

# The effect of 8 weeks aerobic training and consuming green tea on Lipid Profile and the blood sugar of overweight men

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## ABSTRACT

**Introduction and Purpose:** The present study aimed to investigate the effect of 8 weeks of aerobic training with consuming green tea on the lipid profile and blood sugar of overweight men. **Research Method:** 40 overweight men (with the average height of  $178 \pm 5.61$  cm, weight of  $99 \pm 8.03$  kg, BMI of  $30.79 \pm 2.91$  kg / m<sup>2</sup>) were selected from the Education General Office of Qazvin Province by simple random sampling method and randomly divided into four groups of ten control, consumption of green tea, aerobic exercise, and green tea consumption group with aerobic exercise individuals. Aerobic exercise was performed in three sessions per week, which was started from 65% to 85% in the last week and the consumption of green tea bags was in three servings per day, each serving included a two-gram pack of green tea in 200 ml of boiling water prescribed to the subjects of the respective groups during the eight-week experimental period of the study. To evaluate biochemical variables, bloodletting was performed after 14-12 hours of fasting in two stages, i.e., before training and after eight weeks of training as pre-test and post-test, respectively. **Findings:** After testing the research hypotheses by covariance analysis method, it can be said that eight weeks of aerobic training with green tea extract significantly reduced sugar levels ( $P = 0.024$ ), triglycerides (003).  $P = 0$ ), LDL ( $P = 0.039$ ) of blood and significantly increased HDL ( $P = 0.021$ ) of blood of the subjects. **Conclusion:** It can be argued that consuming the green tea supplementation along with aerobic training in overweight men reduces levels of sugar, triglycerides, and increases serum HDL.

**Keywords:** Aerobic Training, Blood Sugar, Green Tea, Lipid Profile, Overweight Men.

## Introduction

Obesity is one of the most common diseases in the world today. It is estimated that about 1.2 billion people worldwide are overweight <sup>[1]</sup>. Overweight (obesity) is associated with a variety of health-related risks, including cardiovascular disease, high blood pressure, and diabetes mellitus <sup>[2]</sup>. Adipose tissue plays an important role in creating insulin resistance or sensitivity. Therefore, finding therapeutic measures to reduce the secretion

or increase the sensitivity of leptin receptors can play an important role in the prevention and control of obesity. Consumption of antioxidants in nature is an example of these measures. Flavonoids are one of the most important groups of antioxidants. Green tea is an important source of flavonoids. Tea contains a group of flavonoid polyphenolic compounds called Catechins, and among the Catechins, epigallocatechin gallate (EGCG) is a powerful antioxidant in laboratory conditions and is the most common and plentiful polyphenol in green tea. The effects of tea, especially green tea, which most of its Catechin is EGCG, have been extensively studied in relation to the preventive effects of cancer and cardiovascular disease <sup>[3]</sup>. The results of epidemiological studies have suggested that long-term consumption of green tea is significantly associated with a reduced risk of cardiovascular disease <sup>[4]</sup>. Recently, however, there has been evidence that EGCG also plays a metabolic role and can be effective in reducing body fat <sup>[3]</sup>. Furthermore, EGCG

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can reduce food intake and decrease blood triglyceride, cholesterol and leptin levels, and stimulates energy metabolism and increase blood HDL levels [5]. Therefore, many studies have all shown that green tea can have positive effects on WHR (waist-hip ratio), subcutaneous fat, HDL, LDL, cholesterol, triglycerides, and blood sugar.

Studies have shown that green tea catechins by reducing LDL oxidation [6], inhibition of vascular smooth muscle cell proliferation [7], absorbing serum cholesterol, and reducing systolic and diastolic blood pressure [8] can lead to the overall elimination of risk factors for atherosclerosis and hypertension. Similarly, researchers in another study showed a significant decrease in fat percentage, body mass index, and an increase in cardio-respiratory capacity due to a combination of 10 weeks of green tea supplementation and moderate-intensity aerobic exercise in obese men [9]. These results suggest new perspectives on the effects of green tea on body weight and highlight its potential benefits in the prevention or treatment of obesity and metabolic syndrome and its associated mechanisms [10].

