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Original Article

The Effect of Eight Weeks of Incremental Pump Body Training on Some Atherogenic Factors in Obese Women With Dyslipidemia

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Abstract

Background: Dyslipidemia is one of the main risk factors for coronary artery disease, stroke, and peripheral vascular disease. This study aimed to evaluate the effect of eight weeks of incremental pump body training on some atherogenic factors in obese women with dyslipidemia.

Materials and Methods: In this quasi-experimental study, 40 obese female subjects in the age range of 30-50 years suffering from dyslipidemia were randomly divided into two groups of body pump training (n = 20) and control (n = 20). The body pump training program consisted of eight weeks with a frequency of 3 sessions per week for 45 minutes with overload and 48 hours of rest. Data were analyzed using independent samples *t* test and paired samples *t* test.

Results: The results showed that eight weeks of body pump training significantly decreased triglyceride, cholesterol, low-density lipoprotein (LDL), and atherogenic index (AI) in obese women with dyslipidemia, while there was a significant increase in high-density lipoprotein (HDL) ($P<0.001$).

Conclusion: The results of this study show that body pump training can properly prevent the progression of dyslipidemia in people suffering this complication.

Keywords: Atherogenic factors, Dyslipidemia, Incremental pump body training, Obese women

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Introduction

Today, cardiovascular disease is one of the main causes of death in developed and developing countries (1). Although the number of deaths has decreased in recent decades due to comprehensive measures to reduce the risk factors, this trend has slowed down as a result of the emergence of factors such as sedentary lifestyle, machine life, and smoking (2). Studies conducted in recent years have shown that dyslipidemia is common in urban and rural communities of Iran. Dyslipidemia is a major cause of atherosclerosis, while hyperlipidemia is an important risk factor for cardiovascular disease (3).

Fat disorders are very common in the world, with their prevalence varying between 20 and 50% in populations. Researchers have recently conducted several studies on the modifiable risk factors for hyperlipidemia. Coronary heart disease is one of the leading causes of death in Iran and in most countries, which is strongly associated with high levels of triglycerides and low-density lipoprotein (LDL) and low levels of high-density lipoprotein (HDL). High blood lipid levels can lead to serious problems such as an increased risk of cardiovascular diseases and stroke. Reliable scientific sources report hyperlipidemia as an independent risk factor for coronary heart disease, which can increase the risk of death in cardiovascular disease. The classification of fat disorders includes low concentration of HDL, high concentration of LDL, high triglyceride, high cholesterol, combined disorder of HDL and LDL, and so on (4). Lipid profile and atherogenic index (AI) are important predictors of dyslipidemia, atherosclerosis, and cardiovascular disease. Any changes in normal lipid levels put people at greater risk of developing cardiovascular diseases and abnormal endothelial cell function (5).

According to previous studies, regular aerobic exercise plays a significant role in the prevention and control of these diseases (5). However, little is known about the preventative effect of strength training on the risk factors for cardiovascular diseases such as high blood pressure, cholesterol levels, obesity, and type 2 diabetes. Some researchers have suggested strength training as a non-pharmacological strategy to reduce the serum concentrations of total cholesterol, triglycerides, and LDL and increase HDL (6). Yet, some authors have reported no changes in lipid and lipoprotein levels after a strength training program (7).

Body pump training is performed with music, barbells, and light weights. The rhythm of exercise gradually slows down at the time of cooling down. The number of calories burned in the body increases due to the use of more muscle groups. Additionally, the number of calories burned is still high in the body even up to 2 hours after exercise and at rest (8). Researchers claim that this type of exercise improves strength and muscle endurance while increasing energy expenditure by more than 600 kcal per session. However, little is known about long-term physiological adaptations in response to the barbell and dumbbell-based training programs and free weights. Body pump training is a branch of resistance training used in groups with free weights of low intensity and high volume (repetitive) (9). In these exercises, pumping is done to increase blood flow and metabolism. Some studies have examined the effect of body pump training and concluded that the two main components are resistance exercises with free weights, balance, and resistance load, which strengthen the central muscles and maintain balance in the body. However, body pump training, which is the same as resistance exercises with many repetitions and light training load, is widely used in health training programs today. This type of exercise has been reported to have favorable effects on the strength, balance, and performance of individuals (10). Increased risk of cardiovascular diseases in women is associated with age-related muscle mass decline, changes in body composition, fat deposition, and functional capacity (7). Various studies have demonstrated the effects of lifestyle on blood lipid profiles. Numerous epidemiological studies show that moderate to vigorous daily physical activity prevents the development of chronic diseases such as cardiovascular complications and premature death. On the other hand, inadequate physical activity is one of the causes of hyperlipidemia (11).

