http://jrhc.miau.ac.ir

Report of Health Care **Original Article**

Volume 5, Issue 3, 2019, p. 43- 51

The Effect of Eight Weeks of Selected Combined Training (Aerobic-Resistance) on Vascular Adhesion Molecules and Lipid Profile in Inactive Elderly Men

Hassan Akhavan [1], Mehrdad Fathi [2], Teimour Darzabi [3], Keyvan Hejazi [4 *]

1. Faculty of Physical Education and Sports Sciences, Bojnourd Branch, Islamic Azad University, Bojnourd, Iran
2. Faculty of Physical Education and Sports Sciences, Ferdowsi University of Mashhad, Mashhad, Iran
3. Faculty of Montazeri, Khorasan Razavi Branch, Technical and Vocational University, Mashhad, Iran
4. Faculty of Physical Education and Sports Sciences, Toos Institute of Higher Education, Mashhad, Iran

Received: 12 March 2019

Accepted: 10 May 2019

Published online: 20 July 2019

***Corresponding author:**
Keyvan Hejazi. Faculty of Physical Education and Sports Sciences, Toos Institute of Higher Education, Mashhad, Iran

Phone: +985136063044

Fax: +985136090585

Email: keyvanhejazi@gmail.com

Competing interests: The authors declare that no competing interests exist.

Citation: Akhavan H, Fathi M, Darzabi T, Hejazi K. The effect of eight weeks of selected combined training (aerobic- resistance) on vascular adhesion molecules and lipid profile in inactive elderly men. Rep Health Care. 2019; 5 (3): 43-51.

Abstract

Introduction: Adhesion molecules and lipid profile play an important role in the pathogenesis of atherosclerosis. The aim of this study was to investigate the effect of combined training (aerobic-resistance) on vascular adhesion molecules and lipid profile in inactive elderly men.

Methods: In this semi-experimental study, 30 elderly men were divided randomly into three equal groups: resistance group (n=10), aerobic training (n=10) and control groups (n=10). The combined training (aerobic-resistance) included running on a treadmill for 20 minutes per session, 3 sessions per week, for 8 weeks, at an intensity of 60 to 70% of HRR. Furthermore, the resistance training comprised 10 circling stationary movements of leg flexion, leg extension, leg press, scott, underarm stretch, chest press, iron cross with dumbbells, biceps flexion, triceps extension, and rowing motion with rope. This training included an intensity of 60 to 70% of one maximum repetition with extra load and 10 repetitions in 2 successive times with 30-second rest between each repetition and 2-minute rest between each movement. To make intra and between groups comparison, paired and independent sample t-test was used.

Results: The levels of ICAM-1 and VCAM-1 in both aerobic (p=0.001) and resistance groups (p=0.002) rather than control group reduced significantly. The amount of LDL-C, TG, TC in both aerobic and resistance groups rather than control group reduced significantly; while the levels of HDL-C in both exercise groups increased significantly. However, a significant difference was seen between 3 groups with regard to serum TG, TC and HDL-C levels ($P<0.05$).

Conclusion: The levels of ICAM-1 and VCAM-1 in both aerobic and resistance groups compared to control group reduced significantly. Therefore, combined training can be used as a good method to improve inflammatory markers in elderly people.

Keywords: Training, Vascular Adhesion Molecules, Elderly

Introduction

Obesity and overweight are nowadays increasing, which is not just limited to developed countries (1, 2). Gaining or losing weight are sometimes arising from energy misbalancing. These factors are considered of the simplest indicators for detecting the imbalance and energy adjustment in body. Changing the trend of energy balancing and misbalancing negatively or positively may be followed with hazardous results in case of continuity (3), so that that the excessive consumption of fats underlies chronic diseases such as diabetes, cardiovascular diseases and some of cancers (2). The source of most of cardiovascular diseases is inflammation.