With regard to the fact that human studies have focused on the effect of combining aerobic exercise and green tea supplementation on substance metabolism [11], a decrease in lipid profile [12] and lipid oxidation [13], and existing research in terms of the type of supplement, its dosage, and the type and length of exercise programs vary, and the results are inconsistent, there is little research on the effect of a period of aerobic exercise with green tea supplementation on the amount of weight-related variables such as glucose, triglycerides, etc. in obese men. So this paper aimed to investigate this issue and answer the question that whether consuming green tea with aerobic exercise can help reduce harmful variables such as LDL, etc. and improve the health index in positive variables such as HDL in obese men or not.

## Research Method

The present research method is semi-experimental. The research was conducted in the form of a pretest-posttest design with three experimental groups and one control group. The statistical population included all male employees of the Education General Office of Qazvin Province, who have a body mass index between

25 and 30 and were overweight. Among the statistical population, 40 people were selected by simple random sampling and randomly divided into four groups.

In this study, total cholesterol and blood sugar in the medical laboratory were measured by the enzymatic method. First, in order to prepare the samples, a call was made in the form of a written request (sample form) from male colleagues of Qazvin Education General Office. After this call, out of 55 volunteers, 40 overweight men were selected by simple random sampling and randomly were divided into two groups (green tea consumption control group and aerobic exercise group). The training group and the training group + consumption of green tea (in the form of herbal tea) during eight weeks performed aerobic exercise and consumption of green tea, so that aerobic exercise was 3 sessions per week and each session was 45 minutes with an intensity of 65%.

At first, the 24-hour food questionnaire was filled out and the volunteers were asked to give 3 ml of blood samples before aerobic exercise and consumption of green tea, and samples were sent to the laboratory for analysis. Measurement of blood sugar levels and blood lipid profile through blood sample analysis (Laboratory) was performed as a pre-test. The results of the analysis were recorded in special tables (pre-test). Then, aerobic exercise and consumption of green tea were performed for 8 weeks. At the end of the course, blood samples were prepared and analyzed once again as before. The results were recorded in the relevant table as a post-test.

## Intense Aerobic Training

One week after the Bruce protocol, a relatively strenuous aerobic exercise program (running on a racetrack) was performed for four weeks, with five sessions per week and one session per day. Running intensity was determined by 74 to 76% oxygen consumption and was determined equal to 75 to 80% of the maximum heart-rate reserve (Table 3).

The running speed of each subject at kilometer per hour and based on 75 to 80% of his maximum heart rate in the treadmill was determined. Therefore, subjects ran at a set speed and using a heart rate monitor watch that marked the heart rate range with an alarm for the subjects so that they would not go out of range, and to reassure colleagues to control the subjects' heart rate while they were running.

**Table 1. The Relationship between Maximum Heart-Rate Reserve and Maximum Oxygen Consumption**

Exercise	Conditions	Equations	r <sup>2</sup>	Maximum oxygen consumption		
				50% fcr	70% fcr	90% fcr
Tape drive	Unstable	10.24%fcr <sup>a</sup> - 24 <sup>b</sup>	0.928	37.7	62.5	87.3
	Stable	10.02%fcr-04 <sup>a</sup>	0.975 <sup>a</sup>	46.7	67.1	87.5
	Resumption	10.5%fcr-34	0.936	18.6	39.6	60.6

According to the maximum heart rate, the intensity was controlled with a heart rate monitor watch.

## Dietary Assessment

To control and maintain the diet during the research protocol and eliminate the effect of nutrition, in one or more explanatory

sessions, how to note consume food and complete the food registration sheet by was taught by the nutritionist to the participants and they were asked to follow their natural diet during the period. Food evaluation was then performed through food registration sheets for 3 consecutive days before blood

sampling by the relevant expert to evaluate the difference between energy and the received micronutrients between groups. The information was then transferred to a computer and analyzed by FOOD WORK software, and the overall energy and composition of the three-day average micronutrients were calculated for the subjects.

