Effects of Intensity of Aerobics on Body Composition and Blood Lipid Profile in Obese/Overweight Females

Sayyed Mohammad Marandi, Neda Ghadiri Bahram Abadi, Fahimeh Esfarjani, Hosein Mojtahedi, Gholamali Ghasemi

Department of Physical Education and Sport Sciences, University of Isfahan, Isfahan, Iran

Correspondence to:
Dr. Sayyed Mohammad Marandi, Department of Physical Education and Sport Sciences, University of Isfahan, Isfahan, Iran.
E-mail: s.m.marandi@spr.ui.ac.ir

Date of Submission: Jun 10, 2012

Date of Acceptance: Sep 09, 2012

How to cite this article: Marandi SM, Abadi NGB, Esfarjani F, Mojtahedi H, Ghasemi G. Effects of intensity of aerobics on body composition and blood lipid profile in obese/overweight females. Int J Prev Med 2013;4 (Suppl 1):S118-25.

Original Article

ABSTRACT

Background: Obesity is a threat to the health of modern urban citizens, especially women. Aerobic is an effect of exercise which rapidly is developing among urban women. This study was designed to examine the effects of light and moderate aerobic intensity on body composition and serum lipid profile in obese/overweight women living in Isfahan.

Methods: Forty-five middle-aged obese/overweight volunteer women (25-40 years, and body mass index (BMI) ≥25 to 30 kg/m^2) were randomly assigned into three groups: 1. Light aerobics [45-50% heart rate reserve maximum (HRR_{max})], 2. Moderate aerobics (70-75% HRR_{max}), 3. No exercise training (control). Training program lasted for 10 weeks and included three sessions of 60 minutes aerobics per week. The intensity of aerobics was controlled by monitoring heart rate. Body composition was measured using skin fold thickness method. Serum lipid was measured.

Results: Both light and moderate aerobics significantly improved weight ($P<0.000$), fat percent ($P<0.045$), BMI ($P<0.000$), fat weight ($P<0/031$), lean body weight ($P < 0.02$), waist-to-hip ratio (WHR) ($P < 0.000$), High-density lipoprotein (HDL) ($P < 0.000$).

Conclusions: Our findings showed that both light and moderate aerobics improved body composition and serum lipid profile in obese/overweight women. Our findings support the application of aerobics for obese/overweight women. Initially, they can start with light programs and proceed to more intense programs.

Keywords: Aerobic, body composition, lipid profile, obese/overweight women

INTRODUCTION

Metabolic complication of obesity is rising not only in developed countries but also in developing countries.[1] In fact, obesity can be presented as (new world syndrome) the greatest health problem in the modern industrial world. The prevalence of this complication is increasing in all age groups in the world.[2] Significant changes that occur from adolescence to middle age affect health and can increase the tendency to the disease. Severe