Hence; vascular injuries and its damages, resulted by taking some materials directly and in some cases increasing the shear pressure indirectly, enhance the sensitivity of vascular endothelial adhesion molecules such as VCAM-1 or its cellular types such as ICAM-1, selectin and integrin (4). Leukocyte adhesion to vascular endothelial cells and their immigration, intensifying the flow of atherosclerosis, is mediated by various groups of adhesive molecules such as intracellular adhesive molecule type 1 (ICAM-1). ICAM-1 and VCAM-1 speed up the trend of forming flat cells through being connected to monocytes and their movement to the endothelium depth (5, 6). ICAM-1 in endothelium level is sated in reaction to pre-inflammatory cytokines secreted from adipose tissue such as interleukin-6, alpha necrosis factor (7, 8). As the result, the rate of fat tissue which is along with reducing body activity and inappropriate diet, strengthens the conditions for inflammation and thrombosis (9). Therefore, any action, moderating the abnormal amount of such materials in blood, somehow prevents cardiovascular diseases. Physical activity can be considered as an effective factor on moderating this type of VCAM. In this field, investigating the effect of 8-week aerobics at an intensity of 50 to 70% and maximum heart rate on the level of adhesive molecules of 24 middle aged women, Hejazi *et al* (2013) concluded that ICAM-1 and VCAM-1 as well as selectin significantly decreased at the end of period (10). Investigating the effect of 12-week aerobics with the intensity of 60 to 75% and maximum heart rate on the level of adhesive molecules of 24 type 2 diabetic obese women, Kahkha *et al* (2015) concluded that the levels of ICAM-1 and VCAM-1, C-reactive protein and alpha necrosis factor significantly decreased in the experimental group (11). On the contrary, in the investigation of the effect of 8-week aerobics at an intensity of 65 to 80% and maximum heart rate of storing and resistance exercise at an intensity of 50 to 60% of a maximum repetition on intercellular adhesive soluble molecule on 39 women by Nayebi Far *et al.* (2010), it was concluded that there was no significant change in the indicators of ICAM-1s, triglyceride, total cholesterol, HDL-C and LDL-C (12). The intervention of regular physical activities, diets, health consulting and drug therapy are the ways, discussed up to now for preventing cardiovascular diseases (13). Although the experts of health and wellbeing sciences agree on the method of physical activity and diet as the most basic and scientific method of reducing cardiovascular diseases (14), they focus on the importance of the role of physical activity in preventing and treating many diseases such as cardiovascular ones before taking medicines, exercise and food consulting. As the result, most of the conducted studies have investigated the effect of aerobics on adhesive molecules. Given the conducted studies, there are a few ones to compare the effect of resistance and aerobics exercising on the level of these indicators. Therefore, the aim of this research is to investigate the effect of 8 weeks of resistance and aerobic training on the levels of adhesive molecules in inactive old men.

Methods

The current study is quasi-experimental with control and experimental groups. In terms of objectives it is applied which was conducted with pretest-posttest design. Statistical sample of this study, included 30 old men, living in Bojnourd in 2016 with the age range of 60-65 years old, who were selected through selective available and purposeful sampling method. The participants were first familiarized with the nature and manner of study. 100 people among the participants were volunteer to complete health and physical questionnaire. After analyzing it, 30 qualified people were selected to participate in the study. To meet the ethical considerations, the participants were familiarized with all phases of study such as training programs and experimental evaluations, before receiving consent form, they were briefed that their information will be confidential. They could also exit the study

