ORIGINAL ARTICLE

The Effect of Combined Exercise Training Course with Curcumin Supplementation on Lipid Profiles of Inactive Middle-Aged Men

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Abstract

Objective: The purpose of this study was to investigate the effect of exercise training and curcumin supplementation combination on the lipid profile of inactive middle-aged men.

Materials and Methods: This is an experimental study. The studied population was middle-aged men who were categorized as inactive. The mean (± standard deviation) age of participants was 34/82 (±6.54). They were 60 volunteers who were assigned to four groups by simple randomization, including the training group (N = 15), the training-curcumin group (N = 15), the curcumin group (N = 15), and the control group (N = 15).Three training sessions were carried out weekly for eight consecutive weeks, including weight training and running on a treadmill with 65 percent of maximum oxygen consumption for the training group. The curcumin was administered as 80 mg gelatin capsule 5 days in a week for eight consecutive weeks. Twenty-four hours before the first session and 48 hours after the last session, blood samples were taken and transferred to the laboratory. The statistical analyses were done via SPSS Software (Version 22).

Results: There was a significant difference between the interactive effects of eight weeks of combined exercise training and supplementation of curcumin on triglyceride and plasma high density lipoprotein (HDL) (*P*-value: 0.008 and 0.002), but their effect on low density lipoprotein (LDL) and cholesterol was not significant (*P*-value: 0.06 and 0.42). Moreover, there was a significant difference between cholesterol, LDL, HDL and triglyceride in the pre-test and post-test.

Conclusion: Combined exercise trainings and curcumin extract can be used to improve the lipid profile of inactive middle aged people.

Keywords: Exercise Training, Curcumin, Lipoproteins

Introduction

The sedentary lifestyles and obesity are the risk factors of non-communicable diseases. The sedentary lifestyle is the most important risk factor of cardiovascular diseases, increased blood lipids, blood pressure and obesity. Lack of proper physical activity and inappropriate diet are top causes of obesity and cardiovascular diseases (1). In this regard, physical exercises can affect the quality of life and health. The combined

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exercise training is a combination of aerobic and strength training that increases muscle mass and simultaneously reduces fat (2). These exercises directly affect the lipoproteins (3). Obesity is one of the most common metabolic disorders. The pathological outcomes of obesity are cardiovascular diseases and metabolic syndrome. Metabolic syndrome is known with obesity, lipid disorders and their oxidation, increased blood glucose level, and inappropriate concentrations of high-density lipoprotein (HDL), and low-density lipoprotein (LDL) (4).

One of the most common lipid disorders in obese people is a high level of triglyceride (TG) and a reduced HDL-C level. High levels of HDL-C are one of the most potent inhibitors of cardiovascular diseases. HDL-C can protect LDL-C from oxidative damages and prevent producing the oxidized LDL-C (5).

A lipid profile consists of total cholesterol (Chol), TG, HDL, LDL, and v-LDL. The lipid profile, with the exception of LDL, has a direct and significant correlation with the body fat mass. This correlation is higher between the serum lipids and the body mass index with fat mass compared to the lean mass in the obese subjects (6).

Medicinal herbs are used as supplements along with various training methods for improving health (7).Curcumin is a yellow substance found in turmeric. In recent decades, beneficial reports have been published on the effects of curcumin, which curcumin is efficient and safe in the prevention and treatment of various diseases (8).

Curcumin (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione) is a yellow pigment which is the main active ingredient of the turmeric plant. It is considered as a high-consumed Indian spice (9). Curcumin is a potent antioxidant used in Indian and Chinese medicines as an anti-inflammatory agent used in the treatment of colic, toothache, chest pain, jaundice and anorexia (10).

The aerobic exercises contribute the higher fat metabolism, resulting in the use of more fat to supply energy. Past studied showed the endurance trainings increase HDL. Some studies showed that aerobic exercises have a greater impact on blood lipoproteins than strength trainings (11-13). The aim of this study was to investigate the synergistic effects of combined exercise training and consuming curcumin supplements on lipid profiles of inactive middle-aged men.

Materials and Methods

The research was a quasi-experimental study and the pre-test, post-test design was used. The statistical population of study was inactive middle-aged men between 30 to 40 years old in Yazd province. The state of inactivity was determined by the standard of physical activity questionnaire and participants who did not do regular physical activity during the past three years. Among those who were referred to a personal gym in Yazd, 60 eligible individuals were selected and participated in the study. Participants were randomly divided into four groups: the control (C), the training (T), the curcumin (CU) and the training with curcumin (TC). The participants with past history of cardiovascular, renal disease, hepatic disease, surgical procedure and smoking were excluded. The included participants were the middle-aged men who did not do regular physical activity in the last three years. A written consent was obtained from the subjects. The blood samples were taken from all groups 24 hours before the start of the training program. They were then transferred to the laboratory for measuring the TG, total Chol, LDL, and HDL.

