Original Article

Evaluation of the effect of 8 weeks of aerobic exercise on triglyceride, cholesterol, HDL, LDL, and hyperglycemic indicators of overweight men

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ABSTRACT

Introduction: Obesity is a type of malnutrition in which the accumulation of fat is so high that the functioning of the body's systems is disrupted. This study aimed to investigate the effect of 8 weeks of aerobic exercise on the indicators of triglycerides, cholesterol, HDL, LDL, and hyperglycemia in overweight men. **Research Method:** 40 overweight men (with an average height of 178±5.61 cm, weight of 99±0.89 kg, and BMI of 30.79±2.91 kg.m^2) from the General Department of Education of Qazvin province with three simple random sampling methods were selected and randomly divided into two groups of control and aerobic exercise. During the eight-week experimental study period, aerobic exercise three times a week from 65% at the beginning to 85% at the end of the week was administered for subjects in the related groups. To evaluate biochemical variables, blood sampling was performed after 12-14 fasting hours in two stages, i.e. before the start of training and after eight weeks of training as pre-test and post-test, respectively. **Results:** After testing the research hypotheses by covariance analysis method, the results showed that eight weeks of aerobic exercise did not have a significant effect on the number of triglycerides and LDL in overweight men ($P > 0.05$). Eight weeks of aerobic exercise also had a significant effect on HDL, cholesterol, and blood glucose levels in overweight men ($P < 0.05$). **Conclusion:** The findings suggest that aerobic exercise affects the indicators of triglycerides, cholesterol, HDL, LDL, and hyperglycemia in overweight men.

Keywords: Aerobic exercise, Blood Sugar, Triglyceride, Cholesterol, HDL, LDL, Overweight men.

Introduction

Obesity and related diseases are one of the major human problems. Storage and utilization of adipose tissue are controlled through a complex network of neural and hormonal signals that activate the absorption and use of food energy. Many hormones underlie this physiological system of regulating body weight hemostasis. Leptin, a hormone secreted by adipose tissue, is a component of this system [1]. Leptin secretion occurs from the body's white adipose tissue and is moderately related to the size of adipose tissue so that in human specimens there is a strong association between leptin and body fat content.

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Obesity is a major cause of many chronic diseases such as diabetes, high blood pressure, and heart disease. The main cause of overweight is the imbalance between energy intake and energy expenditure. Also, one of the main risk factors for heart disease in men is an increase in blood fats. There are many ways to reduce blood lipids. On the other hand, weight gain can lead to chronic metabolic diseases, including type 2 diabetes. Today, medical experts recommend non-pharmacological methods such as exercise and physical activity to lose weight and prevent many diseases. Exercise is an effective way to prevent and treat cardiovascular risk factors [2].

Lifestyle changes such as increased physical activity and low-calorie diets have been suggested as the first interventions to reduce excess body fat and prevent the development of cardiovascular disease and metabolic complications [3]. In this regard, some researchers consider inactivity to be more important than calorie intake and consider lethargy and inattention to physical activity to be the primary characteristics of obese people. The more active a person is, the more energy he or she will consume on a daily basis, and the faster the obesity will go away. Therefore, forced muscle activity is often an essential part of obesity treatment, and because of the high risk of obesity, interventions that help reduce or maintain weight are of particular importance [4].

The discussion of fats and its relationship to energy consumption and exercise is one of the most important topics in medical science. If people who are prone to obesity and do not exercise consume too much fat, their fat metabolism will be disrupted and their blood levels will rise, or they will be stored too much under the skin or liver. This makes them fat. Obese people generally have too much cholesterol in their blood, which predisposes them to diseases such as atherosclerosis and heart disease. The goal of an exercise program should be to lose fat rather than lose weight. However, physical activity, exercise, and exercise help maintain the desired weight and reduce body fat by reducing fat storage [5].

