

## Effect of Aerobic Exercise with and without Green Coffee Supplementation on Serum Apolipoprotein B and Atherogenic Indices of Overweight Men

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### ABSTRACT

**Background and Objectives:** Coronary heart disease has a direct correlation with plasma levels of Apolipoprotein B (ApoB) and low-density lipoprotein (LDL) and an inverse relationship with high-density lipoprotein (HDL) level. This study aimed at comparing effect of eight weeks of aerobic training with and without green coffee supplementation on serum ApoB level and atherogenic indices of overweight men.

**Methods:** Thirty overweight men were randomly divided into two groups: training + green coffee supplementation (T+G; n=15) and training + placebo (T+P; n=15). Participants in both groups performed aerobic training, three sessions per week for eight weeks. Initial exercise intensity was set at 50% of maximum heart rate but gradually increased to 75% of maximum heart rate in the last two weeks. In a single-blind design, the subjects in the T+G group received a 400 mg capsule of green coffee bean extract one hour before each exercise session. The T+P group received placebo at the same time. Paired sample t-test and independent t-test were used to compare intra-group and inter-group variations, respectively. All statistical analyses were performed using SPSS (version 22) at significance level of 0.05.

**Results:** ApoB, LDL/HDL and total cholesterol/HDL decreased significantly in both groups. However, the changes were more notable in the T+G group compared to the T+P group.

**Conclusion:** The eight-week training program along with green coffee supplementation has positive effects on serum ApoB and atherogenic indices of overweight, inactive men. Therefore, it can be suggested as a non-pharmacological method of preventing cardiovascular disease.

**Keywords:** Aerobic exercise, green coffee, Overweight, Apolipoprotein b.

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## INTRODUCTION

Coronary artery disease (CAD) is a common obesity-associated cardiovascular disease (CVD) which has a direct correlation with high plasma level of low-density lipoprotein (VLDL and LDL) and decreased plasma level of high-density lipoprotein (HDL) (1). Physical activity is one of the factors that could alter lipid profile, especially HDL-cholesterol (HDL-C) and LDL (2). HDL-C plays an important role in prevention of CVD through reverse cholesterol transport (3), which involves removal and transporting excess cholesterol from peripheral tissues, including the wall of arteries and macrophages to the liver (4). Physical activity may reduce risk of mortality in obese individuals by reducing inflammation and coagulation factors. Aquatic exercise can reduce some CVD risk factors, such as apolipoprotein b (ApoB) to apolipoprotein a (ApoA) ratio (5). Aerobic training can help lower weight, body fat percentage (BFP) and body mass index (BMI) in overweight women. Moreover, it significantly improves the reverse cholesterol transfer by increasing ApoA1 and decreasing ApoB concentrations, thus reducing the risk of developing atherosclerosis. Kadoglou et al. (2010) showed that 12 months of exercise increases HDL and decreases ApoB-100 levels (6). ApoB is a key structural protein of VLDL and LDL and a predictor of CAD (7). It is essential for binding of LDL to its receptor and ultimately cholesterol absorption (8).

Green coffee extract contains high concentrations of chlorogenic acid that affects lipid and glucose metabolism (9). In addition to reducing intestinal absorption of fat and accumulation of visceral fat, the extract increases the metabolism of fat in the liver (10). Chlorogenic acid helps increase the activity of a liver enzyme called carnitine palmitoyl transferase (11). Caffeine present in the green beans blocks adenosine receptors, thus increasing the amount of selenium monosaccharide (12). The extract inhibits cyclic nucleotide phosphodiesterases that convert cAMP to AMP, thereby increasing cAMP levels which in turn increases the activity of hormone-sensitive lipase, thus resulting in lipolysis (13). According to Naderi et al. (2018), eight weeks of combined training and green coffee supplementation affects secretion of adipokines, reduces adenosine level and insulin resistance and

stimulates weight loss.

The present study aimed to determine effects of green coffee supplementation along with aerobic exercise on serum levels of ApoB and atherogenic indices of overweight men.