The participants in the T and TC groups were trained according to the principles of exercise training. The training program was in three sessions per week in a total time of eight weeks and each session lasted for 70 minutes. The training included 10 minutes of warm up, 30 minutes of weight training which consisted of chest presses, underhand cable pulldowns, military presses, leg presses, deadlifts

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involving the upper and lower muscles in 3 sets with 70 percent of one repetition maximum and 25 to 35 minutes of endurance training including continuous running with intensity of 65 percent of maximum heart rate and five minutes of cooling down (table 1). The weight training was performed before the endurance training. The C group did not have any training or regular physical activity. The maximum strength was calculated using the following formula:

One repetition maximum= weight lifted (kg) ÷ [1.0278 - (.0278 × number of repetitions completed)]

Blood sampling was carried out 24 hours after the last training session in a 12-hour fasting state at the laboratory. To simulate the sampling time to control the circadian rhythm, sampling was carried out at the beginning and end of the study at 8 o'clock in the mornings. Serum concentration of LDL, HDL, total Chol, and TG were measured by enzymatic method (using Pars Azmoon Co. kits, Tehran, Iran) and a biochemical autoanalyzer (Electra model).

This research is based on a master's thesis on physical fitness in Islamic Azad University of Yazd with the code of 1395/106 .This research was accepted in Islamic Azad University, Yazd Branch and the ethics code was IR.IAU.B. 1397,28-14-5/1129 in.

Statistical Analyses

Descriptive statistical methods including central tendency and dispersion indices were used to analyze the data. Shapiro-Wilk test was used to test the normal distribution of samples. In order to investigate the interactive effect of the variables, a two-way analysis of variance (ANOVA) with repeated measures and paired T-test were used. *P*-value less than 0.05 were considered as significant. All statistical analyses were conducted using SPSS Software (Version 22).

Results

The mean age, height, weight, Chol, TG, HDL and LDL of the four groups were presented in Table 2. The findings showed that all subjects in all four groups before the intervention stage were not significantly different in all variables (Table 2). One-way ANOVA was used to determine the effectiveness of intervention in each group. The results showed that the mean of total plasma Chol, TG and LDL in CU, T, and TC were significantly decreased. Also, the mean of HDL was significantly increased in CU, T, and TC (Table 3).

Discussion

The purpose of the present study was to investigate the effect of a combined exercise training course with curcumin supplementation on Lipoproteins. The results of the study showed that the interactive effect of combined exercise training course along with curcumin supplementation on the concentration of TG and HDL is significant. Moreover, the results showed that all three methods of combined exercise training, curcumin supplementation, and synergistic use of supplementation and training lead to an increase in plasma HDL and a decrease in serum LDL, TG and Chol levels from pre-test to post-test.

Regarding the effect of curcumin supplementation on Lipoproteins, the study by Jang and colleagues showed that curcumin supplementation in mice caused a significant reduction in TG and HDL but no change in LDL level (14). Furthermore, the results of the study by Zahid showed a decrease in LDL level in the turmeric supplementation consumer group. HDL to LDL ratio had a significant increase as well (15). In a study by

Table 1. Combined Exercise Training Program

Training Repetition	First Week		Second Week		Third Week		Forth Week		Fifth Week		Sixth Week		Seventh Week		Eighth Week	
	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps	Intensity Percentage	Reps
Endurance	65	25	65	25	65	30	65	30	65	35	65	35	65	40	65	40
Strength	60	3*8	60	3*8	60	3*10	60	3*10	60	3*12	60	3*12	60	3*14	60	3*14

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Table 2. Age, Height, Weight, Body Mass Index, TG, Chol, LDL and HDL in studied sample

Variable	Curcumin	Training	Curcumin-training	Control	*P*-value*
	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)
Age	34.79±6.62	33.20±4.35	36.45±3.51	34.85±3.54	0.401
Length	175.30±7.54	173.13±7.24	176.2±3.26	174.12±4.09	0.655
Weight	85.25±9.32	84.19±6.41	88.57±10.27	85.50±8.60	0.667
BMI(kg/m^2)	27.81±2.19	28.09±2.35	28.60±4.09	28.14±2.20	0.158
TG	227.90±86.21	231.60±64.10	235.00±76/23	232.20±48.95	0.668
Chol	200.20±18.06	197.40±16.71	206.90±32.86	200.50±34.17	0.528
HDL	29.20±4.82	29.70±4.98	30.80±5.82	28.20±5.26	0.801
LDL	131.00±23.90	131.7±26.79	126.00±37.92	133.70±18.14	0.721