obesity is associated with increased mortality.[3] Two major patterns of fat distribution are: Central obesity or apple shape (android), the density and greater fat accumulation in the abdominal region is seen either as visceral or subcutaneous obesity and pear-shaped peripheral (gynoid) in which fat density in the lower extremities (hips, thighs, and legs) is observed. There are fundamental differences between these two types of obesity because most heart disease and metabolic are associated with vascular and visceral fat stores.[4] Obesity reduces vascular compliance and work with the stiffness and hardness and increased resistance to blood vessels in the long term[5] and by factors such as additional energy absorption, low used energy, low level of basal metabolism, reduce fat oxidation, and sympathetic activity.[6] The researchers reported that obesity and decreased levels of High-density lipoprotein (HDL) and increased Low-density lipoprotein (LDL) levels and triacylglycerol are the factors related to heart disease. Two Months of aerobic activity three times a week for 60 minutes have desirable effects on body composition and blood lipid profiles in young women. The researchers found that aerobic exercise reduces fat mass and decreased body weight that followed.[7] Regular exercise may cause a gradual reduction of triglycerides (TG), total cholesterol (TC), LDL, Body Mass Index (BMI), body mass, body fat and increased HDL, body mass, and Basal Metabolic Rate (BMR). A low-calorie diet improves the lipid profile, which if combined with exercise, is targeted at improving body composition.[8] People who associated diet with physical activity achieve better results in reducing body fat, particularly visceral fat than in other areas affected by activities. Some researchers reported that those who follow appropriate diet and aerobic exercise for 60 to 90 minutes in 5 to 7 days a week increase the values of $VO_{2\,max}$ and HDL and achieve decreased waist circumference. Aerobic exercise (aerobic) is more effective than other exercises in reducing body fat percentage. For this reason, most studies recommend aerobic exercise.[9] American College of Sports Medicine (ACSM) and Centers for Disease Control have recommended that adults should (if not possible each day) exercise most days of the week for 3 minutes or more. Administration of such exercise leads to significant health benefits. Longitudinal studies show that many factors are effective in reducing obesity of whole-body reduced by aerobic exercise training. These infinite factors include characteristics (gender, baseline obesity, and genetic background) and various aspects of exercise program (duration, intensity, and type of exercise). Most studies show that exercise training, has the potential capacity in changing the body composition. Unfortunately, weight loss through diet alone reduces fat-free mass during the intervention period, and weakens fat oxidation after the intervention period, which may cause re-weight.[10]

In order to prevent re-weight gain after losing weight, researchers suggest that obesity should be associated with exercise and reducing energy consumption.[11] Aerobic exercise reduces acyl-CoA synthesis and markedly acyl-CoA synthesis mRNA levels, lipoprotein lipase, and GLUT4 in intra-abdominal fat. Acyl-CoA synthesis is a key enzyme for fat accumulation in adipose tissue. Lipoprotein lipase and GLUT4, two important factors for metabolic energy, respectively, are fat and glucose in adipose tissue. Lipoprotein lipase and GLUT4, thus aerobic activity can be controlled with diet, positive effects on reducing abdominal fat and whole body fat is under a weight loss program.[12] Body composition is considered as one of the most important aspects of health for people of all ages, gender, and ethnic groups. It has been well-estimated that aerobic activity can be used as an important component of a comprehensive plan for intervention in reducing weight and lowering the weight, however, there is always this debate that which duration and intensity of exercise would be a stronger stimulus in reducing body fat content.[13] It seems that aerobic activity (endurance) is one of the best forms of exercise in weight control programs. Changes in body composition are often overlooked in weight control programs. However, reducing the fat mass of body mass loss by maintaining lean body mass, compared to all programs should be the real targets and exercise training appears to be necessary for developing this purpose. But the most effective prescription is still debatable.[14] The result of the study of Narayani and Sudhan (2010) indicate that the body fat percentage and total cholesterol decreases and increase HDL cholesterol in obese women after 6 weeks of endurance training.[15] Low-calorie diet plus exercise can reduce body fat through a small cell size but does not change the number of cells.[16] Jaafari and colleagues (2007) in their study investigated the