Nevertheless, various studies have achieved different and somehow contradictory results about physical activity and different levels of hyperlipidemia according to the method used and populations studied (4). Hence, the present study looks for an answer to the question whether eight weeks of incremental body pump training has a significant effect on some atherogenic factors in obese women with dyslipidemia or not.

Materials and Methods

This quasi-experimental study with a pretest-posttest design was performed on two experimental and control groups in 2020. The statistical population of the study consisted of obese women with dyslipidemia in Karaj. The sample size was determined using cochran sample and considering a power of 0.8 and an alpha of 0.05 for each group. The willingness of the subjects to participate in the research stages, female gender, dyslipidemia, and an age of 30-50 years were the inclusion criteria. Suffering from other chronic illnesses, having a mental illness, having a regular exercise program for the past three months, absence from more than two consecutive training sessions, and attending regular exercise sessions other than body pump training were conditions for excluding the patient from the study.

To comply with the ethical charter, patients were informed of the purpose and procedures of the study. Then, they completed a written consent form before sampling. One day before the start of the exercise program, blood samples were taken and the anthropometric characteristics of the subjects were assessed. The standing height of the subjects (cm) was measured using a height gauge, and their weight (kg) was measured with a minimum of clothes and without shoes using a scale (ADE brand, Germany). The body mass index (BMI) was calculated by dividing body weight (kg) by height (m) squared using the following formula: weight (kg)/[height (m)]2. Then, the training group participated in an exercise program for eight weeks and three sessions per week with a specific intensity and duration.

To evaluate biochemical variables, blood samples were taken in two stages (before training and after eight weeks of training) after 12 hours of fasting. In the first step, all subjects were asked not to engage in strenuous physical activity for two days before the test. The temperature and time of the test were recorded to maintain these conditions in the next step. After 5 minutes, 5 mL of blood was taken from the vein of each subject's right hand while sitting on a chair. Blood sampling was performed by the nurses of the center. The serum samples were poured into microtubes and stored at -80°C after centrifugation and separation. Blood biochemical factors, including total cholesterol, triglyceride, HDL, and LDL, were measured by enzymatic method using a biochemical autoanalyzer and Pars Azmon kits. AI values were calculated by the formula AI = Col / HDL-C.

The body pump training consisted of 3 sessions per week for 8 weeks (Table 1). In each session, the exercise began with a five-minute warm-up, including stretching, and ended with a cool-down after the program. The duration of training was 45 minutes with exercise overload and 48 hours of rest. The intensity of exercises based on overload was added to the weights used, and the speed of movements was increased with the help of music. In the early weeks, the intensity of the exercise was 20%-25% of one repetition maximum (1RM), reaching 40%-45% of one repetition maximum in the sixth to eighth weeks. Specific muscle groups were trained in each session. The weights used in these exercises included free weights, barbells, and step aerobics. These exercises were accompanied by music, based on 32 beats per minute, and proportional to the speed of the subjects in each session (12). The subjects in the control group did not participate in any exercise program.

Table 1. Schedule of Incremental Pump Body Training

No. of Weeks	Type of Movement	Intensity of Training
Week 1-2	Warm-up (including lift, squat, wrist, and leg position changes.) Squat (the distance between legs and speed of movement are different and 40% of the weight of the chest press.) Chest press (the speed of movement and angle of the hand vary during the movement along with the push-up.) Back muscles (scapular muscles, Latissimus dorsi muscles, and scapular muscles along with hamstrings.) Triceps (in lying and standing positions with dumbbells; the speed of movements and the angle of the legs change.) Biceps (with dumbbells, free weights, and barbells; the speed of movement, position of legs, angle of movement of hand, and speed of movements are different.) Launch (with and without weights; the speed of movements varies according to the beat.) *Deltoid muscle* (with weights and barbells; the speed of movement changes with the rhythm of the song.) Abdominal (with and without weights; the type of movements can be changed in each session and specific abdominal movements can be used.) Cool-down (beating slows down during cool-down.)	20-25% 1RM
Week 3-4	The movements performed are common, and only the time and intensity of the exercises increase.	25-30% 1RM
Week 5-6	The movements performed are common, and only the time and intensity of the exercises increase.	30-35% 1RM
Week 7-8	The movements performed are common, only the time and intensity of the exercises increase.	35-45% 1RM

Descriptive and inferential statistics were used to analyze the data. Accordingly, the former helped to describe, classify, and adjust raw scores by the calculation of mean and standard deviation, tables, and figures while the latter examined the normal distribution of data using Shapiro-Wilk test.