whenever they wanted. Being healthy based on health questionnaire, not taking drugs, not smoking and not participating in any training program at least for 6 months before participating in the present training were inclusion criteria. The exclusion criteria also included suffering from cardiovascular diseases, diabetes, neurological disorders, blood pressure and absence in two sequential sessions or three non-sequential sessions of the training program. Based upon the conditions of study, the participants entered the study and signed the consent form voluntarily. The level of people's physical activity in this study was determined using Kaiser physical activity survey (15). The participants were then randomly divided into three groups of resistance training (n=10), aerobics training (n=10) and control (n=10). To evaluate the participants' body composition, their height was measured with Seca stadiometer (made in Germany) with a sensitivity of 5 mm. Tmeasure the length, scaled stadiometer was used. To this end, without shoes, the person stood up straightly so that his weight was equally divided on both legs, the head and eyes were parallel to the horizon. Then, at the end of usual exhalation, the horizontal ruler was put on the head, tangent on braincase while making right angel with vertical ruler. So, the personبs length was obtained based on centimeter. The weight of qualified participants was measured by digital scale, made in Germany Beurer co. (model PS07-PS06), so that that the person went on the scale without shoes and with a warmup clothes. His weight was measured based on kilogram. To measure the body mass index of participants, their length and weight were calculated before beginning physical training. Then through dividing weight into the square of height in meters, the body mass index of them was obtained. In this formula, weight is based on kilogram, length based on meter and body mass index equal to square kilogram. The blood samples in this study were collected 48 hours before starting the training and 48 hours after the last session while all subjects were fasting for 10-12 hours. Blood sampling was conducted at 8:00 to 9:00 a.m.in the laboratory from each participant's left hand vein in a sitting and resting position sitting and resting. In both phases of the pre and post-test; the amount of 5cc blood was taken from anticubital vein. The samples were kept frozen in the temperature of -18cg. To determine the rate of ICAM-1 and VCAM-1, ELISA method was used by the kit of Japan Manufacturing Cassibile Co. with sensitivity degree of less than CV=0.01. The concentrations of triglyceride, cholesterol and HDL-C were measured through enzyme method (by commercial kits of Pars Azmoun Co.), the rate of intra test changes coefficients (accuracy) for the kit of measuring cholesterol, triglyceride and HDL-C were 4%, 4%, 4.5%, respectively, and the sensitivity of kits were 3,4,1mg respectively. Training protocol in this study includes endurance and resistance training for 8 weeks of three sessions for one hour. Endurance training program included running on rotating tape for 20 minutes and an intensity of of 60 to 70% of heart rate reserve. The intensity was calculated based on maximum heart rate recorded for each elderly separately through Karvonen Formula of equation (1). It was controlled during training by heart rate monitor of Polar, made in Finland. The resistance training was considered equal to 70% of a maximum repetition with 10 repetitions in each move in two sequential sets with resting intervals of 30 seconds between each stop and totally two minutes between each set. The intensity of resistance training was determined as the maximum repetition for each person based on equation (2). The resistance training included 10 circular stations. They respectively were leg flexion, leg extension, foot press, squat, axillary stretching, chest press, the cross with dumbbell, biceps, triceps and sit-ups (16). During the combined training intervention, the control group was not included in any physical activity. They used to do their routines.

Equation (1): Target heart rate= (%60 or %70+ (((220- age) – Resting heart rate)) + Resting heart rate

Equation (2): One maximum repetition = displaced weight (kilograms)/ (0/0278 x number of repetition to exhaustion) – 1/0278

At the end of research, the collected data were analyzed using SPSS16. The normalization of data distribution was statistically confirmed using The Shapiro- Wilk test. Then, to compare the intra and inter group means, inferential statistics (paired sample t- test and independent sample t-test) were used ($p<0.05$).

Results

The characteristics of participants in the study have been shown in Table 1, separated for three groups of aerobics training, resistance training and control. These groups were not significantly different in terms of age, length, weight and body mass index ($P>0.05$). According to Table 2, 8 weeks of aerobics and resistance training resulted in a significant reduction in the weight and body mass indexe in old men. The rate of low density lipoprotein, triglyceride, total cholesterol in both groups significantly decreased while it significantly increased at the end of the period. The level of ICAM-1 in the aerobics training group ($p=0.00$) and in the resistance training group (P-0.02), and the level of VCAM-1 in the aerobics group ($P=0.02$) and in the resistance group ($P=0.01$) significantly decreased at the end of period. Inter group changes show that there is no significant different between the effect of both intervention (aerobics and resistance) in the levels of ICAM-1 and VCAM-1.

Discussion

The aim of the current study was to investigate the effect of 8 weeks of resistance and aerobics training on the level of ICAM-1 and lipid profile of inactive old men. Based on the obtained results from the findings of current study, ICAM-1 and VCAM-1 significantly decreased in both groups. These results are consistent with the findings of Kargarfard *et al* (2016), Tofighi *et a*l (2014) (17, 18). Investigating the effectiveness of 8 weeks of aerobics and high intensity interval training on the values of adhesive molecules in 30 obese participants and 30 participants with normal weight, divided into three groups of aerobics, high intensity interval training and control, Kargarfard *et al* (2016) concluded that ICAM-1 in both groups significantly decreased. Yet, the levels of VCAM-1 were only decreased in high intensity interval training. The values of ICAM-1 and VCAM-1 in the group with normal weight were similar to fat groups (18). The effect of aerobics training with omega 3 consumption on cellular adhesive molecules of fat women was investigated by Tofighi *et al* (2014). They concluded that not only ICAM-1 reduction was affected by the separate effects of supplementation and training, but also the interventions of training and supplementation had a synergistic effect on reducing the concentration of this inflammatory factor. Moreover, VCAM-1s only significantly decreased in the group of training and supplementation (combined) (17). The results are not consistent with the findings of Nikbakht *et al* (2016)(19). Who investigated the effect of 8 weeks of resistance training on serum adhesion molecules of overweight men. They concluded that there is a significant difference between the effect of 8 weeks of resistance training in the ICAM-1s of both groups. ICAM-1s in resistance group showed significant changes in the pretest and posttest of the groups. In case of VCAM-1 and selectin E values, there was no significant change (19). The human homoeostasis reaction to sport activities depends on the severity, duration and the type of training. Different mechanisms have been proposed for reducing ICAM-1. Given the relationship between ICAM-1 changes or the percentage of body fat, the reduction of central obesity is probably one of the involved factors in reducing ICAM-1 (20).