effect of walking sessions per week on the changed body composition, sedentary 36 women who had no history of disease. Results showed the mean weight, percent body fat, waist-to-hip ratio (WHR) and BMI were significantly altered.[17] The effects of regular exercise on middle-aged females can be seen in literature and research samples. Deformation in the body composition and increased blood pressure caused by overweight and age can be observed in middle-aged individuals. It has been proved that the negative effects of sedentary living on individuals can be lowered with exercise. According to literature, sports activities promote life quality, and general physical performance completely affects positively the functional capacity of the systems.[18] Rahmaninia and Hojati (2000) investigated 20 minutes of aerobic exercise for 6 weeks on body composition and aerobic power of the girl students. Results showed significant decrease fat and increase aerobic power in the experimental group than the control group changes in body weight, fat weight and lean body weight with that decrease, but this reduction was not significant.[19] Soory and colleagues (2007) investigated the effect of exercise intensity on cardiovascular risk factors - vascular of non-athlete male students in the two different intensity aerobic training on blood lipid profile concentrations were measured in 47 sedentary male students. Comparing the results of the exercise group and control group, there was no significant effect of varying the intensity of exercise on triglyceride levels and also significant effect of moderate intensity exercise on cholesterol levels, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and low-density lipoprotein (VLDL) while aerobic training. Although intense exercise had significant effect on some factors such as HDL-C, LDL-C, and had high cholesterol.[20] Afzal Poor and colleagues (2003) studied the effects of extreme and moderate aerobic exercise on lipid profile and paraoxonase activity in healthy non-athletes male. The results suggest the existence of significant differences in levels of HDL-C, the ratio of HDL-C to LDL-C as well as its ratio TG, diastolic blood pressure, $VO_{2\ max}$, resting heart rate and indexes of body composition between the control group and the group with aerobic exercise was so high and there was a significant difference between groups in the amounts of LDL-C, TC, and TG.[21] Exercise program accompanied with diet makes the individuals feel psychologically good, healthy, and safe enabling them to escape from atherosclerotic risk factors of obesity. It has been proved with the obtained results that the negative effects of sedentary living on individuals are decreased with exercises.[22] De Souza e Silva and colleagues (2009) studied Effects of two types of aerobic exercise on body fat content and lipid profiles in 45 university male-students. And the results showed significant decrease in body fat content, waist circumference, and LDL levels in both aerobic training and military exercises in the control group.[9] Ghroubi and colleagues (2009) investigated the effects of physical exercise along with diet in treating obesity in young people through a combination of the two exercise protocols. Control group without training and experimental group with diet and activity intensity were 60% of maximum heart beat on the treadmill and the third group had a diet plus strength training. Maximum weight loss was observed in the group with strength training. Reduction in waist circumference, respectively, in the second and third groups was significant.[23] Barbara and colleagues (2009) studied the combined effect of resistance exercise on body composition and lipid profiles of older women and found a significant reduction in TG, HDL, in combination with aerobic exercise and concluded that a combination of aerobic exercise training is more effective than resistance training in improving body composition and lipid profiles.[24] Elmahgoub and colleagues (2009) studied the effect of combined exercise program on indices of body composition, physical fitness and lipid profiles of mentally retarded young people and observed that the exercise group compared with the control group, decreased their weight, BMI, waist circumference, fat mass, levels of LDL, TG, and cholesterol, while HDL levels significantly increased.[25] Wong and colleagues (2008) examined 12-week exercise program on aerobic fitness, body composition, blood lipids in obese adolescents. Results showed that exercises significant reduction in BMI, body mass index, net TG levels, and body weight is effective comparing to the control group.[26] Irving and colleagues (2008) investigated the effect of exercise intensity on abdominal visceral fat and body composition in obese middle-aged 27 women participated in the period with a 16-week intervention of aerobic activity. Results showed that

in the group with severe activities abdominal fat was significantly reduced.[27] The step aerobic dance program proved to be a useful exercise modality for weight loss and in terms of body composition. There was a clear response to the 8-week step aerobic dance program in terms of central obesity in sedentary obese Turkish women. Regular physical activity leads to significant changes in terms of increased health-related fitness, and can reduce risk factors for developing a range of disabling medical conditions which occur in inactive people[20]. In general, exercise is beneficial for health and physical fitness, while a sedentary lifestyle has a negative effect on a person's well-being.[28]

Unfortunately, because of the conflicting studies, the effect of aerobic exercise intensity on body composition in obese/overweight is still unclear. The aim of this study is to compare the effects of moderate and vigorous aerobic exercise on body composition and some blood parameters in women with obesity and overweight.

