulated the gene expression of AT1 and AT2 in these individuals.

Conclusions

Another important factor for the increased level of angiotensin type 2 is reported to be sensitivity to sodium at older ages, which also increases the activity of angiotensin type 2 for sodium excretion (2, 23). Nevertheless, the literature has revealed that the lack of physical activity is another factor for increased activity level of angiotensin type 2 (24). Low mobility stimulates the factors that have an impact on increased concentration of angiotensin and sensitivity to it. Low mobility may cause an elevation in the level of serum sodium, AT1 and AT2 receptors, renin gene secretion, and stimulation of renin-angiotensin system, leading to an increase in the level of angiotensin type 2 (24, 25).

Moreover, Iehia et al. (2008) demonstrated that eight weeks of regular exercise in mice with

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infarction led to decreased gene expression of ACE (22). On the other hand, Costa et al. (2011) evaluated the acute response of physical activity to the ACE activity in eight racing horses. A standard test was performed on all the horses until exhaustion. The blood samples were taken before, during, and after the test. The results indicated that the activity of ACE increased until the end of the test, which returned to its basic state 30 min after the test. Also, the exercise intensity was reported in the mentioned study as the major factor for the changes in ACE (26).

Studies have shown that the ACE level could be affected in two ways. One of these ways is the stimulation of cellular receptors and promoters of ACE gene, and second one is increased inhibition of ACE activity (27). The researchers have concluded that the best results for modifying the risk factors for hypertension and reducing the risk of cardiovascular diseases (by reducing such indicators as ACE) are obtained when the exercise is started at a low intensity and increased to 60% of maximum oxygen intake by increased heart and respiratory fitness. Besides, the duration of exercise could also increase in each session concerning the intensity of exercise (2, 26).

Moreover, the findings of the current study indicated that eight weeks of aerobic exercise had no significant impact on the lipid profile indicators. Although the level of cholesterol and triglycerides decreased in the exercise group, this reduction was not significant. This finding is in line with the results obtained by Stoedefalke et al. (2000) and Welsman et al. (1997), however, it contradicts the results obtained by Kraus et al. (2003) (17, 28, 29).

Stod Fulk et al. (2000) detected no significant change in the lipid profile of the participants after 20 weeks of activity at 75-80% heart rate on treadmill (17). Some researchers affirmed that the regular physical activity increased the transfer and use of triglycerides through muscle (28). It has been demonstrated that plasma insulin levels decreased during and after the physical activity, and one of the factors affecting the level of cholesterol may be the amount of plasma insulin. It seems that decreased insulin level activated the adipose tissue lipolysis and increased the plasma-free fatty acid concentration (29).

Along with decreased insulin, glucagon secretion also increases, which accelerates the process of lipolysis (30). Some of the causes of discrepancy between the mentioned studies and the present research could be the duration and type of exercise, level of training, and age of the participants. Our subjects were at a young age and it seems that the physiological responses of young individuals to exercise are different, compared to those of the middle-aged and old people.

The evaluation of the total results of the present study demonstrated that eight weeks of exercise could somehow improve the cardiovascular risk factors among the overweight females. It could be concluded that the regular and long-term exercise could act as a preventive factor for the occurrence of cardiovascular diseases in the overweight women.

Acknowledgments

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Conflict of Interests

There is no conflict of interest in this study.

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مقاله پژوهشی

تاثیر هشت هفته تمرین هوازی بر مقادیر سرمی آنزیم مبدل آنژیوتانسین و نیمرخ لیپیدی زنان غیرفعال دارای اضافه وزن

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چکیده

زمینه و هدف: در حال حاضر شیوع پرفشاری خون رو به افزایش است و یکی از عوامل تاثیرگذار در بروز و توسعه فشارخون بالا و آترواسکلروز اختلال در سیستم رنین- آنژیوتانسین است که آنزیم مبدل آنژیوتانسین اندوتلیومی، آنزیم اصلی آن محسوب می گردد. هدف از تحقیق حاضر بررسی تاثیر هشت هفته تمرین هوازی بر مقادیر سرمی آنزیم مبدل آنژیوتانسین و نیمرخ لیپیدی زنان غیرفعال دارای اضافه وزن بود.

مواد و روش‌ها: در این تحقیق نیمه تجربی، ۲۰ زن (۲۰-۳۰ سال) با شاخص توده بدنی بالاتر از ۲۵ کیلوگرم بر متر مربع به شکل تصادفی در دو گروه کنترل (۱۰ نفر) و تمرین (۱۰ نفر) تقسیم شدند. گروه تمرین برنامهٔ تمرینی که شامل هشت هفته فعالیت هوازی، هفته ای سه جلسه و به مدت ۶۰-۴۰ دقیقه با شدت ۵۵ تا ۷۵ درصد حداکثر ضربان قلب بود را انجام دادند. ۴۸ ساعت پیش و پس از اتمام برنامه تمرین هوازی، اندازه های تن سنجی، حداکثر اکسیژن مصرفی، نیمرخ لیپیدی وآنزیم مبدل آنژیوتانسین آزمودنی‌ها اندازه گیری شدند. تجزیه و تحلیل داده ها با استفاده از آزمون آماری تی تست مستقل و وابسته در سطح معناداری کمتر از ۰/۰۵ انجام شد.

نتایج: نتایج نشان داد مقادیر وزن (p=۰/۰۱) و نمایه توده بدن (p=۰/۰۱) درگروه تمرین کاهش معناداری یافته است. در حالی که، تغییرات بین گروهی میزان آنزیم مبدل آنژیوتانسی (p=۰/۵۴۳)، LDL (p=۰/۹۲۷)، HDL (p=۰/۱۲۰)، تری گلیسرید (p=۰/۷۸۸) و کلسترول (p=۰/۳۲۴) تفاوت معنی داری نداشتند.

نتیجه گیری: بررسی نتایج کلی این پژوهش نشان می دهد که برنامهٔ تمرینی هشت هفته ای تا حدود اندکی توانسته است منجر به بهبود عوامل خطرزای قلبی عروقی زنان شود و می توان اظهار داشت در صورتی که تمرینات بدنی به طور منظم و طولانی مدت اجرا شود، احتمالاً می تواند یک عامل پیشگیری کننده در بروز بیماری های قلبی عروقی زنان دارای اضافه وزن باشد.

کلمات کلیدی: آنزیم مبدل آنژیوتانسین، نیمرخ لیپیدی، تمرین هوازی، زنان دارای اضافه وزن

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