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The Effect of Combined Exercise with Coffee Consumption on Fasting Blood Sugar Levels and Abdominal Obesity in Overweight Middle-aged Prediabetic Men

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Abstract

Pre-diabetes is defined as an increase in blood glucose levels above normal, but not to the extent that it is considered diabetes. One way to control the progression of diabetes is to eat a healthy diet and exercise. Accordingly, the aim of this study was to investigate the effect of combined exercise and coffee consumption on fasting blood sugar and middle-aged pre diabetic men. In this study, 44 overweight middle-aged men with (body mass index of 28.3 ± 2.8 kg / m2) were purposefully selected and randomly divided into four groups of 11: Exercise Combination, coffee consumption, combined exercise + coffee consumption and control group were divided. Pre-test and post-test groups including weight, body mass index, percentage of fasting fat and blood glucose were measured 24 hours before and after the project. The training groups then performed the training protocol for 8 weeks, three sessions per minute and 90 minutes each session. The coffee and exercise + coffee group consumed 10 grams of coffee every other day. Data were analyzed using covariance test and significance level of 0.05. The results showed a significant decrease in body mass index, fat percentage and serum concentration of fasting blood glucose in the exercise groups compared to the control group (P> 5%). This study showed that combined exercise with coffee can be effective in controlling fasting blood sugar and abdominal obesity.

Keywords: *Combined Exercises; Coffee; Fasting Blood Glucose; Prediabetes; Overweight*

Introduction

Pre-diabetes is an increase in blood glucose levels above normal, and a person is on the verge of developing diabetes, but not enough to be considered a diabetic. Pre diabetes usually has no specific symptoms until advanced stages and can quickly turn into type 2 diabetes if left untreated. Diabetes is a common metabolic disorder that causes high blood sugar and impaired metabolism of carbohydrates, fats and proteins (1).

Diabetes is one of the most costly endocrine diseases in the world and has grown several hundredfold over the past three decades. Statistics show that two people get diabetes every 10 seconds and one person dies every 8 seconds due to diabetes. About 50% of people with diabetes worldwide are unaware of their disease (2). Studies in Iran show that diabetes and pre diabetes are spreading rapidly. According to non-communicable disease management statistics, 11% of the population over the age of 25 have diabetes, this statistic is 12.8% in Tehran (3).

Abdominal obesity is defined by a certain quorum defined for the circumference of the abdomen. According to studies conducted in 2009 for the population of Iran, 95 cm waist size for men and women is known as the border of abdominal obesity (4). Obesity and abdominal obesity is a multifactorial disease that is affected by genes, environment and the interaction of the two (5) It is more dangerous than fat accumulation in other parts of the body and can lead to premature death by increasing cardiovascular disease, diabetes, fatty liver and respiratory diseases (6). Abdominal obesity is known to be the most important risk factor for type 2 diabetes. The more fat there is in the tissues, the more insulin resistant the cells become (7). The results of Rahmanian and Shojaei (2018) study showed that high body mass index, LDL and blood pressure are the causes of diabetes and pre-diabetes (3)

Salem et al. (2015), in their research reported that central obesity increases the risk of diabetes (8). Derakhshan et al. (2011) also showed that abdominal obesity has the slightest association with metabolic syndrome and should be controlled in diabetic patients (9). Lifestyle modifications including physical activity, proper diet and weight loss are ways to control the progression of diabetes (10). Studies have shown that regular exercise reduces the risk of cardiovascular factors and metabolic syndromes such as diabetes and insulin resistance (11). Frequent muscle contractions during exercise facilitate the entry of sugar into muscle cells in the absence of insulin and thus its consumption. In addition, exercise increases levels (glucose-carrying protein 4) and decreases insulin resistance (12).
The American Diabetes Association recommends that diabetic and pre-diabetic patients should engage in moderate-intensity resistance training and aerobic exercise five days a week (13). The results of the study of mental and clear vision (1399), showed that combined resistance aerobic exercise significantly improves abdominal obesity (14).

Studies have shown that coffee helps the body metabolize sugar, and people who drank an average cup of coffee every day for a month had more insulin in their blood (15). Dutch researchers have found that caffeine in coffee affects insulin function and reduces the risk of type 2 diabetes in adults. The polyphenols in coffee contain the mineral magnesium, and magnesium intake is associated with a reduction in type 2 diabetes (16). Considering the beneficial effects of exercise and coffee in weight prevention and control and pre diabetes, the present study aimed to investigate the effect of 8 weeks of combined exercise with coffee consumption on fasting blood glucose and abdominal obesity in middle-aged men with pre diabetes and Overweight was done.

Methodology

The method of the present study was quasi-experimental with pretest-posttest design and control group. The statistical population of the study consisted of all middle-aged men with a body mass index of 28.3 ±3.2, overweight and pre diabetic in Isfahan Iran. A total of 44 men were selected based on FELIS formula and randomly divided into four groups (combined training (11 people), combined training + coffee consumption (11 people), coffee consumption (11 people)) and control group (11 people). Cardiovascular disease, lack of physical disability to exercise, having a body mass index greater than 25, high fasting blood sugar and also having a medical certificate that exercise was considered unimpeded were considered.

The indicators of abdominal obesity in this study were the waist to pelvis ratio and waist size. Measurement of height (cm) and weight (kg) with a standard scale equipped, body mass index (kg / m^2), waist circumference (WC) using a flexible tape measure, pelvic circumference were measured by measuring the largest diameter in the hip area transversely without skin compression, and the waist-to-pelvic ratio (WHR) was measured by dividing the waist circumference by the pelvis.