Paired *t*-test was used to compare the means of the pretest and posttest, and the means of the two groups were compared using independent *t* test. Data analysis was performed using SPSS at a significance level of $P \geq 0.05$.

Results

After being invited to participate, 40 women with a mean age of 40.35 ± 2.28 years and a mean weight of 75.34 ± 3.82 kg were selected by available convenience sampling and simple random (based on the completed sheet of readiness to participate in a physical activity) and divided into body pump training group (n = 20) and control group (n = 20). Based on the results of Shapiro-Wilk test, the distribution of data was normal in all variables in both control and experimental groups ($P > 0.05$). Table 2 shows the anthropometric data of the subjects.

The results showed that eight weeks of body pump training significantly decreased triglyceride, cholesterol, LDL, and AI in obese women with dyslipidemia, while there was a significant increase in HDL ($P < 0.001$). Accordingly, there were significant differences between the body pump training and control groups in terms of triglyceride, cholesterol, LDL, HDL, and AI ($P < 0.001$) (Table 3).

Table 2. Demographic Characteristics of the Subjects in the Study Groups

Group	Variable			
	Age (y)	Height (cm)	Weight (kg)	BMI (kg/m²)
Experimental	39.5 ± 5.96	157.55 ± 2.99	76.95 ± 2.32	31.0 ± 3.64
Control	41.14 ± 5.52	156.8 ± 3.34	76.45 ± 4.12	31.06 ± 4.28

Note. BMI, body mass index.

Discussion

The results of this study showed that eight weeks of body pump training significantly reduced the serum levels of LDL in obese women with dyslipidemia. There was also a statistically significant difference in serum levels of LDL between the two groups after eight weeks of body pump training. Research has shown that LDLs naturally carry 60%-80% of plasma cholesterol (13). During exercise, the body's endocrine system can increase fat oxidation through an increase in epinephrine, norepinephrine, growth hormone, and cortisol and the use of fatty acids as fuel (14). Body pump training uses fat as the main source of energy production (12). Therefore, the decrease in LDL can be due to its effect on the percentage of body fat used as the main source of energy production (12). Possibly, body pump training activates norepinephrine, epinephrine, growth hormone, and cortisol and increases metabolism through an increase in the oxidation of fatty acids and a significant reduction in the subjects' LDLs (12). Hence, body pump training may reduce serum levels of LDLs, releasing them into the bloodstream and delivering them to muscle tissue for energy.

The results of this study also showed that eight weeks of body pump training significantly increased serum levels of HDL in obese women with dyslipidemia, leading to statistically significant differences in serum levels of HDL in the two groups after eight weeks of body pump training. Other studies have also shown that exercise significantly reduces oxidative stress by increasing the antioxidant capacity of the body (15). Research shows that regular exercise (by reducing the stimulation of the sympathetic system and increasing anti-inflammatory cytokines) inhibits the release of inflammatory mediators (interleukin 1 beta and tumor necrosis factor alpha) in adipose tissue (16) and decreases the concentration of cell adhesion molecules (17). Studies have also shown

Table 3. Changes (mean ± SD) of Research Parameters in Experimental and Control Groups

Variable	Group	Pretest	Posttest	Intragroup Changes		Intergroup Changes	
				t	*P*	*t*	*P*
(AI)	Experimental	0.76 ± 0.03	0.58 ± 0.05	33.85	0.0001	-30.60	<0.0001
	Control	0.74 ± 0.04	0.76 ± 0.03	-0.58	0.67		
LDL (mg/dL)	Experimental	175.2 ± 5.28	120.253.29	37.66	0.0001	-31.60	<0.0001
	Control	172.556.86	172.456.61	0.21	0.85		
HDL (mg/dL)	Experimental	35.4 ± 1.27	39.1 ± 2.02	-6.37	0.0001	3.12	<0.0001
	Control	36.35 ± 1.59	36.25 ± 1.44	1.77	0.09		
Cholesterol (mg/dL)	Experimental	266.05 ± 17.52	180.55 ± 3.70	21.55	0.0001	-25.62	<0.0001
	Control	263.2 ± 16.3	263.45 ± 16.18	-0.88	0.41		
TG (mg/dL)	Experimental	222.45 ± 19.53	151.75 ± 4.86	16.07	0.0001	-14.92	<0.0001
	Control	219.0 ± 19.63	218.7 ± 19.45	0.59	0.57		