### Data Collection Method

Aerobic exercise was three sessions per week for eight weeks. One session consisted of 10 minutes warm-up, 30 minutes aerobic exercise, running and local exercises, and 5 minutes of cooling down, which started at 65% of maximum heart rate and increased by 5% every two weeks. The green tea bag was consumed three times a day. Each meal consisted of one (two grams) green tea in 200 ml of boiling water, brewed without heat for 6-8 minutes. The total amount of green tea catechin in this study was between 340 mg-480mg/200 ml.

To evaluate biochemical variables, blood sampling (blood collection) was performed after 12-14 hours of fasting in two stages, before training and after eight weeks of training. In the first stage, for blood sampling, all subjects were asked not to do any strenuous physical activity for two days before the test. The subjects then came to the lab. 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, and after this period and 48 hours after the last

training session, all the subjects were invited to the laboratory again and, like the first stage, the blood samples were collected. HDL-C, LDL-C, and triglyceride were measured using a quantitative detection kit and photometric method.

### Data Analysis Method

Mean and standard deviation indicators have been used to describe the statistical distribution of different variables. All data of homogeneity of variance and testing normal distribution of variables in groups were calculated using Levin and Kolmogorov-Smirnov tests, respectively. Comparison of variables in each group in pretest and posttest was performed by the dependent t-test and to compare variables in pretest and posttest between the three groups, a covariance test was used. Data analysis was performed using SPSS software and Excel program at a significance level of  $P \leq 0.05$  for all statistical tests.

### Findings

Tables 2 and 3 show descriptive statistics indicators (mean, standard deviation, variance, minimum, maximum, and sample size) for all variables tested in the study for two groups. The normal limit of kurtosis and skewness is between 2 to -2 and if the amount of kurtosis and skewness is in this range, the studied variables are natural, and the default covariance analysis test is observed in this section.

**Table 2. Statistical Descriptions for all Variables of Aerobic Training Group + Green Tea Supplement**

Statistical parameters of the research variables	Kurtosis		Skewness		Variance	standard deviation of sum	Standard error of the mean	Mean
	Standard error	Amount	Standard error	Amount				
Pre-test								
BMI	1.334	-0.350	0.687	-0.071	31.566	2.913	2.913	30.791
Weight (kg)	1.334	0.113	0.687	-1.162	70.455	8.393	8.393	90.7
Height (cm)	1.334	1.013	0.687	-1.287	8.486	14.37	5.618	171.7
Blood glucose	1.334	4.649	0.687	7.047	706.667	14.37	4.54	98
Triglyceride	1.334	-0.327	0.687	0.881	23367.844	149.54	47.27	270.70
Cholesterol	1.334	-0.466	0.687	0.297	1177.789	34.31	10.85	198.70
LDL	1.334	0.860	0.687	0.572	1177.956	33.58	10.62	102.20
HDL	1.334	5.369	0.687	1.998	59.958	7.74	2.44	34.250
Post-test								
Blood glucose	1.334	0.311	0.687	1.055	91.778	9.58	3.07	86
Triglyceride	1.334	-1.380	0.687	0.357	9239.600	96.17	30.39	216.60
Cholesterol	1.334	0.915	0.687	-0.428	674.717	25.97	8.21	177.10
LDL	1.334	2.682	0.687	1.159	869.511	29.48	9.32	87.80
HDL	1.334	5.603	0.687	2.146	66.989	8.18	2.58	40.90

**Table 3. Statistical Descriptions for All Control Group Variables**

Statistical parameters of the research variables	Kurtosis		Skewness		Variance	standard deviation of sum	Standard error of the mean	Mean
	Standard error	Amount	Standard error	Amount				
Pre-test								
BMI	1.334	-1.62	0.68	0.09	5.78	1.16	1.16	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	28.51	24.87	224.50
Cholesterol	1.334	-1.776	0.687	0.366	276.10	16.61	5.25	199.10
LDL	1.334	1.325	0.687	-1.100	553.76	23.52	7.44	107.70
HDL	1.334	-1.693	0.687	-0.375	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

### The Results of Kolmogorov- Smirnov Test

In Tables 4 and 5, the Kolmogorov-Smirnov test is used to check the naturalness and normality of the data for both groups. In the control group, the results of the K-S test show that at a significant level ( $P > 0.05$ ), the data collected in the cholesterol variable in the pre-test were not normal and the data normality assumption in this variable was not observed. In Aerobic training + green tea supplement group, the results of K-S test show that at a significant level ( $P > 0.05$ ) the collected data in the variables of glucose and HDL in the pre-test and HDL in the post-test were not normal and the data normality assumption is not observed in these variables but in other variables, the assumption that the data is natural or normal has been observed.