Table 1. Main characteristics of the subjects at baseline

Groups	Variables (Mean ± SD)			
	Age (year)	Height (cm)	Weight (Kg)	BMI (Kg/m^2)
Aerobic (n=10)	62.80±1.76	171.70±5.11	79.70±5.44	27.11±2.52
Resistance (n=10)	61.60±1.71	173.20±5.20	80.40±5.48	26.83±2.12
Control (n=10)	61.90±1.47	169.50±4.53	78.80±4.67	27.54±2.91

Table 2. Changes in the body composition, lipid profile and vascular adhesion molecules of subjects in the two study groups

Variables	Groups	Stage		Difference			
		Pre-test (Mean±SD)	Post-test (Mean±SD)	t	P *	F	P **
Weight (Kg)	Aerobic	79.70±5.44	79.02±5.52	8.23	0.001†		
	Resistance	80.40±5.48	79.68±5.73	3.41	0.008†	0.07	0.92
	Control	78.80±4.67	78.99±4.59	-1.59	0.122		
BMI (Kg/m^2)	Aerobic	27.11±2.52	26.88±2.56	8.24	0.001†		
	Resistance	26.83±2.12	26.60±2.26	3.25	0.001†	0.72	0.48
	Control	27.54±2.91	27.60±2.87	-1.58	0.123		
HDL-C (mg/dl)	Aerobic	41.40±7.24	43.60±7.06	-4.94	0.001†		
	Resistance	41.80±4.93	44.60±4.94	-3.93	0.003†	5.17	0.009†
	Control	40.50±5.09	39.40±4.41	3.61	0.001†		
LDL-C (mg/dl)	Aerobic	102.00±9.89	98.90±9.51	7.03	0.001†		
	Resistance	98.70±8.48	94.80±8.91	5.18	0.001†	2.36	0.10
	Control	100.70±4.59	100.60±4.62	0.19	0.84		
TG (mg/dl)	Aerobic	58.70±9.54	56.60±9.85	3.70	0.001†		
	Resistance	53.70±1.00	49.10±1.07	3.23	0.001†	8.44	0.001†
	Control	60.40±2.98	60.20±2.97	0.55	0.58		
TC (mg/dl)	Aerobic	152.10±9.36	148.10±11.52	4.18	0.001†		
	Resistance	145.90±10.98	141.60±9.15	3.52	0.001†	6.60	0.003†
	Control	153.10±5.35	153.60±7.74	-0.79	0.43		
ICAM (ng/ml)	Aerobic	550.50±246.75	535.10±242.29	3.02	0.001†		
	Resistance	565±340.47	536.10±359.48	2.69	0.002†	1.65	0.201
	Control	560.30±174.45	559.80±164.43	2.19	0.305		
VCAM (ng/ml)	Aerobic	581.00±450.63	573.20±50.4.87	2.53	0.02†		
	Resistance	612.20±405.21	583.20±351.94	3.06	0.01†	2.64	0.08
	Control	608.30±465.58	617.70±405.05	-1.57	0.127		

† Statistically significant difference (P<0.05) * Significant difference within group ** significant difference between groups