METHODS

The study is a pretest-posttest control group. Obese/overweight, 25 to 40 years who went to Iranian health clinic to treat obesity formed the statistical community. We selected them based on having a BMI ≥ 25 to 30 kg/m^2 and without any disease. Approximately 60 people volunteered as a sample to participate in the project and 45 people continued until the cooperation so that the evaluations based on all participants in terms of diet and activity levels (Prescribed by professionals Community Health Clinic) were matched and randomly assigned to three groups of 15. Two experimental groups were under the effect of each independent variable separately, 1. With aerobic exercise light intense (45-50% of maximal HRR) and 2. Aerobic exercise with moderate intensity (70-75% maximal HRR), and 3. The control group remained without training.

Data collection: Selected participants appeared in physiology laboratory at the faculty of Physical Education of Isfahan University for pretest measurements included height, weight, waist circumference, hip circumference, and skin fold in four regions (ventral, anterior femoral, triceps, and above the pelvis) to estimate fat percentage, fat weight, lean body weight. Auto analyzer method for measuring levels of lipid profiles with BT3000 assay kit was production of Pars Company.

Exercise program: Aerobic exercise program consists of two protocols with different intensity of the stretching and movement so that each group will perform its own protocol. Training groups are working under the control of the researchers 10 weeks, three sessions per week and about 60 minutes each session. Polar heart beat meter was used to control the intensity of exercise in each session, and after 10 weeks, all variables were measured in three groups.

Statistical analysis

Statistical methods used in this study consisted of calculating descriptive statistics for the central and dispersion parameters, one-way analysis of variance (ANOVA) and comparison groups to evaluate the homogeneity of each of the variables included in the three studied group using Scheffe test. All operations were performed with SPSS and statistical significant level of tests was ($P < 0.05$).

RESULTS

Noticing the results of this research in the following tables, we can see that aerobic exercise has caused a significant change in weight ($P < 0.000$), fat percent ($P < 0.045$), BMI ($P < 0.000$), fat weight ($P < 0.031$), lean body weight ($P < 0.02$), WHR ($P < 0.000$), and HDL ($P < 0.000$) of experimental group has been created [Table 1].

According to these results, significant changes resulting from the variance analysis for detecting differences between groups with Scheffe *post hoc* test were investigated [Table 2]. Comparing the data obtained from the aerobic exercise group with the control group, we found out that significant changes in aerobic exercise with moderate intensity, was more obvious.

DISCUSSION

Epidemiologic studies have shown that sedentary life relates to the increases of age and heart disease. Obesity is one of the factors that cause heart disease. Beneficial effects of aerobic training programs on blood lipid profiles have been evaluated. Although the data are contradictory in this regard, it is proposed that increase in HDL and reduction in TG content after exercise may be associated with gradual effects of exercise training. However,

prolonged exercise has been recognized as an important factor for weight loss. Proper amount of exercise is needed to improve long-term weight loss is still debated. Moreover, owning an appropriate diet and keeping the amount of energy consumption is of equal importance. Long-term weight loss is more effective when combined with exercise interventions. Mild to severe levels of exercise in combination with reduced energy consumption during a 12-month intervention, reduces body weight by 8-10%. Determining the level of exercise intensity and maintaining it at least 150 minutes per week of moderate-intensity exercise is important until the power of person goes beyond the prescribed amount of exercise, which thus brings it to 60 minutes a day.[29] It is suggested that the combination of strength and aerobic exercise is effective in improving body composition. Evaluation has shown that the combination of exercise reduced fat mass and increased body weight in obese middle-aged women, which is probably a result of growth hormone. In order to treat obesity researchers recommended 30 minutes of activity most days a week.[24] Aerobic exercise combined with controlled diet may cause further reduction in fat mass, when compared to using diet only. Significant changes in BMI, body fat mass and body mass in pure aerobic exercise group compared with control groups is interesting. Aerobic, adds up the exercise capability of your body to use fat as a substrate increases and total fat oxidation during. In addition, there is a high correlation between the content within the muscle and insulin resistance. It may be suggested that the body mass increases due to increased blood flow and capillary in skeletal muscle and adipose tissue. Lipolyze triacylglycerol is high, and the transfer of fatty acids from blood to muscle sarcoplasm is high; these are the effects on fat during exercise and these effects support by activation of certain enzymes in the oxidative pathway, supports this process. Aerobic exercise activates lipoprotein lipase and increased lipoprotein lipase (LPL) activity may play an important role in reducing insulin resistance during exercise.[30] Most people can take 30 minutes a day walking or converted to jogging activity that is of higher intensity than walking for