Increased physical activity and daily exercise play a role in people's health in several ways. Daily physical activity increases the physical capacity to do things. This, in turn, increases the body's ability to meet the unexpected needs of life, thus reducing the pressure on organs such as the heart. This energy consumption is also more useful in weight loss. Increasing physical activity or daily exercise reduces appetite in some cases while increasing basal metabolic rate or energy consumption increases body rest. The physiological changes caused by increasing daily physical activity partly answer the question of why exercise is associated with weight loss and body fat. Losing weight and body fat is good for lowering blood cholesterol and changing the way cholesterol is transported in the blood. The summarized results of several studies have shown a fat loss in animal models, and linked this reduction to increased energy intake, increased glucose uptake by muscle, reduced glucose uptake by adipose tissue, and reduced food absorption [6].

Sport now plays a huge role as a very powerful and constructive factor in education, solving economic and social problems, and building a healthy and strong generation. Although exercise and physical activity have many beneficial effects, if they do not conform to modern scientific principles, they not only do not benefit a person, they can even lead to a series of negative physiological consequences, in other words, negative adaptation. On the other hand, elite athletes in various disciplines, to win medals and positions, go through everything, even their health, and spend most of their time in intense training to have the best performance in competitions [7].

According to the above, it is necessary to determine the effect of aerobic exercise on lipid profile and blood sugar. The present study was conducted due to the simultaneous study of aerobic exercise on blood sugar and lipid profile. Due to the low cost of the procedures and the supplement used, it can be prescribed for most sections of the society if the result is positive.

Research Method

The present research method is semi-experimental. The research was conducted in the form of a pre-test-post-test design with three experimental groups and one control group. The statistical population consisted of all male employees of the General Department of Education of Qazvin city who had a body mass index between 25 and 30 and overweight. First, to prepare the samples, a call was made in the form of a written request (sample form) from the male colleagues of the General Department of Education of Qazvin city. After this call, out of 55 volunteers, 40 overweight men were selected by simple random sampling and randomly divided into 2 groups (control group and aerobic exercise group). The two groups performed aerobic exercise over eight weeks, 3 sessions per week, and 45 minutes each session with an intensity of 65%.

Measurement of blood sugar levels and blood lipid profiles was performed by blood sample analysis (laboratory) as a pre-test. The results of the analysis were recorded in special tables (pre-tests). Then, aerobic exercise was performed for 8 weeks and at the end of the course, blood samples were taken and analyzed once again, as in the previous method. The results were recorded in the relevant table as a posttest.

In this study, total cholesterol and blood sugar in the medical laboratory were measured by the enzymatic methods.

Performing intense aerobic exercises

One week after the Bruce Maximum Test, a relatively intense aerobic exercise program (running on a track) was performed for four weeks, five days a week, and one session each day. Running intensity was determined with 74 to 76% oxygen consumption and equal to 75 to 80% heart rate reserve.

The speed of each subject running at kilometers per hour was determined based on 75 to 80% of his maximum heart rate on the treadmill. Thus, subjects ran at a set speed and using pacemaker watches, which marked the heart rate range with an alarm for the subjects so that they would not go out of range. To be sure, colleagues controlled the subjects' running rate while running.

Table 1. The relationship between the maximum heart rate reserve and the maximum oxygen consumption.

Exercise	Condition	Equations	r^2	50% fcr	70% fcr	90% fcr
				Maximum oxygen consumption		

	Unstable	1.24%fcr-24	0.928	37.7	62.5	87.3
Treadmill	Stable	1.02%fcr-04	0.975	46.7	67.1	87.5
	Recycle	1.05%fcr-34	0.936	18.6	39.6	60.6

Based on the heart rate, the maximum intensity was controlled with a pacemaker watch.

Data collection method

Aerobic exercise was three sessions per week for eight weeks. The one-session program included 10 minutes of warm-up, 30 minutes of aerobic exercise, running and local exercises, and 5 minutes of cooling. These exercises started with an intensity of 65% of maximum heart rate and every two weeks, 5% was added to their heart rate until the last week reached 80% of maximum heart rate.