Factors such as changes of oxidation capacity might be effective in this case. Aerobics, especially high intensity programs, increase the anti-oxidant capacity of body and are followed with reduction of oxidation pressure (21, 22). Doing long-term exercises with increasing the anti-inflammatory cytokine inhibit the release of inflammatory factors such as interleukin-1 beta from adipose tissue. Finally, all these factors lead to the reduction of adhesive molecules levels (23, 24). Additionally, since cortisol acts as a strong anti-inflammatory in inhibiting the secretion of cytokines and inflammatory mechanisms(25) and high intensity interval training mainly provide more cortisol during training, one of reasons of reducing ICAM-1 because of extreme periodic exercises can be attributed to this factor. Given the mechanism, relating the adhesive molecules level and obesity as well as the effect of physical activity on inflammatory factors, reducing fat tissue especially visceral adipose tissue, improvement of blood lipid profile and reduction of producing pro-inflammatory factors such as interleukin-6, alpha-necrotic factor and C-reactive protein are inhibited by liver cells and following that, ICAM-1 will be reduced and endothelial function will be improved (26). The significant changes of high density lipoprotein levels are another case which may justify the reduction of ICAM-1. Existing mechanism about increasing the high density lipoprotein levels following physical activity is given the effect of physical exercise in moderating fat saving, body general metabolism, insulin activity in the liver, muscle and fat tissue. The effect of regular physical activity on endothelial function also emerges through increasing high density lipoprotein level. High density lipoprotein or provoking prostacyclin release from vessel walls or smooth muscle cells inhibit platelet aggregation and lead to reduction of adhesive molecules (26, 27). According to the obtained results, the levels of low density lipoprotein, triglyceride, total cholesterol significantly decreased in both groups of aerobics and resistance training while high density lipoprotein increased at the end of period. These findings are consistent with those of Monazamnezhad *et al* (2015) (28). Yet, they are not consistent with the findings of Miele *et al* (2017) and Mir *et al* (2014) (29, 30). Monazamnezhad *et al* (2015) investigated the effect of 8 weeks of aerobics at an intensity of 50 to 70% of heart rate reserve on 28 women of 20 to 45 years old. They concluded that the levels of triglyceride, total cholesterol, VLDL and body fat percentage significantly decreased (28). Miele *et al* (2017) investigated the effect of 16 weeks of short aerobics with the average intensity on the lipid profile of 46 women, suffering from kidney disease. The found out that triglyceride and high density lipoprotein as well as body composition did not change in both groups (29). Mir *et al* (2014) investigated the effect of combined training on homocysteine, CRP and the lipid profiles of old men of 60 to 70 years old. They figured out that homocysteine levels and serum CRP significantly decreased during the combined training. Yet the indicators of TC, TG, HDL-C and LDL-C did not significantly change in both groups (30). Leucine Cholesterol Acyl Transferase is synthesized in the liver and secreted into plasma. Its major part is connected to HDL. This enzyme contributes to the formation of cholesterol ester transfer protein and transferring it to VLDL and sometimes LDL-C. Leucine Cholesterol Acyl Transferase with Apo lipoprotein A (cofactor) esterifies free cholesterol. The shortage of such enzyme might be due to genetic disorders or lack of Apo lipoprotein A. LCAT enzyme leads to reduction of cholesterol ester transfer protein and HDL-C. The liver absorbs the residues of chylomicrons, including cholesterol, cholesterol ester and Apo proteins with endocytosis and separates them from each other. Therefore, the derived fat acids from food or synthesized in the liver, turn to

triacylglycerol and packed as the particles of VLDL with cholesterol and esters of it. It finally enters the blood flow(31, 32). In this case, regular physical activity increases lipoprotein lipase. This enzyme is stated to have a major role in converting VLDL to HDL. Physical exercise has been proved to increase Leucine Cholesterol Acyl Transferase enzyme. It increases intra muscular esterified cholesterol to HDL. It might be another reason of HDL increase (31-33). Increasing HDL-C after sport activity is similar to reducing triacylglycerol based on accumulation (about one day after activity) and their disappearing (about three days after activity). The relationship between such contradictory changes probably increases the activity of lipoprotein lipase, speeds up the decomposition of glycerol in VLDL and eliminates the particles of lipoprotein. This mood creates excess fatty acids (free cholesterol and phospholipid), transferred to HDL-C. Additionally, sport activity creates Leucine Cholesterol Acyl Transferase enzyme, feeding the particles of HDL-C (31). Given that the study had some limitations such as various diets, different compatibility responses to physical activity, the low number of participants due to the withdrawal of some of them from participating in the current study and individual difference, therefore the results shall be generalized cautiously.