**Table 4. The Results of Kolmogorov-Smirnov Test to Evaluate the Data Normality of Aerobic Training+ Green Tea Supplement Group Variables**

Statistical parameters of research variables	Kolmogorov-Smirnov Z	Sig
Pre-test		
Blood glucose	0.300	0.001
Triglyceride	0.216	0.200
Cholesterol	0.145	0.200
LDL	0.181	0.200
HDL	0.311	0.007
Post-test		
Blood glucose	0.258	0.057
Triglyceride	0.179	0.200
Cholesterol	0.197	0.200
LDL	0.257	0.060
HDL	0.299	0.017

**Table 5. The Results of the Kolmogorov-Smirnov Test to Evaluate the Data Normality of Control Group Variables**

Statistical parameters of research 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	0.060
HDL	0.242	0.099

In addition, the results of the post hoc test on blood glucose variables showed no significant difference between the control group and the aerobic group with green tea. For the variables of triglyceride, cholesterol, LDL, and HDL, the results showed a significant difference between the control group, the aerobic exercise group, and green tea supplement at the level of  $P < 0.05$ .

### Inferential Statistics

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

Examining the relationship between eight weeks of aerobic exercise and green tea extract consumption on men's blood sugar with overweight results is shown in Table 6. As it can be seen in examining the difference between aerobic exercise pre-test with green tea supplement and aerobic exercise post-test with the green tea supplement in the blood glucose variable, since the significance level is greater than the error value of 0.05, the null hypothesis is confirmed, which indicates that there is no significant difference between pre-test and post-test scores on blood glucose levels. In other words, eight weeks of aerobic training with consuming green tea extract does not have a significant effect on the blood sugar level of overweight men. Furthermore, since the significance level is greater than the error value of 0.05, there is no significant difference between these two variables of blood glucose in the control group and aerobic exercise post-test with green tea supplementation.

$$F_{(3,10)}=3/514, P>0/05, \text{ Partial } \eta^2=0/539$$

$$H_0 = \bar{x}_1 - \bar{x}_2 - \bar{x}_3 = 0 \quad H_1 = \bar{x}_1 - \bar{x}_2 - \bar{x}_3 \neq$$

**Table 6. Summary of Covariance Model Effect of Eight Weeks of Aerobic Exercise with Green Tea Extract on the Blood Glucose Dependent Variable: Blood Glucose Post-Test**

Resources	The third type of sum squares	Freedom degree	Mean square	F coefficient	Significance level	Partial eta square
Modified model	811.87	1	135.313	28.741	0.01	0.983
Separated	9.344	1	9.344	1.985	0.254	0.398
Pre-test	16.543	1	16.543	3.514	0.158	0.539
Control group	135.057	5	27.011	5.737	0.091	0.905
Error	14.124	3	4.708			
Sum	74786	10				
The total modified	826	9				

In relation to the effect of 8 weeks of aerobic exercise along with the consumption of green tea extract on the amount of triglycerides in the blood of overweight men, the results of Table 7 were obtained. According to the table, in examining the difference between aerobic exercise pre-test with green tea supplement and post-test aerobic exercise with green tea supplement in triglyceride variable, since the significance level is less than the error value of 0.05, the null hypothesis is rejected and the alternative hypothesis is confirmed, which indicates that there is a significant difference between pre-test and post-test scores in the amount of triglycerides. In other words, eight weeks of aerobic exercise with consuming green tea extract has a significant effect on blood triglyceride levels in overweight men. In addition, there is no significant difference between the control group and the post-test of aerobic exercise with the green tea supplement in the triglyceride variable because the significance level is greater than the error value of 0.05.