Table 1: Comparison the Mean and SD indicators studied in experimental and control groups

Index	Group	Light aerobics	Moderate aerobics	Control group	*P*
Height (cm)	Pre test	159/03±6/96	159/03±6/48	160/43±7/33	0.5
	Post test	159/04±6/92	159/86±6/68	160/46±7/30	
Weight (kg)	Pre test	70/166±9/41	74/63±9/85	78/5±14/45	0.000
	Post test	68/13±7/09	70/40±8/52	78/00±14/10	
BMI (kg/m^2)	Pre test	27/83±4/147	29/19±3/86	30/38±4/98	0.000
	Post test	27/09±3/99	27/00±3/54	30/73±4/76	
FP (%)	Pre test	39/47±2/11	42/14±3/64	43/40±3/74	0.045
	Post test	38/17±3/18	36/98±2/42	43/2±2±/67	
FW (kg)	Pre test	27/79±5/61	31/66±6/51	34/40±8/58	0.031
	Post test	26/23±4/99	26/9±4/67	33/50±7/13	
LBW (kg)	Pre test	42/37±6/00	42/97±4/38	44/9±6/55	0.02
	Post test	43/1±4/80	44/44±5/44	44/49±7/37	
WHR (cm)	Pre test	0/85±0/08	0/85±0/05	0/87±0/05	0.000
	Post test	0/84±0/06	0/81±0/03	0/87±0/06	
HDL (mg/dl)	Pre test	46/4±11/72	34/40±7/56	48/40±13/77	0.000
	Post test	52/60±8/79	50/60±7/52	49/13±11/01	
LDL (mg/dl)	Pre test	58/06±20/82	88/9±21/72	92/9±28/4	0.281
	Post test	84/2±17/95	81/4±22/05	93/7±30/7	
TG (mg/dl)	Pre test	92/86±48/95	110/07±62/25	92/66±32/80	0.570
	Post test	89/8±46/5	96/80±37/5	115/57±41/00	
colsterol (mg/dl)	Pre test	155/2±27/5	154/07±26/10	170/46±36/41	0.117
	Post test	149/4±22/31	151/73±24/60	170/14±34/30	

LDL=Low-density lipoprotein, HDL=High-density lipoprotein, WHR=Waist-to-hip ratio

Table 2: Comparison of differences in test groups compared with Scheffe post hoc test

Index	Groups p	Groups	*P*
Weight (kg)	The first group of experimental	The second group of experimental	0.000
		controls	0.758
	The second group of experimental	The first group of experimental	0.000
		controls	0.000
BMI (kg/m^2)	The first group of experimental	The second group of experimental	0.428
		controls	0.04
	The second group of experimental	The first group of experimental	0.428
		controls	0.002
Fat percent (%)	The first group of experimental	The second group of experimental	0.106
		controls	0.480
	The second group of experimental	The first group of experimental	0.106
		controls	0.007
Fat weight (kg)	The first group of experimental	The second group of experimental	0.053
		controls	0.963
	The second group of experimental	The first group of experimental	0.053
		controls	0.094
LBW (kg)	The first group of experimental	The second group of experimental	0.428
		controls	0.04
	The second group of experimental	The first group of experimental	0.428
		controls	0.002
WHR (cm)	The first group of experimental	The second group of experimental	0.044
		controls	0.5
	The second group of experimental	The first group of experimental	0.044
		controls	0.002
HDL (mg/dl)	The first group of experimental	The second group of experimental	0.03
		controls	0.986
	The second group of experimental	The first group of experimental	0.03
		controls	0.02