## MATERIALS AND METHODS

This was a quasi-experimental study with a pre- and post-test design. Study population included 30 healthy, inactive and overweight young men. Inclusion criteria consisted BMI of 25-30 Kg/m<sup>2</sup>, no history of diabetes or cardiovascular, liver, kidney and lung disease and inactivity (lack of regular exercise). Exclusion criteria included use of any supplement or weight loss medication over the past six months. After obtaining consent from the participants, the subjects were randomly and equally divided into two groups: aerobic exercise-green coffee supplementation and aerobic exercise-placebo (control group). Those who did not participate in more than three sessions and not follow the training and supplementation instructions were excluded from the study. The INBODY 170 body composition analyzer (South Korea) was used to measure weight. Height of each subject was measured using a digital height gauge (SKAA, Germany). Heart rate of the participants was monitored using a Polar F1TM heart rate monitor (Finland). The subjects were asked not to take any supplements or medication before start of the training protocol. A meeting was held in order to explain the general purpose of the study and details of training protocols. In a single-blind design, the subjects in the exercise + supplementation group received a 400 mg capsule of green coffee bean extract (Zist Takhmir Co., Iran) one hour before each exercise session. The control group received the same amount of placebo (14).

Exercise sessions were held three times a week and included 10 minutes of warming up (slow running and stretching), 30 minutes of aerobic exercise and 10 minutes of cool down (light stretching). In the first week, training intensity was set at 55% of maximum heart rate, but was gradually increased to 75% of maximum heart rate at the end of each week by adding two minutes to the training duration so that at the end of the week the main training session lasted 44 minutes. After 12 hours of overnight fasting, venous

blood samples (5 mL) were taken from each subject 48 hours before the first training session and 48 hours after the last training session.

The subjects were advised not to perform any physical activity for 36 hours prior to blood sampling.

Blood samples were collected in EDTA tubes and immediately centrifuged at 3000 rpm for 10 minutes. Apo B, LDL-C, HDL and total cholesterol (TC) were measured by enzymatic method using photometric reading and Pars Azmun kits (Iran) with a sensitivity of 1 mg/dl and a coefficient of variation of 1.5%.

The subjects were asked to maintain their dietary habits throughout the study. Data were analyzed using SPSS software (version 22). Mean and standard deviation (SD) were calculated after testing normality of data using

the Shapiro-Wilk test. The Levene's test was also used to ensure the homogeneity of variances. Paired sample t-test and independent t-test were used to compare intra-group and inter-group variations, respectively. All statistical analyses were performed at significance level of 0.05.

## RESULTS

According to the outcomes, weight, BMI and BFP values decreased significantly ( $p=0.001$ ). The Apo B and TC / HDL concentration decreased significantly in both groups ( $P = 0.001$ ), ( $P=0.005$ ) respectively. About the LDL / HDL ratio, we saw a significant difference between groups ( $p=0.029$ ). Lean body mass increased in both groups, however was not statistically significant.

Table 1- The characteristics of the participants

Groups	Age (years)	Height (Cm)
Training + Green coffee	25.2 $\pm$ 3.04	162 $\pm$ 2.058
Training + Placebo	26.2 $\pm$ 2.35	160 $\pm$ 1.063

Table 2- Comparison of pre- and post-test value of body composition variables between the groups

Variable	Group	Pre-test	Post-test	Variation			
				Intra-group		Inter-group	
				T	P	F	P
Weight (Kg)	Training + Green coffee	71.71 $\pm$ 6.05	69.29 $\pm$ 5.43	6.51	0.00	49.59	0.001
	Training + Placebo	66.49 $\pm$ 8.37	65.56 $\pm$ 8.11	3.047	0.014		
BMI (Kg/m <sup>2</sup> )	Training + Green coffee	28.62 $\pm$ 1.25	27.70 $\pm$ 0.01	7.172	0.00	23.75	0.001
	Training + Placebo	26.54 $\pm$ 1.71	25.98 $\pm$ 1.63	4.75	0.003		
Skeletal muscle mass (%)	Training + Green coffee	24.61 $\pm$ 3.49	25.35 $\pm$ 3.85	1.87	0.093	1.39	0.26
	Training + Placebo	23.50 $\pm$ 3.53	23.66 $\pm$ 3.64	1.38	0.2		
BFP (%)	Training + Green coffee	32.03 $\pm$ 4.87	27.96 $\pm$ 3.34	3.13	0.011	5.58	0.001
	Training + Placebo	25.50 $\pm$ 3.05	25 $\pm$ 3.01	2.522	0.032		