$$F(3,10)=8/712, P<0/05, \quad \text{Partial } \eta^2=0/642$$

$$H_0 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 = 0 \quad H_1 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 \neq 0$$

**Table 7. Summary of Covariance Model of the Effect of Eight Weeks of Aerobic Exercise with Consuming Green Tea Extract on the Amount of Triglyceride Dependent Variable: Triglyceride Post-test**

Resources	The third type of sum squares	Freedom degree	Mean square	F coefficient	Significance level	Partial eta square
Modified model	986.354	1	253.214	29.647	0.00	0.956
Separated	8.254	1	11.256	2.658	0.089	0.467
Pre-test	17.321	1	19.578	8.712	0.003	0.642
Control group	128.147	5	32.127	3.215	0.087	0.785
Error	15.124	3	7.214			
Sum	85479	10				
The total modified	841	9				

The results of the effect of eight weeks of aerobic exercise with green tea extract consumption on blood HDL of overweight men are given in Table 8. In examining the difference between pre-test aerobic exercise with green tea supplement and post-test aerobic exercise with green tea supplement in the variable HDL, since the significance level is lower than the error value of 0.05, the null hypothesis is rejected and the alternative hypothesis is confirmed, indicating that there is a significant difference between pre-test and post-test scores in HDL. In other words, eight weeks of aerobic exercise with consuming green tea extract has a significant effect on the level of HDL in the blood of overweight men. In addition, there is no significant difference between the control group and the post-test of aerobic exercise with green tea supplement in the HDL variable because the significance level is greater than the error value of 0.05.

$$F(3,10)=7/512, P<0/05, \text{Partial } \eta^2=0/718$$

$$H_0 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 = 0$$

$$H_1 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 \neq 0$$

**Table 8. Summary of Covariance Model of the Effect of Eight Weeks of Aerobic Exercise with Consuming Green Tea Extract on the HDL Dependent Variable: HDL Post-test**

Resources	The third type of sum squares	Freedom degree	Mean square	F coefficient	Significance level	Partial eta square
Modified model	697.07	6	153.01	27.98	0.001	0.913
Separated	7.89	1	10.21	1.78	0.654	0.553
Pre-test	16.87	1	16.84	7.51	0.021	0.718
Control group	132.25	5	27.21	1.69	0.136	0.697
Error	16.37	3	6.34			
Sum	86578	10				
The total modified	921	9				

The results of the study of the effect of eight weeks of aerobic exercise with consuming green tea extract on blood LDL levels of overweight men are presented in Table 9. As shown in the table, the difference between pre-test aerobic exercise with green tea supplement and the aerobic exercise test post-test with green tea supplement in the LDL variable has a significantly lower level than the error value of 0.05, so the null hypothesis is rejected and the alternative hypothesis is confirmed, which indicates that there is a significant difference between pre-test and post-test scores on LDL levels. In other words, eight weeks of aerobic exercise with consuming green tea extract has a significant effect on blood LDL levels in overweight men. In addition, between the control group and aerobic exercise post-test with green tea supplementation in the LDL variable, since the significance level is greater than the error value of 0.05, there is no significant difference between the two variables.

**Table 9. Summary of Covariance Model of the Effect of Eight Weeks of Aerobic Exercise with Green Tea Extract Consumption on LDL Rate Dependent Variable: LDL Posttest**

Resources	The third type of sum squares	Freedom degree	Mean square	F coefficient	Significance level	Partial eta square
Modified model	589.32	6	165.48	21.19	0.013	0.872
Separated	8.52	1	9.16	0.875	0.749	0.638
Pre-test	15.14	1	15.27	5.986	0.039	0.627
Control group	245.20	5	25.47	1.278	0.149	0.863
Error	15.89	3	7.36			
Sum	78963	10				
The total modified	834	9				