20 minutes. The importance of central obesity as an independent risk factor for heart disease - cardiovascular, diabetes type 2, and hypertension has been found. Comparing the high and low intensity physical exercise has shown that the net mass of more vigorous activity has increased, while this finding was not statistically significant. There is always a minimum amount of activity needed to maintain weight. Minimum levels of activity can include walking to the 6/9 km during the week, which reduces the amount of central fat and total body fat. The amounts of activity can be balanced without a change in diet and more exercise may lose weight of inborn obese people.[31] Intense activity is likely to be an effective stimulus for changes in body composition. Particularly vigorous activity decreases significantly the weight, BMI, fat percentage, fat mass, and waist. This could indicate that strenuous exercise can be the subject of total energy intake and energy expenditure during exercise is more effective than moderate activity. There is About 400 kcal difference in energy consumption between high and low intensity activity during 16 weeks of activity, which is approximately 25 kcal per week of vigorous activity and oxygen consumption fare much worse. High-intensity activity to mild activity in visceral fat, the abdominal fuel cycle is more effective, because the lipolytic hormones are sprinkled and after exercise provide the needed energy, fat oxidation and add a negative energy balance. The intense activity of abdominal obesity - visceral reduces further.[27] Researches have shown that people who do regularly certain exercises, loss much weight than those without a particular sport. Intense aerobic activity with increased activity in heart beat increases. During intense exercise, heart beat increases. Metabolic rate increases after exercise, however, does not seem to affect metabolism of people who are not physically able to prepare the necessary amount of time to maintain the metabolic rate after exercise. Following a diet, aerobic activity, and strength activity normally decrease lean mass and increase strength and $VO_{2\,max}$ when compared to diet alone.[32] Training program twice a week during 12 weeks of aerobic fitness improves, while not effective in improving the parameters of adipose tissue in obese and normal weight gain for the higher intensity exercise training and dietary interventions are needed. Add a program that improves strength and power to be obese and to provide useful physiological overload for them to increase their energy intake, and prevent further weight gain, it is important.[26] We can also guess that lipid lowering reduces body fat mass can be explained and justified.[25] Two months aerobic exercise for 60 minutes, three times a week, has a

desirable effect on body composition and blood lipid profile of young women. Body weight and BMI are factors that are directly associated with heart disease have vascular connections. The researchers found that aerobic exercise reduces fat mass and decreased body weight that followed. Time needed to change some parameters are based on: 2 weeks for the levels of tumor associated glycoprotein (TAG), 4 weeks for $VO_{2\ max}$, 6 weeks, and 8 weeks for body weight and BMI, body fat mass, and to change HDL levels in blood.[7] Regular exercise may be a gradual reduction of TG, TC, LDL, BMI, body mass, body fat and increase HDL, body mass, and BMR is the net.[8] Some researchers reported that people who adhere to diet and aerobic exercise for 60 to 90 minutes in 5 to 7 days a week due to the increase in $VO_{2\ max}$ and HDL levels are achieved and their waist circumference decreased. Since physical activity significantly reduces body fat content for the treatment of heart disease, it is very important in cardiovascular exercise (aerobics) compared to other training is more effective in reducing body fat percentage, so most studies, exercises offer aerobics.[9] Perhaps the increased skeletal muscle lipoprotein lipase activity and increased lipoprotein lipase mass index, blood lipids during exercise is one of the factors. Increase in capillary density, the greater the potential for harvest and use of fatty acids that may increase the density function of HDL in people who provide training.[33] Differences in severity, type, and duration of exercise protocols may be differences between individuals. Degrees of glucose tolerance and body fat distribution between the individual participants may be from other causes. Differences in diet can cause differences in the application data protocol a sport. Applied regardless of the type of aerobic activity, per exercise reduces body fat.[9] Increasing physical activity and weight control program to prevent young people it supports.[26] In sedentary overweight women, with aerobic activity, three days a week for 60 minutes of moderate intensity can be remarkably improved their body composition.[17] It can be said that in the obese and overweight women, the applied exercise protocol have an important effect on the antropometric and hematologic levels, regular aerobic exercises will reduce the body fat percentage without the loss of the muscle.[18] Thus, to exercise longer is a need for significant reduction in body fat mass.[19] To improve health and body composition are recommended.[20] As a result, exercises cause favorable changes in lipids and lipoproteins.