*paired T-test, ** 2 way ANOVA

Table 3. Comparison of Lipid Profile Indices in Pre-test and Post-test

Variable	Groups	Pre-test(Mean ± SD)	Post-test(Mean ± SD)	*P*-value*	*P*-value**
TG	Curcumin-training	235±76.23	164.10±46.88	0.005	0.008
	Training	231.60±64.10	169.50±66.43	0.01	
	Curcumin	227.90±86.21	185.40±28.63	0.01	
	Control	232.20±48.95	231.80±76.84	0.09	
Chol	Curcumin-training	206.90±32.86	152.90±28.24	0.001	0.06
	Training	197.40±16.71	176.50±28.98	0.04	
	Curcumin	200.20±18.06	166.90±23.43	0.01	
	Control	200.50±34.17	202.30±38.38	0.86	
HDL	Curcumin-training	30.80±5.82	40.50±3.89	0.003	0.001
	Training	29.70±4.98	34.20±7.50	0.04	
	Curcumin	29.20±4.82	36.90±6.06	0.02	
	Control	28.20±5.26	28.50±4.97	0.74	
LDL	Curcumin-training	126±37.92	122.70±12.02	0.003	0.42
	Training	131.7±26.79	96.26±12.28	0.06	
	Curcumin	131±23.90	112.30±11.33	0.08	
	Control	133.70±18.14	131.40±5.68	0.49	

*paired T-test, ** 2 way ANOVA

Baum and colleagues the consumption of 1 and 4 grams of curcumin per day for six months, revealed no significant change in the blood lipid profiles which can be attributed to the small and healthy samples (16).

Various studies showed that natural antioxidants reduce the risk of chronic illnesses by preventing the oxidative stress (16). Considering the antioxidant properties of curcumin, the mechanism of the antioxidant compounds in reducing the lipids and lipoproteins, diabetic rats' lipid profiles improvement by inhibiting biosynthesis of Chol, increasing the conversion of Chol to bile acids, and increasing lipoprotein lipase activity, the concentration of Chol, which is a component of the lipoproteins, is reduced followed by the reduction in lipoprotein synthesis. Moreover, with the activation of lipoprotein lipase, the decomposition of lipoproteins increases and their concentration decreases (17).

Some of the previous studies revealed a positive effect on the lipid profiles (18-20); whereas, some did not indicate a significant effect on the lipid profiles (21-23). Considering the previous research, discrepancy of the results can be attributed to the nutritional status, physical fitness, initial values of lipid profiles, and type, amount, and intensity of the exercise.

Katzmarzyk and colleagues by investigating obesity, physical fitness and prediction of cardiovascular risk factors found that body fat percentage, body mass index, and waist-hip ratio were significantly correlated with all risk factors for cardiovascular diseases (24). Similar results were obtained in a similar study by Cole and colleagues (25). This connection may be due to physiological reasons that the body uses fatty acids as a fuel during exercise, or it can be related to changes in various hormones such as the growth hormone, epinephrine, norepinephrine, and decreased insulin concentration during the exercise

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(24,25). Based on the results of this study, it can be said that body fat percentage, body mass index, and waist-hip ratio have a direct correlation with blood lipids and it seems that they are reliable indicators for the diagnosis of blood lipids. Therefore, increasing these indexes can increase the risk of cardiovascular diseases.

The increase in fatty acids followed by metabolism and muscle energy production seems to reduce the adipose tissue TG and subsequently leads to weight loss. TG is a type of fat or lipid found in the blood, and our body converts excess calories into TG for the proper use. These fats are stored in fat cells and circulate in the blood when they are needed to provide the energy for the muscles to work. Increases in TG level can be due to obesity and sedentary lifestyles, and lowering the TG level can be achieved by exercising (26).

Based on studies, it seems that the main mechanism for improving lipid profiles after strength-endurance trainings is to increase the activity of lipoprotein lipase (LPL) enzyme in mobilizing fatty tissues to convert them to free fatty acids for energy production, as well as the reduction in hepatic TG synthase enzymes. In the present study, because of the increased physical activity in the exercise training group and the tendency of the body to use fatty acids as substrates for energy production, there is a possibility of increased lipoprotein lipase enzyme activity. The result is an increase in Chol uptake which is followed by a reduction in TG and Chol.

Conclusions

The results of the present study showed that the use of combined exercise training and curcumin supplementation are effective for the improvement of all lipid profile indices in inactive men. Concurrent use of combined exercise training and curcumin supplementation had a synergistic effect on HDL and TG. Therefore, it indicated that the combination of exercise and supplements could have more beneficial effects. Based on the results, it is suggested that the combined exercise training and curcumin supplementation be used to improve the lipid profiles of inactive men.

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