Conclusion

In summary, based on the obtained results, the levels of ICAM-1 and VCAM-1 significantly decreased in both groups of aerobics and resistance training. The levels of low density lipoprotein, triglyceride, total cholesterol and high density lipoprotein in both groups respectively decrease and increase significantly. Therefore, aerobics and resistance training can be used as a method for improving some of the related indicators to promote health of untrained men. It can be considered as a safe and interesting method for them. This factor may decrease the potential risk of related diseases to obesity and can be used as an effective non-medical treatment for preventing the diseases.

Ethical issues

Not applicable.

Authors' contributions

All authors equally contributed to the writing and revision of this paper.

Acknowledgments

We would like to express our appreciation to the men participating in the study.

References

1. Khalilzadeh M, Azali Alamdari K, Choobineh S, Ebadi Shirmard B, Ghahramani M. Effects of aerobic training with low and intermediate intensity on appetite, body weight, exercise energy expenditure and plasma ghrelin level in relatively thin and obese sedentary women. Iranian J Nutr Sci Food Technol. 2011; 6 (1): 1- 10.
2. Atashak S, Azarbayjani M, Sharafi H. Effect of three-month progressive resistance training on leptin and Interleukin-6 concentration in obese men. Pajoohandeh J. 2011; 16 (4): 154- 161.
3. Saghebjoo M. The influence of circuit resistance training intensity on ghrelin to obestatin ratio of plasma in healthy young women. Iranian J Endocrinol Metab. 2011; 12 (6): 626- 632.
4. Soori R, Ranjbar K, Salehian O, Eslam D. The effect of high interval intensity training on plassma soluble intercellular adhesion molecule-1 (sicam-1) in sedentary obese male. Sport Biosci. 2013; 5: 91- 102.
5. Fuster V, Ross R, Topol E. Atherosclerosis and coronary artery disease:. 1, editor: Lippincott-Raven Publishers; 1996.
6. Samaniego F, Markham PD, Gendelman R, Gallo RC, Ensoli B. Inflammatory cytokines induce endothelial cells to produce and release basic fibroblast growth factor and to promote Kaposi's

sarcoma-like lesions in nude mice. J Immunol. 1997; 158 (4): 1887- 1894.
7. Esposito K, Pontillo A, Di Palo C, Giugliano G, Masella M, Marfella R, et al. Effect of weight loss and lifestyle changes on vascular inflammatory markers in obese women: a randomized trial. Jama J. 2003; 289 (14): 1799- 1804.
8. Rector RS, Turk JR, Sun GY, Guilford BL, Toedebusch BW, McClanahan MW, et al. Short-term lifestyle modification alters circulating biomarkers of endothelial health in sedentary, overweight adults. Appl Physiol Nutr Metab. 2006; 31 (5): 512- 517.
9. Mora S, Lee IM, Buring JE, Ridker PM. Association of physical activity and body mass index with novel and traditional cardiovascular biomarkers in women. JAMA. 2006; 295 (12): 1412- 1419.
10. Hejazi SM, Abrishami LH, Mohammad Khani J, Boghrabadi V. The effects of 8-week aerobic exercises on serum levels of cell adhesion molecules among middle-aged women. Adv Stud Biol. 2013; 5 (6): 279- 289.
11. Kahkha H, Nasrabadi R, Nuraeinjar M. Effect of Twelve weeks aerobic training on selected molecules 1, TNF-**α**, CRP, ICAM-1, VCAM-1 type 2 diabetes in middle-aged women. J Sci Res Development. 2015; 2 (1): 154- 157.
12. Nayebi Far S. Effect of resistance and aerobic exercise on soluble intercellular adhesion molecule and serum lipid profile of overweight women. J Sport Biomotor Sci. 2010; 2 (4): 77- 87.
13. Buttar HS, Li T, Ravi N. Prevention of cardiovascular diseases: Role of exercise, dietary interventions, obesity and smoking cessation. Experimental Clin Cardiol. 2005; 10 (4): 229.
14. Kromhout D, Menotti A, Kesteloot H, Sans S. Prevention of coronary heart disease by diet and lifestyle: evidence from prospective cross-cultural, cohort, and intervention studies. Circulation. 2002; 105 (7): 893- 898.
15. Sternfeld B, Ainsworth BE, Quesenberry JrC. Physical activity patterns in a diverse population of women. Prev Med. 1999; 28 (3): 313- 323.
16. Noushabadi A, Abedi B. Effects of combination training on insulin resistance index and some inflammatory markers in inactive men. Horizon Med Sci. 2012; 18 (3): 95- 105.
17. Tofighi A, Ghafari G. Effect of aerobic training with Omega-3 consumption on soluble adhesion molecules in the obese women. Tabriz Med Sci Univ J. 2014; 36 (1): 20.
18. Kargarfard M, Lam ET, Shariat A, Asle Mohammadi M, Afrasiabi S, Shaw I, et al. Effects of endurance and high intensity training on ICAM-1 and VCAM-1 levels and arterial pressure in obese and normal weight adolescents. Physician Sportsmed. 2016; 44 (3): 208- 216.
19. Nikbakht H, Gaeini A, Salamat K. The effect of endurance training on serum adhesion molecules in overweight men. J Kurdistan Univ Med Sci. 2016; 21 (3): 12-18.
20. Ranković G, Miličić B, Savić T, **Đ**inđić B, Mančev Z, Peć**i**ć G. Effects of physical exercise on inflammatory parameters and risk for repeated acute coronary syndrome in patients with ischemic heart disease. Vojnosanitetski Pregled. 2009; 66 (1): 44-48.
21. Wannamethee SG, Lowe GD, Shaper AG, Rumley A, Lennon L, Whincup PH. Associations between cigarette smoking, pipe/cigar smoking, and smoking cessation, and haemostatic and inflammatory markers for cardiovascular disease. Eur Heart J. 2005; 26 (17): 1765-1773.
22. Parissis JT, Filippatos G, Nikolaou V, Adamopoulos S. Cytokines and anti-cytokine therapeutic approaches to chronic heart failure. Eur J Int Med. 2002; 13 (6): 356- 364.
23. Maeda S, Tanabe T, Otsuki T, Sugawara J, Iemitsu M, Miyauchi T, et al. Moderate