To evaluate biochemical variables, blood sampling was performed after 14-14 hours of fasting in two stages, before training and after eight weeks of training. In the first stage, to perform blood sampling, all subjects were asked not to do any strenuous physical activity for two days before the test. Subjects were then present in the laboratory. Blood samples were taken at 8-10 in the morning and 3 ml of blood was taken from the vein of the right hand of each subject while sitting and at rest. After this stage, the subjects were affected by the independent variable for eight weeks. After this period and 48 hours after the last training session, all subjects were invited to the laboratory again and blood samples were taken from them as in the first stage. HDL-C, LDL-C, and triglyceride were measured using a quantitative detection kit and photometric method.

Data analysis method

The "mean" and "standard deviation" indices were used to describe the statistical distribution of the various variables. All information on homoscedasticities and the variability test of variable distribution in groups were calculated using Levine and Kolmogorov-Smirnov tests, respectively. Comparison of variables in each group in pre-test and post-test was performed using the t-dependent statistical test and to compare the variables in pre-test and post-test between three groups, a covariance statistical test was used. Data analysis was performed using SPSS software and Excel program at a significant level of $P \leq 0.05$ for all statistical tests.

Results

Descriptive results

Tables 2 and 3 show descriptive statistics indicators (mean, standard deviation, variance, minimum, maximum, and sample size) for all variables tested in the aerobic control and exercise groups.

Table 2. Statistical descriptions for all variables of the aerobic exercise group

Statistical parameters Variables	Elongation		Obliquity		Variance	Total SD	Mean standard error	Mean
	Standard error	Amount	Standard error	Amount				
				Pre-test				
BMI	1.334	0.301	0.687	0.4101	26.233	1.635	1.635	30.32
Weight (kg)	1.334	1.450	0.687	0.7459	40.944	6.398	6.398	91.5
Height (cm)	1.334	4.325	0.687	-1.842	2.674	5.121	5.121	173.7
Blood glucose	1.334	0.327	0.687	0.278	107.344	10.36	3.27	93.30
triglyceride	1.334	0.154	0.687	-1.004	1906.489	43.66	13.80	136.60
Cholesterol	1.334	-1.609	0.687	-0.072	1491.122	38.61	12.21	166.70
LDL	1.334	0.908	0.687	-1.199	452.267	21.26	6.72	112.60
HDL	1.334	-1.007	0.687	-0.331	99.60	9.97	3.15	43.60
				Post-test				
Blood glucose	1.334	-0.029	0.687	-0.916	33.60	5.79	1.83	88.60
triglyceride	1.334	1.695	0.687	0.348	1192.50	34.53	10.92	107.50
Cholesterol	1.334	-1.997	0.687	-0.013	1290.22	35.91	11.35	147
LDL	1.334	2.666	0.687	-1.157	515.656	22.70	7.18	112.90
HDL	1.334	-1.503	0.687	-0.131	108.178	40.40	3.28	50.20

Table 3. Statistical descriptions for all variables of the control group.

Statistical parameters Variables	Elongation		Obliquity		Variance	Total SD	Mean standard error	Mean
	Standard error	Amount	Standard error	Amount				
				Pre-test				
BMI	1.334	-1.62	0.68	0.09	5.78	0.16	0.16	28.42
Weight (kg)	1.334	-1.17	0.68	-0.54	23.56	4.85	4.85	89.7
Height (cm)	1.334	-0.70	0.68	-0.44	1.35	2.40	2.40	177.3
Blood glucose	1.334	0.963	0.987	0.959	159.78	12.64	3.99	95.70
triglyceride	1.334	-1.598	0.687	0.226	6164.72	78.51	24.82	224.50
Cholesterol	1.334	-1.726	0.687	0.361	276.10	16.61	5.25	199.10

LDL	1.334	1.325	0.687	-1.155	553.76	23.52	7.44	107.70
HDL	1.334	-1.693	0.687	-0.357	12.82	3.58	1.13	30.90
Post-test								
Blood glucose	1.334	-1.699	0.687	-0.072	20.23	4.49	1.42	89.30
triglyceride	1.334	-1.490	0.687	0.256	5056.01	71.10	22.48	215.70
Cholesterol	1.334	-1.430	0.687	0.566	179.38	13.39	4.23	198.50
LDL	1.334	-1.180	0.687	-1.004	528.45	22.98	7.26	105.70
HDL	1.334	-1.615	0.687	-0.460	16.94	4.11	1.30	32