CONCLUSION

Furthermore, diet program in addition to exercise program will provide more prolific results with obese people. It has been proved with the obtained results that the negative effects of sedentary living on individuals are decreased with exercises.[22]

REFERENCES

1. Ren J. Leptin and hyperleptinemia-From friend to foe for cardiovascular function. J Endocrinol 2004;181:1-10.
2. Nammi S, Koka S, Chinnala KM, Boini KM. Obesity: An overview on its current perspectives and treatment options. Nutr J 2004;3:3.
3. Volpe SL, Kobusingye H, Bailur S, Stanek E. Effect of diet and exercise on body composition, energy intake and leptin levels in overweight women and men. J Am Coll Nutr 2008;27:195-208.
4. Formiguera X, Cantón A. Obesity: Epidemiology and clinical aspects. Best Pract Res Clin Gastroenterol 2004;18:1125-46.
5. Cooke JP, Oka RK. Does leptin cause vascular disease? Circulation 2002;106:1904-05.
6. Blaak EE, van Aggel-Leijssen DP, Wagenmakers AJ, Saris WH, van Baak MA. Impaired oxidation of plasma-derived fatty acids in type 2 diabetic subjects during moderate-intensity exercise. Diabetes 2000;49:2102-7.
7. Stasiulis A, Mockiene A, Vizbaraite D, Mockus P. Aerobic exercise-induced changes in body composition and blood lipids in young women. Medicina (Kaunas) 2010;46:129-34.
8. Talanian JL, Galloway SD, Heigenhauser GJ, Bonen A, Spriet LL. Two weeks of high-intensity aerobic interval training increases the capacity for fat oxidation during exercise in women. J Appl Physiol 2007;102:1439-47.
9. De Souza e Silva MJ, de Souza Rabelo A, Vale RG, Ferrão ML, Gonçalves LC, de Sá Rego Fortes M, *et al*. Effects of two kinds of aerobic training on body fat content and serum lipid profile in cadets. Biomed Human Kinet 2009;1:72-5.
10. Janssen I, Ross R. Effect of sex on the change in visceral, subcutaneous adipose tissue and skeletal muscle in response to weight loss. Int J Obes Relat Metab Disord 1999;23:1035-46.
11. Jakicic JM, Clark K, Coleman E, Donnelly JE, Foreyt J, Melanson E, *et al*. American College of Sports Medicine position stand. Appropriate intervention strategies for