The results of eight weeks of aerobic exercise with consuming green tea extract on blood cholesterol in overweight men were

obtained from the results of the table. In examining the difference between pre-test of aerobic exercise with green tea supplement and post-test of aerobic exercise with green tea supplement in the cholesterol variable, the level of significance is greater than the error value of 0.05, so the null hypothesis is confirmed, indicating that between pretest and posttest scores, there are no significant differences in the cholesterol. In other words, eight weeks of aerobic exercise with green tea extract does not have a significant effect on blood cholesterol in overweight men. In addition, between the control group and post-test of aerobic exercise with green tea supplement in the cholesterol variable, since the level of significance is greater than the error value of 0.05, there is no significant difference between these two variables.

$$F(3,10)=0/869, P>0/05, \text{Partial } \eta^2=0/572$$

$$H_0 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 = 0 \quad H_1 = \bar{X}_1 - \bar{X}_2 - \bar{X}_3 \neq 0$$

**Table 10. Summary of Covariance Model of the Effect of Eight Weeks of Aerobic Exercise with Green Tea Extract Consumption on the Dependent Variable Cholesterol: Cholesterol Posttest**

Resources	The third type of sum squares	Freedom degree	Mean square	F coefficient	Significance level	Partial eta square
Modified model	623.25	6	156.48	3.021	0.214	0.879
Separated	9.45	1	8.52	0.986	0.658	0.512
Pre-test	16.23	1	16.13	0.869	0.589	0.572
Control group	345.36	5	24.14	1.785	0.217	0.456
Error	16.25	3	8.23			
Sum	65896	10				
The total modified	325	9				

## Discussion and Conclusion

Obesity or overweight is a major problem for men. A person will be overweight when he has a body mass index (BMI) above 24.9. Being overweight increases a number of metabolic disorders, including decreased sensitivity to environmental insulin, increased subcutaneous fat, impaired blood lipids, increased risk of insulin resistance, type 2 diabetes, and cardiovascular disease. Influential factors on the amount of weight gain are heredity, lifestyle, nutritional status, physical inactivity, and especially the body imbalance energy.

On the other hand, there are substances whose consumption accelerates the process of burning fat and also more sugar consumption in the cells. One of these substances that have been considered by the researchers is green tea. Green tea products reduce the accumulation of liver fat due to their high antioxidant properties and catechins such as epigallocatechin gallate, epicatechin gallate, and epicatechin and increase the consumption of sugar in the body's cells [14].

The overall purpose of this study was to investigate the effect of 8 weeks of aerobic exercise with green tea consumption on lipid profile and blood sugar of overweight men. For this purpose, 55

overweight men (BMI) above 25 of Education General Office of Qazvin Province who volunteered to participate in the study were selected and studied as two groups of control and green tea group with aerobic exercise. After testing the research hypotheses by covariance analysis, the following results were obtained:

1. 8 weeks of aerobic exercise with the consumption of green tea extract has a significant effect on blood sugar levels of overweight men.

In a study by Wu et al. (2004), mice fed a 12-week diet of green tea extract and fructose showed a significant reduction in insulin, glucose, and insulin resistance compared with their protein-only counterparts [15]. These changes were in line with the increase in glucose transporter protein and insulin-dependent receptors in fat cells.

2. A week of aerobic exercise with consuming green tea extract has a significant effect on blood triglyceride levels in overweight men.

Ichinose et al. (2011) investigated the effect of aerobic exercise and the consumption of green tea extract on fat metabolism during exercise in healthy male subjects [11]. Subjects practiced pedaling on a bicycle with an intensity of 60% and high oxygen consumption for 60 minutes 3 times a week for 10 weeks. During this period, the experimental group consumed 572.8 mg of catechin daily. The results showed that eating catechins with aerobic exercise reduces the respiratory exchange ratio and increases the use of fats during exercise.

Maki et al. (2009) showed in a study that a combination of 625 mg/d catechin and 39 mg/d caffeine combined with moderate-intensity exercise reduces abdominal fat, and this reduction is very important because increased abdominal fat is a risk factor for cardiovascular disease and is closely related to metabolic disorders, especially insulin resistance and high triglycerides [16]. The reason for the contradictions between the results of this study may be due to the subjects being tested because the physical metabolism activities of women are different from those of men. It is also possible that Hill et al. (2007) used only EGCG, while it is unclear whether EGCG is a unique mediator of metabolic properties or whether other green tea catechins may be more effective than EGCG. On the other hand, considering that EGCG forms about one-third of tea catechins, it may not have been enough to affect weight and body composition [3].