Table 3- Comparison of pre- and post-test value of Apo B, TC/HDL and LDL/HDL between the groups

Variable	Group	Pre-test	Post-test	Variation			
				Intra-group		Intra-group	
				T	P	F	P
ApoB (ml/dc)	Training + Green coffee	88.12 $\pm$ 2.66	72.23 $\pm$ 2.45	6.05	0.00		
	Training + Placebo	86 $\pm$ 2.25	183 $\pm$ 151	5.81	0.005	6.30	0.001
TC/HDL (ml/dc)	Training + Green coffee	4.59 $\pm$ 1.02	3.59 $\pm$ 1.12	5.08	0.000		
	Training + Placebo	4.37 $\pm$ 0.93	3.87 $\pm$ 1.06	2.48	0.03	3.98	0.005
LDL/HDL (mg/dc)	Training + Green coffee	2.65 $\pm$ 0.0654	1.92 $\pm$ 0.78	3.87	0.002		
	Training + Placebo	2.57 $\pm$ 0.93	2.26 $\pm$ 0.423	2.32	0.04	3.58	0.029

## DISCUSSION

The aim of this study was to investigate the effect of eight weeks of aerobic training with and without green coffee supplementation on serum level of ApoB and atherogenic indices of overweight, inactive men. In our study, although training alone significantly decreased ApoB, LDL/HDL and TC/HDL ratio, but this decrease became more profound in the training and supplementaion group. Pourvaghar et al. (2012) studied the effect of a single session of intensive aerobic exercise on ApoA, ApoB and some serum lipid parameters

of 26 participants. They observed a significant decrease in serum concentrations of LDL, ApoA and ApoB following high-intensity aerobic exercise(15). In study by Ketabi Poor et al. (2013) on effects of aquatic exercise on ApoA, ApoB and serum lipoproteins of obese and normal-weight menopausal women, the exercise training increased ApoA and decreased ApoB and ApoB/ApoA ratio. The study also reported a significant decrease in LDL levels following the water aerobic exercise (16). Banz et al. reported that

cholesterol, LDL and triglyceride levels decrease significantly following endurance and resistance training (17). Ghorbanian et al. studied the effect of eight weeks combined interval endurance training on a daily basis of four 24-minute days, concluded that the TC, TG, LDL / HDL, TC / HDL and BMI decreased significantly (18). A moderate-intensity exercise intervention significantly altered ApoA and ApoA/ApoB values, but did not affect ApoB (19). The difference between results of the mentioned study and our study could be due to the difference in characteristics of the subjects, weight, exercise intensity, age of participants and genetic factors. It has been shown that exercise along with diet restriction is the method of choice for treating obesity. Aerobic exercise can lower plasma concentrations of cholesterol, which prevents the early onset of CVD (20). According to Sugiura et al. (2002), exercise increases the activity of lipoprotein lipase (LPL) and lecithin cholesterol-acyltransferase (LCAT), which in turn lowers LDL, triglyceride and cholesterol levels (21). Limited number of studies has investigated the effect of green coffee supplementation on

serum levels of ApoB and atherogenic indices. It is suggested that constituents of green coffee including caffeine and theophylline can act as antagonists of A1 and A2 receptor adenosine receptors and compete to inhibit activity of adenosine in different tissues of the body (22). By blocking adenosine receptors, caffeine also increases the amount of cyclic adenosine monophosphate, reduces production of free radicals and stimulates production of prostaglandins and anti-inflammatory cytokines.

## CONCLUSION

The eight-week training program along with green coffee supplementation has positive effects on serum ApoB and atherogenic indices of overweight, inactive men. Therefore, it can be suggested as a non-pharmacological method of preventing CVDs.

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## CONFLICT OF INTEREST

There is no conflict of interest to declare.

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