weight loss and prevention of weight regain for adults. Med Sci Sports Exerc 2001;29:2145-56.
12. Okura T, Nakata Y, Lee DJ, Ohkawara K, Tanaka K. Effects of aerobic exercise and obesity phenotype on abdominal fat reduction in response to weight loss. Int J Obes (Lond) 2005;29:1259-66.
13. Marra C, Bottaro M, Oliveira RJ, Novaes JS. Effect of moderate and high intensity aerobic exercise on the body composition of overweight men. JEPonline 2005;8:39-45.
14. Mougios V, Kazaki M, Christoulas K, Ziogas G, Petridou A. Does the intensity of an exercise programme modulate body composition changes? Int J Sports Med 2006;26:178-81.
15. Narayani U, Sudhan PR. Effect of aerobic training on percentage of body fat, total cholesterol and HDL-C among obese women. World J Sport Sci 2010;3:33-6.
16. You T, Murphy KM, Lyles MF, Demons JL, Lenchik L, Nicklas BJ. Addition of aerobic exercise to dietary weight loss preferentially reduces abdominal adipocyte size. Int J Obes (Lond) 2006;30:1211-6.
17. Jaafari A. Compare the effect number of sessions walking in week on body composition changes of low mobile and overweight women. Olympic J 2007;1:27-36.
18. Çakamakci E, Sanioglu A, Vatansev H, Marakoglu K. The effects of 8-week step-aerobic exercise on the body composition and hematologlic parameters in the obese and overweight females. Sci Mov Health 2010;10;808-13.
19. Rahmaninia F, Hojati Z. The effect of selected exercise program on body composition and aerobic power of student girls. Motion J 2001;5:109-19.
20. Surry R. Determine the effect of exercise intense on cardiovascular disease of inactive men students. J Res Sport Sci 2006;15:133-45.
21. Afzalpur ME. The effect of moderate and intense aerobic exercise on PON1 enzyme activity and serum lipid profile of health and inactive men. Olympic J 2005;24:115-34.
22. Vatansev H, Çakmakci E. The effects of 8-week aerobic exercises on the blood lipid and body composition of the overweight and obese females. Sci Mov Health 2010;10:814-20.
23. Ghroubi S, Elleuch H, Chikh T, Kaffel N, Abid M, Elleuch MH. Physical training combined with dietary measures in the treatment of adult obesity. A comparison of two protocols. Ann Phys Rehabil Med 2009;52:394-413.
24. Nicklas BJ, Wang X, You T, Lyles MF, Demons J, Easter L, *et al*. Effect of exercise intensity on abdominal fat loss during calorie restriction in overweight and obese postmenopausal women: A randomized, controlled trial. Am J Clin Nutr 2009;89:1043-52.
25. Elmahgoub SM, Lambers S, Stegen S, Van Laethem C, Cambier D, Calders P. The influence of combined exercise training on indices of obesity, physical fitness and lipid profile in overweight and obese adolescents with mental retardation. Eur J Pediatr 2009;168:1327-33.
26. Wong PC, Chia MY, Tsou IY, Wansaicheong GK, Tan B, Wang JC, *et al*. Effects of a 12-week exercise training programme on aerobic fitness, body composition, blood lipids and C-Reactive protein in adolescents with obesity. Ann Acad Med Singapore 2008;37:286-93.
27. Irving BA, Davis CK, Brock DW, Weltman JY, Swift D, Barrett EJ, *et al*. Effect of exercise training intensity on abdominal visceral fat and body composition. Med Sci Sports Exerc 2008;40:1863-72.
28. Arslan F. The effects of an eight-week step-aerobic dance exercise programme on body composition parameters in middle-aged sedentary obese women. ISMJ 2011;12:160-8.
29. Jakicic JM, Marcus BH, Gallagher KI, Napolitano M, Lang W. Effect of exercise duration and intensity on weight loss in overweight, sedentary women: A randomized trial. JAMA 2003;290:1323-30.
30. Fenkci S, Sarsan A, Rota S, Ardic F. Effects of resistance or aerobic exercises on metabolic parameters in obese women who are not on a diet. Adv Ther 2006;23:404-13.
31. Slentz CA, Duscha BD, Johnson JL, Ketchum K, Lori B, Aiken BS, *et al*. Effects of the amount of exercise on body weight, body composition, and measures of central obesity. Arch Intern Med 2004;164:31-9.
32. Fernandez AC, Túlio de Mello M, Tufik S, Morcelli de Castro P, Fisberg M. Influence of the aerobic and anaerobic training on the body fat mass in obese adolescents. Rev Bras Med Esporte 2004;10:159-64.
33. Margues E, Carvalho J, Soares JM, Margues F, Mota J. Effects of resistance and multicomponent exercise on lipid profiles of older women. Maturitas 2009;63:84-8.

Source of Support: This study was conducted as a thesis funded by Isfahan University, Isfahan, Iran, **Conflict of Interest:** None declared.