3. 8 weeks of aerobic exercise with consuming green tea extract has an effect on blood HDL levels of overweight men. The catechins in green tea increase fat oxidation, even at rest, and will be increased when it is combined with moderate physical activity. Catechin also causes long-term stimulation of the sympathetic nervous system by inhibiting the enzyme catechol-methyltransferase (the enzyme responsible for breaking down noradrenaline at the nerve synapse). Therefore, it increases energy consumption, and

3-Caffeine in green tea by reducing the activity of phosphodiesterase reduces the breakdown of adenylyl cyclase and on the other hand, increases the activity of sympathetic nerves.

4. 8 weeks of aerobic exercise with green tea extract has an effect on LDL levels in the blood of overweight men. In a study, Kazeminasab et al. (2015) reported that after eight weeks of aerobic exercise, LDL and TC levels decreased significantly and HDL-C increased<sup>[17]</sup>. One of the mechanisms of LDL reduction is due to catechins in green tea, which inhibits LDL oxidation by CuSO<sub>4</sub> and also inhibits cholesterol biosynthesis by inhibiting the enzyme. Another possible mechanism is the involvement of cholesterol micelles in the digestive system which, by forming insoluble cholesterol, causes the secretion of cholesterol through the feces and reduces the absorption of cholesterol. Decreased cholesterol uptake and decreased hepatic cholesterol concentration increase the expression and activity of LDL receptors. On the other hand, polyphenols in green tea by inhibiting LDL oxidation, increasing serum antioxidant activity, and HDL levels decrease atherosclerosis.
5. 8 weeks of aerobic exercise with the consumption of green tea extract has an effect on blood cholesterol in overweight men. Vasilescu et al. (2011) stated that 28 weeks of intermittent training significantly reduced LDL and TC levels and significantly increased HDL-C<sup>[18]</sup>. The probable cause of changes in total cholesterol and LDL in response to exercise is the type of physical activity, speed, and intensity of exercise. On the other hand, EGCG accounts for 15-20% of the weight of green tea and has hypocholesterolemic properties, and reduces intestinal absorption of cholesterol, which can be possible causes of the effect of green tea on lipids.

In this study, 30 overweight men were divided into three groups of ten individuals, including resistance training group and green tea supplement, resistance training group, and control group. The results showed that after eight weeks of training and supplementation, there was a significant reduction in cholesterol levels in the supplement and exercise groups, as well as a decrease in low-density lipoprotein and an increase in high-density lipoprotein in the exercise-supplement and exercise groups.

This study showed that aerobic exercise and its combination with green tea supplementation significantly reduced cholesterol, LDL, blood sugar, triglycerides, and increased HDL in obese people. Since medicinal herbs have fewer side effects than chemicals, it seems logical that after conducting the necessary and sufficient research in this field, green tea supplement and aerobic exercise should be used to improve the indicators of this study.

Due to the importance of research variables in people's health, this type of exercise is recommended as a preventive method. Similar studies to the present study should be performed on both

genders to determine sexual (gender) differences in response to exercise and green tea supplementation.

Increasing the amount of blood lipids (HDL-LDL cholesterol, triglycerides) affects the health and provides the basis for type 2 diabetes, high blood pressure, and cardiovascular disease. However, there are substances that people can use to prevent the process of accumulating subcutaneous fat, blood lipids, and high blood sugar by consuming them continuously. Today, green tea is one of the most popular ingredients in the field of slimming. Green tea products due to their high antioxidant properties and catechins such as epigallocatechin gallate, epigallocatechin, epicatechin gallate, and catechin reduce the accumulation of hepatic fat and increase the consumption of sugar in the body's cells<sup>[19]</sup>.