Note. AI, Atherogenic index; HDL, high-density lipoprotein; LDL, low-density lipoprotein; TG, triglycerides.

that regular exercise increases lipolysis by increasing lipoprotein lipase, decreasing LDL, increasing HDL, and preventing the deposition of cholesterol in the arteries, thus reducing the risk of cardiovascular disease (18). The body pump training (by increasing antioxidant capacity, reducing sympathetic system stimulation, and increasing anti-inflammatory cytokines and also lipoprotein lipase enzyme) can decrease LDL and increase serum levels of high-density in obese women with dyslipidemia (19).

The results of this study showed that eight weeks of body pump training significantly reduced serum triglyceride in obese women with dyslipidemia, leading to statistically significant differences in serum triglyceride levels in the two groups after eight weeks of body pump training. A large amount of carbohydrates used in each meal is converted to triglycerides and then stored for later release in the form of fatty acids from triglycerides to produce energy (4). During exercise, adrenaline and glucagon are secreted by the adrenal glands and pancreas, which activate this hormone-sensitive lipase in adipose tissue and the lipoprotein lipase (20). Hence, fatty acids released from triglycerides are delivered to muscle tissue through the bloodstream and from intracellular fat sources (21). Therefore, it is possible that body pump training releases adrenaline and glucagon and activates lipoprotein lipase to release triglycerides into the bloodstream and deliver them to muscle tissue, which, in turn, can reduce the serum level of triglycerides in subjects (19).

The results of this study showed that eight weeks of body pump training significantly reduced serum cholesterol levels in obese women with dyslipidemia, leading to statistically significant differences in serum cholesterol levels of the two groups after eight weeks of body pump training. Cholesterol is present in the diet of all individuals and can be slowly absorbed from the gastrointestinal tract by intestinal lymph and synthesized by the liver. Cholesterol is mainly transported within the body in combination with LDL packages such as LDL and HDL (22). During light to moderate short-term training, the energy from the oxidation of carbohydrates and fats is almost equal (23). The energy used by fats (through the enzyme lipoprotein lipase and the oxidation of fatty acids) reduces total cholesterol (24). Therefore, it is possible that body pump training for energy supply reduces the serum cholesterol levels of subjects by activating the enzyme lipoprotein lipase and oxidation of carbohydrates and fats (19).

The results of this study showed that eight weeks of body pump training significantly reduced the serum levels of AI in obese women with dyslipidemia. There was also a significant difference in serum levels of AI between the two groups of body pump training and control. Body pump training increases the use of energy reserves. Some researchers have introduced exercise as the best way to lose weight (12). Exercise, especially body pump training, increases the capacity of oxidative enzymes in muscle fibers through an increase in mitochondrial density. In addition, increasing the activity of electron transfer chain enzymes increases the activity of enzymes involved in lipid oxidation, especially beta-oxidation cycle enzymes, and also the activity of lipoprotein lipase (25). On the other hand, body pump training increases the density of beta-adrenergic receptors at the cellular level of adipose tissue and their sensitivity to the lipolysis process (11). The distribution of catecholamines, decreased insulin due to body pump training, and increased fat oxidation may be the main reasons for this trend (12). Exercise appears to increase beta-oxidation enzymes in muscles and also the release of free fatty acids from fat reservoirs to be more easily available to muscles (26). Additionally, body pump training uses more fat as the main source of energy production, which reduces the level of LDL and body fat percentage (19). Considering that the AI is obtained from the fraction of LDL and HDL, the decrease of LDL and the increase of HDLs in these subjects following body pump training are supposed to improve the AI in the subject.

Conclusion

The results of this study showed that eight weeks of body pump training could improve triglyceride, cholesterol, LDL, high-density lipoprotein, and AI in obese women with dyslipidemia. As shown by the results, the use of these exercises could help in the treatment and improvement of this pervasive disease affecting the world today.

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Authors' Contribution

Conceptualization: AL; Study validation and supervision: BA; Data analysis and interpretation: AL, BA; Writing and reviewing: MV.

Conflict of Interest Disclosures

There is no conflict of interests to be declared.

Ethical Statement

Prior to the beginning of the study, ethical approval was obtained from the Scientific and Ethical Committee of Mahallat Branch, Islamic Azad University (162415586).

Informed Consent

All participants gave their written informed consent after receiving explanations about the study objective and methodology.

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