Kolmogorov-Smirnov test: Tables 4 and 5 show the results of the Kolmogorov-Smirnov test to check the naturalness of the data in control and aerobic groups. In the control group, the K-S test results show that at a significant level ($P > 0.05$) the data collected in the cholesterol variable were not normal in the pretest and the presumption that the data were normal in this variable was not observed. In the aerobic exercise group, the results of the K-S test showed that at a significant level ($P > 0.05$), the data collected in the triglyceride variable were not normal in the pretest and the presumption that the data were normal in this variable was not observed. However, in other variables, the presumption of data normality was observed.

Table 4. Kolmogorov-Smirnov test results to check the normality of aerobic exercise group variables

Statistical parameters / Variables	Kolmogorov-Smirnov Z	Sig
Pre-test		
Blood glucose	0.125	0.200
triglyceride	0.312	0.007
Cholesterol	0.182	0.200
LDL	0.218	0.194
HDL	0.170	0.200
Post-test		
Blood glucose	0.261	0.053
triglyceride	0.206	0.200
Cholesterol	0.198	0.200
LDL	0.261	0.053
HDL	0.137	0.200

Table 5. Kolmogorov-Smirnov test results to check the normality of control group variables

Statistical parameters / Variables	Kolmogorov-Smirnov Z	Sig
Pre-test		
Blood glucose	0.259	0.056
triglyceride	0.201	0.200
Cholesterol	0.285	0.021
LDL	0.199	0.200
HDL	0.221	0.181
Post-test		
Blood glucose	0.230	0.141
triglyceride	0.162	0.200
Cholesterol	0.203	0.200
LDL	0.190	0.200
HDL	0.242	0.099

Also, the results of the follow-up test on the blood glucose variable showed that there was no significant difference between the control group and the aerobic group. In the case of triglyceride, LDL, and HDL cholesterol, the results showed a significant difference between the control group and the aerobic exercise group ($P < 0.05$).

Inferential statistics

The covariance model has been used to statistically infer and generalize the data obtained from the analysis of the scores of the sample individuals to the research community.

In examining the relationship between eight weeks of aerobic exercise and blood triglyceride levels in overweight men, the results were shown in Table 6. In examining the difference between aerobic exercise pre-test and post-test aerobic exercise in the triglyceride variable, the significance level is greater than the error value of 05.0. Therefore, hypothesis zero is confirmed, which indicates that there is no significant difference between the pre-test and post-test scores in triglyceride levels. In other words, eight weeks of aerobic exercise has no significant effect on blood triglyceride levels in overweight men. Also, there is no significant difference between the control and post-test of aerobic exercise, since in the triglyceride variable the significance level is greater than the error value of 0.05.

$F(3,10)=0/875, P>0/05, \text{Partial } \eta 2=0/635$

$H0 = \bar{x}1 - \bar{x}2 - \bar{x}3 = 0$ $H1 = \bar{x}1 - \bar{x}2 - \bar{x}3 \neq 0$

Table 6. Summary of the covariance model of the effect of eight weeks of aerobic exercise on triglyceride levels (dependent variable: triglyceride post-test)

Sources	The third type of the sum of squares	Degrees of freedom	Average squares	Coefficient F	The significance level	Partial eta squared
Modified model	875.94	6	189.85	2.134	0.519	0.983
Isolated	11.89	1	9.78	0.786	0.965	0.865
Pre-test	19.32	1	18.86	0.968	0.875	0.635

control group	456.30	5	27.58	1.157	0.314	0.527
Error	18.98	3	899			
Total	85796	10				
Totally modified	486	9				

In relation to the effect of eight weeks of aerobic exercise on the blood glucose level of overweight men, the results of Table 7 were obtained. According to the results in examining the difference between aerobic exercise pre-test and post-test aerobic exercise in glucocorticoid variables, the significance level is smaller than the error value of 0.05. Therefore, the null hypothesis is rejected and the opposite hypothesis is confirmed, which indicates that there is a significant difference between pre-test and post-test scores in blood glucose levels. In other words, eight weeks of aerobic exercise has a significant effect on the blood glucose level of overweight men. Also, between the control group and the post-test of aerobic exercise in the blood glucose variable, the significance level is less than the error value of 0.05. Therefore, there is a significant difference between these two variables.