regular exercise increases basal production of nitric oxide in elderly women. Hypertension Res. 2004; 27 (12): 947- 953.
24. Piro M, Giubilato G, Pinnelli M, Giordano PS, Biasucci L. Endothelium and inflammation. Panminerva Med. 2005; 47 (2): 75- 80.
25. Ziccardi P, Nappo F, Giugliano G, Esposito K, Marfella R, Cioffi M, et al. Reduction of inflammatory cytokine concentrations and improvement of endothelial functions in obese women after weight loss over one year. Circulation. 2002; 105 (7): 804- 809.
26. Soori R, Rezaeian N, Montazeri H. Effects of resistance and endurance training on coronary heart disease biomarker in sedentary obese women. Iranian J Endocrinol Metab. 2011; 13 (2): 179- 189.
27. Lerch PG, Spycher MO, Doran JE. Reconstituted high density lipoprotein (rHDL) modulates platelet activity in vitro and ex vivo. Thromb Haemostasis. 1998; 79 (02): 316- 320.
28. Monazamnezhad A, Habibi A, Majdinasab N, Ghalvand A. The effects of aerobic exercise on lipid profile and body composition in women with multiple sclerosis. Jundishapur J Chronic Disease Care. 2015; 4 (1): e4281.
29. Miele EM, Headley SA, Germain M, Joubert J, Herrick S, Milch C, et al. High-density lipoprotein particle pattern and overall lipid responses to a short-term moderate-intensity aerobic exercise training intervention in patients with chronic kidney disease. Clin Kidney J. 2017; 10 (4): 524- 531.
30. Mir E, Fathei M, Sayeedi MM, Hejazi K. The effect of eight weeks combined training (aerobic- resistance) on homocysteine, C- reactive protein and lipid profile in inactive elderly men. Med J Tabriz Univ Med Sci Health Services. 2015; 36 (6): 2- 10.
31. Mougios V. Exercise biochemistry. 1, editor: Human Kinetics; 2006.
32. Robergs RA, Ghiasvand F, Parker D. Biochemistry of exercise-induced metabolic acidosis. Am J Physiol Regul Integr Compar Physiol. 2004; 287 (3): R502- R516.
33. Linda M, Hemura S. Lipid and lipoprotein prfile, cordiovascular Fitness, boody composition and deit during and after resistance, aerobic and combination training in young women. Eur J Appl physiol. 2000; 82: 451- 458.