## References

1. Kelly T, Yang W, Chen C, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes.*; 2008; 32(9): 1431-7.
2. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obes Rev.* May; 5 Suppl, 2004; 1: 4-104.
3. Hill AM, Coates AM, Buckley JD, Ross R, Thielecke F, Howe PR. Can EGCG reduce abdominal fat in obese subjects? *J Am Coll Nutr.*; 2007; 26(4): 396S-402S.
4. Chacko SM, Thambi PT, Kuttan R, Nishigaki I. Beneficial effects of green tea: a literature review. *Chinese Medicine*, 2010; 5: 13.
5. Cabrera C, Artacho R, Giménez R. Beneficial effects of green tea—a review. *J Am Coll Nutr.*; 2006; 25(2): 79-99.
6. Clement Y. Can green tea do that? A literature review of the clinical evidence. *Prev Med.*; 2009; 49(2): 83-7.
7. Deka A, Vita JA. Tea and cardiovascular disease. *Pharmacol Res.*; 2011; 64(2): 136-45.
8. Sone T, Kuriyama S, Nakaya N, Hozawa A, Shimazu T, Nomura K, et al. Randomized controlled trial for an effect of catechin-enriched green tea consumption on adiponectin and cardiovascular disease risk factors. *Food Nutr Res.*; 2011; 55(1):8326.
9. Haghghi A, Ildarabadi A, Hamedineya MR. The Effect of Aerobic Training and Green Tea Supplement on Serum Leptin and Insulin Resistance in Overweight and Obese Men. *Sport Bioscience.*; 2013; 4(15): 23-43.
10. Rains TM, Agarwal S, Maki KC. Antiobesity effects of green tea catechins: a mechanistic review. *J Nutr Biochem.*; 2011; 22(1): 1-7.
11. Ichinose T, Nomura S, Someya Y, Akimoto S, Tachiyashiki K, Imaizumi K. Effect of endurance training supplemented with green tea extract on substrate metabolism during exercise in humans. *Medicine and science in sports*, 2011; 21 (4): 598-605.
12. Maffei M, Halaas J, Ravussin E, Pratley RE, Maki KC, Reeves MS, et al. Green tea catechin consumption enhances

- exercise – induced abdominal fat loss in overweight and obese adults. *Journal of Nutrition*, 2009; 139: 264-270.
13. Venables MC, Hulston CJ, Cox HR, Jeukendrup AE. Green tea extract ingestion, fat oxidation and glucose tolerance in healthy humans. *The American journal of clinical nutrition*, 2008; 87: 778-784.
  14. Nagao T, Komine Y, Soga S, Meguro S, Hase T, Tanaka Y, Tokimitsu I. Ingestion of a tea rich in catechins leads to a reduction in body fat and malondialdehyde – modified LDL in men. *American journal clinical nutrition*, 2005; 81:122-129.
  15. Wu LY, Juan CC, Ho LT, Hsu YP, Hwang LS. Effect of green tea supplementation on insulin sensitivity in Sprague-Dawley rats. *J Agric Food Chem.*; 2004; 52(3):643-8.
  16. Maki KC, Reeves MS, Farmer M, Yasunaga K, Matsuo N, Katsuragi Y, Komikado M, Tokimitsu I, Wilder D, Jones F, Blumberg JB. Green tea catechin consumption enhances exercise-induced abdominal fat loss in overweight and obese adults. *J Nutr.*; 2009; 139(2): 264-70.
  17. Kazeminasab F, Marandi S, Ghaedi K, Esfarjani F, Moshtaghian S. The effect of endurance training on lipid profile and expression level of Liver X Receptor  $\alpha$  Gene in Male Wistar Rats. *G3M.*; 2012; 10 (2): 21-29. [in Persian]
  18. Vasilescu M, Rusu L, Balseanu TA, Cosma G, Dragomir M. Effects of the Intermittent Exercise Programs on Lipid Profile and Anthropometric Characteristics at Obese Young Subjects. *WASET*; 2011; 952-955.
  19. Haghighi, A., Ildarabadi, A., Hamed Neya, M. R. 'The Effect of Aerobic Training and Green Tea Supplement on Serum Leptin and Insulin Resistance in Overweight and Obese Men', *Sport Biosciences*, 2013; 4(15), pp.23.