F(3,10)=7/524,P<0/05,Partial ŋ2=0/458

$H0 = \bar{X}1 - \bar{X}2 - \bar{X}3 = 0$ $H1 = \bar{X}1 - \bar{X}2 - \bar{X}3 \neq 0$

Table 7. Summary of the covariance model of the effect of eight weeks of aerobic exercise on blood glucose levels (dependent variable: blood glucose post-test)

Sources	The third type of the sum of squares	Degrees of freedom	Average squares	Coefficient F	The significance level	Partial eta squared
Modified model	736.32	6	136.96	23.057	0.008	0.896
Isolated	8.96	1	10.85	6.365	0.038	0.234
Pre-test	16.52	1	16.34	7.524	0.024	0.458
control group	328.10	5	25.68	4.398	0.041	0.685
Error	17.32	3	10.89			
Total	69853	10				
Totally modified	389	9				

The results of a study of the effect of eight weeks of aerobic exercise on HDL in the blood of overweight men are shown in Table 8. In examining the difference between aerobic exercise pre-test and aerobic exercise post-test in the HDL variable, the level of significance is less than the error value of 0.05. Therefore, the null hypothesis is rejected and the opposite hypothesis is confirmed, which indicates that there is a significant difference between the pre-test and post-test scores in HDL. In other words, 8 weeks of aerobic exercise has a significant effect on the blood HDL of overweight men. Also, because the significance level of the HDL variable is greater than the error value of 0.05 between the control and post-test groups of aerobic exercise, there is no significant difference between these two variables.

F(3,10)=6/364,P<0/05,Partial ŋ2=0/342

$H0 = \bar{X}1 - \bar{X}2 - \bar{X}3 = 0$ $H1 = \bar{X}1 - \bar{X}2 - \bar{X}3 \neq 0$

Table 8. Summary of the covariance model of the effect of eight weeks of aerobic exercise on HDL levels (dependent variable: HDL post-test)

Sources	The third type of the sum of squares	Degrees of freedom	Average squares	Coefficient F	The significance level	Partial eta squared
Modified model	897.36	6	167.25	24.13	0.009	0.979
Isolated	7.85	1	9.47	3.36	0.046	0.652
Pre-test	19.36	1	17.13	6.36	0.020	0.342
control group	278.36	5	21.28	1.007	0.536	0.752
Error	19.47	3	11.24			
Total	72365	10				
Totally modified	452	9				

The results of the eight-week aerobic exercise on LDL blood weight in overweight men are also presented in Table 9. According to these results, in examining the difference between aerobic exercise pre-test and aerobic exercise post-test in the LDL variable, the level of significance is greater than the error value of 0.05. Thus, the null hypothesis is confirmed, indicating that there is no significant difference between pre-test and post-test scores on LDL levels. In other words, eight weeks of aerobic exercise does not have a significant effect on blood LDL levels in overweight men. Also, because the significance level between the control group and the post-test of aerobic exercise in the LDL variable is greater than the error value of 0.05, there is no significant difference between these two variables.

$F(3,10)=0/345, P>0/05$, Partial $\eta 2=0/528$

$H0 = \bar{x}1 - \bar{x}2 - \bar{x}3 = 0$ $H1 = \bar{x}1 - \bar{x}2 - \bar{x}3 \neq 0$

Table 9. Summary of the covariance model of the effect of eight weeks of aerobic exercise on LDL levels (dependent variable: LDL post-test)

Sources	The third type of the sum of squares	Degrees of freedom	Average squares	Coefficient F	The significance level	Partial eta squared
Modified model	758.36	6	145.65	2.98	0.318	0.867
Isolated	9.34	1	8.47	1.86	0.213	0.364
Pre-test	20.36	1	16.34	0.345	0.879	0.528
control group	215.39	5	22.78	0.897	0.634	0.751
Error	17.96	3	10.34			
Total	63478	10				
Totally modified	524	9				

Examining whether eight weeks of aerobic exercise did not affect the blood cholesterol levels of overweight men, it was found that for a significant difference, the level of significance (critical value) should be less than 0.05. As shown in the table above, in examining the difference between the aerobic exercise pre-test and the post-test aerobic exercise in the cholesterol variable, the significance level is smaller than the error value of 0.05. Therefore, the null hypothesis is rejected and the hypothesis is confirmed to be inconsistent, indicating that there is a significant difference between pre-test and post-test scores on cholesterol levels. In other words, eight weeks of aerobic exercise has a significant effect on the blood cholesterol level of overweight men. Also, because the significance level between the control group and the aerobic exercise test in the cholesterol variable is greater than the error value of 0.05, there is no significant difference between these two variables.

$F(3,10)=8/230, P<0/05$, Partial $\eta 2=0/634$

$H0 = \bar{x}1 - \bar{x}2 - \bar{x}3 = 0$ $H1 = \bar{x}1 - \bar{x}2 - \bar{x}3 \neq 0$

Table 10. Summary of the covariance model of the effect of eight weeks of aerobic exercise on cholesterol levels (dependent variable: cholesterol post-test)

Sources	The third type of the sum of squares	Degrees of freedom	Average squares	Coefficient F	The significance level	Partial eta squared
Modified model	857.39	6	127.68	18.85	0.009	0.857
Isolated	10.58	1	9.52	4.63	0.033	0.938
Pre-test	21.24	1	12.24	8.23	0.015	0.634
control group	196.47	5	20.78	0.21	0.963	0.698
Error	16.27	3	11.36			
Total	75896	10				
Totally modified	652	9				

Discussion

Weight gain increases blood lipids including triglycerides, total cholesterol, HDL-LDL subcutaneous fats. This leads to an increase in a number of metabolic disorders, including decreased insulin sensitivity, hyperlipidemia, hypertension, increased risk of insulin resistance, type 2 diabetes, and cardiovascular disease. Exercise plays an important role in health, especially weight control. Exercise also plays an important role in reducing adipose tissue and lowering blood sugar. One of the most important benefits of exercise in this area is to increase energy consumption in active people. It has been reported that energy expenditure at rest and in normal states is lower than when people engage in aerobic exercise and use oxygen to start burning their stored fat. The aim of this study was to evaluate the effect of 8 weeks of aerobic exercise on triglyceride, cholesterol, HDL, LDL, and blood sugar indices in overweight men. For this purpose, 55 overweight male volunteers with a BMI above 25 were selected in the General Department of Education of Qazvin Province and were studied in the control group and aerobic exercise group.

Aerobic exercise was three sessions per week for eight weeks. The one-session program included 10 minutes of warm-up, 30 minutes of aerobic exercise, running and localized exercises, and 5 minutes of cooling, starting at 65% of maximum heart rate and every two weeks, their heart rate increased by 5% to reach 80% of their maximum heart rate in the last week.

After testing the research hypotheses by analysis of covariance, the following results were obtained:

1. 8 weeks of aerobic exercise has a significant effect on blood triglyceride levels in overweight men. In examining the difference between aerobic pre-test and post-test aerobic exercise in the triglyceride variable, the significance level is greater than the error value of 0.05, which indicates that there is a significant difference between the pre-test and post-test scores in the triglyceride level. In other words, 8 weeks of aerobic exercise does not have a significant effect on the blood triglyceride level of overweight men. Also, because the significance level between the control group and the aerobic exercise test in the triglyceride variable is greater than the error value of 0.05, there is no significant difference between these two variables.
2. 8 weeks of aerobic exercise has a significant effect on blood sugar levels in overweight men. In examining the difference between aerobic exercise pre-test and post-aerobic exercise test in the glucocorticoid variable, the significance level is smaller than the error value of 0.05. This indicates that there is a significant difference between pre-test and post-test scores on glucose levels. In other words, 8 weeks of aerobic exercise has a significant effect on the blood glucose level of overweight men. Also, because the level of significance between the control group and the aerobic exercise test in the blood glucose variable is smaller than the error value of 0.05, there is a significant difference between these two variables. Although this reduction was not significant, it may justify a slight reduction in glucose in the present study. Due to the slight decrease in these variables, perhaps if the duration of the training period or the number of repetitions of training on weekdays increases, the effect of aerobic training on this factor will be more pronounced. Also, in the present study, subjects had basal levels of normal glucose, and a significant change could likely depend on this factor. This result is consistent with the findings of Ross et al. (2000) who examined the effect of 3 to 4 months of aerobic exercise on fasting glucose levels in obese men and women with normal basal glucose levels [8]. Ross et al. showed that exercise has a small effect on fasting glucose levels in healthy and non-diabetic individuals. In the study of Choi et al. (2009), three months of combined activity (aerobic and strength) had no significant effect on insulin levels, glucose, and insulin resistance, which is consistent with the findings of the present study [9]. In a study by Wahhabi (2009), fasting glucose levels showed a significant change, which does not agree with the findings of the present study on glucose [10].
3. 8 weeks of aerobic exercise affects the blood HDL level of overweight men. Among the effective adaptations following aerobic activity is an increase in mitochondrial volume followed by the activity of lipolysis enzymes, which increase the ability of fat catabolism during exercise. Evidence suggests that catecholamines and growth hormone levels increase during physical activity, which increases the rate of lipolysis. Increased HDL may be due to increased activity of the enzyme lipoprotein lipase (LPL). The LPL enzyme is effective in converting VLDL to HDL, and with increasing activity, HDL-C levels increase. On the other hand, in addition to LDL, acetyltransferase (LACT) cholesterol converts cholesterol into HDL particles. Increasing this enzyme may be responsible for increasing HDL due to exercise. LACT is greatly increased in some sports. Other mechanisms may play a role, such as reducing insulin sensitivity, which causes changes in the levels of fats and lipoproteins in the blood [11].
4. 8 weeks of aerobic exercise affects the blood LDL levels of overweight men. Numerous studies have shown that aerobic exercise is associated with lower serum LDL-c levels. Aerobic exercise uses fat as the main source of energy compared to resistance training. Therefore, the reason for the decrease in LDL levels in endurance and combination groups can be due to the effect that such exercises have on the percentage of body fat due to the use of fat as a source of energy production. Sugiura et al. (2002) stated that exercise increases the activity of the enzyme lipoprotein lipase (LPL) and lecithin cholesterol acyltransferase (LCAT) [12]. These two enzymes decrease LDL triglycerides and cholesterol and increase HDL [12]. Wilund et al. (2009) stated that aerobic exercise can reduce LDL and thus prevent heart disease by increasing cholesterol absorption characteristics [13].
5. 8 weeks of aerobic exercise affects the blood cholesterol level of overweight men. In examining the difference between aerobic exercise pre-test and aerobic exercise post-test in the cholesterol variable, the level of significance is less than the error value of 0.05. This indicates that there is a significant difference between pre-test and post-test scores on cholesterol levels. In other words, 8 weeks of aerobic exercise has a significant effect on blood cholesterol levels in overweight men. Also, because the level of significance between the control group and the post-test of aerobic

exercise in the cholesterol variable is greater than the error value of 0.05, there is no significant difference between these two variables. This inconsistency may be related to the type of subjects, the duration of the exercise, or the time of sampling.

Research shows that lowering plasma cholesterol levels prevents the early onset of cardiovascular disease. Aerobic exercise can be one of the major causes of low blood cholesterol levels. Of course, thyroid and sex hormone levels can also be considered as factors affecting this variable [14].

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