All anthropometric measurements were performed by a trained person with three repetitions and then their mean was calculated. Blood samples were taken to determine blood sugar levels after 12 hours of fasting, and under the same conditions for all subjects. The experimental groups then performed the combined exercise activity protocol for 8 weeks, three sessions per week and each session for 60 to 70 minutes. A modified Bruce test was used to estimate the maximum volume of oxygen consumption.

The training protocol was designed according to the physical condition and age of the subjects and based on the principle of overload, with six types of training programs, with various movements in 6 tables, and each program had 3 training sections and by warming up for 10 to 15 The minute began, then the main part of the exercise, including movements (balance, speed, coordination, strength, aerobic endurance and flexibility) with an intensity of 60 to 70% of the maximum heart rate. At the end of each session, the cooling operation was performed by performing stretching movements and light exercise for 10 minutes.

Coffee consumption for the coffee consumption group and the combined exercise + coffee group was one day in the middle of one cup (180 cc) of Indonesian Robusta coffee, of cherry and Java type, and the medium roast of softness was 0.5. The amount of coffee consumed per serving was two servings, and the weight of each serving was 4 to 5 grams. Each serving was 8 to 10 grams per cup (serving) of 180 cc, and the amount of caffeine in the sample per serving was between 215 and 235 mg per serving of 180 cc.

In addition to descriptive statistics, analysis of covariance was used to analyze the data. Before using analysis of covariance, the assumptions of normality of data distribution and homogeneity of variance of variables were examined by Shapiro-Wilk Test and Levin Test. The results showed that the research variables have a natural distribution, and the same assumption of variance has been observed. All statistical operations were performed with SPSS 23 software at the significant level ($P < 0.05$).

Results

Table 1 shows the demographic characteristics including age, height, weight, and body mass index by groups. Table 2 shows the mean and standard deviation of pre-test and post-test related to research variables in the four groups studied. According to the results, the mean of fasting blood sugar, waist circumference and waist-to-pelvic ratio decreased in the post-test. But it has not changed in the control group.

Table 1 Demographic characteristics of four research group

Variable	Combined Exercise and coffee group	Combined Exercise group	Coffee group	Control group
	M±SD	M±SD	M±SD	M±SD
Height (cm)	1/0±752/53	1/0±69/71	1/0±71/82	1/0±71/32
Weight (kg)	99/21±98/23	88/16±95/61	87/7±30/04	91/7±17/57
Age (year)	42/9±31/31	41/6±63/97	38/13±63/90	44/7±90/43
BMI (kg/m^2)	32/6±45/05	31/5±17/51	30/2±05/98	30/2±92/37

Table 2 Mean and standard deviation of pre-test and post-test of research variable

Variables	Groups	n	Pre test M±SD	Post test M±SD
Waist- to- pelvis ratio WHR (cm)	Combined Exercise group	11	% 99 ± % 6	% 99 ± % 8
	Coffee group	11	% 99 ± % 5	% 99 ± % 6
	Combined Exercise and coffee group	11	% 99 ± % 5	% 98 ± % 5
	Control group	11	% 99 ± % 5	% 98 ± % 6
Fasting blood sugar FBS (mg/dl)	Combined Exercise group	11	103/ 45 ± 10/16	97/63 ± 14 /33
	Coffee group	11	101/81 ± 21/42	93/36 ±8/92
	Combined Exercise and coffee group	11	119/ 18 ±56/59	95/ 9 ± 11/17
	Control group	11	110/ 2±47/57	111/72 ± 26/38
Waist Circumference WC (cm)	Combined Exercise group	11	102/6 ± 11/8	96/36 ± 11/18
	Coffee group	11	101/5 ± 4/65	98/7 ± 6/96
	Combined Exercise and coffee group	11	109 ± 12/49	96 ± 11/58
	Control group	11	105 ± 7/33	105/ ± 8/5

Table 3 Results of ANCOVA analysis Effect of group membership on FBS, WHR, WC

Variables		Sum of Square	df	Mean of Square	F	P	Effect Size	Statistical power
Fasting blood sugar FBS (mg/dl)	group	1210/658	3	403/553	2/339	0/049	0/152	0/544
	Error	6729/627	39	172/555	-	-	-	-
Waist- to- Pelvis Ratio WHR (cm)	group	0/001	3	0/000056	1/042	0/988	0/004	0/057
	Error	0/047	35	0/001	-	-	-	-
Waist Circumference WC (cm)	group	71/449	3	23/816	1/356	0/272	0/104	0/329
	Error	614/625	35	17/561	-	-	-	-
	Error	14/392	35	0/411	-	-	-	-

Table 4 The results of Post Hoc Tests LSD for compare groups

Variables	Group (1)	Group (1)	Mean Deference	Standard. Error	P
Fasting blood sugar FBS (mg/dl)	Combined Exercise group	Coffee group	-3/157	6/101	0/608
		Combined Exercise and coffee group	-0/272	5/840	0/963
		Control group	-14/838	5/919	*0/017
	Control group	Combined Exercise and coffee group	2/885	5/842	0/624
		Control group	-11/680	5/723	*0/049
	Combined Exercise and coffee group	Control group	-14/566	5/517	*0/012
Waist- to-Pelvis Ratio WHR (cm)	Combined Exercise group	Coffee group	2/099	2/305	0/368
		Combined Exercise and coffee group	3/818	2/520	0/138
		Control group	-12/644	2/408	**0/001
	Control group	Combined Exercise and coffee group	1/718	2/581	0/510
		Control group	-14/743	2/400	**0/001
	Combined Exercise and coffee group	Control group	-16/462	2/448	**0/001
Waist Circumference WC (cm)	Combined Exercise group	Coffee group	-0/553	1/746	0/753
		Combined Exercise and coffee group	-1/603	1/909	0/406
		Control group	-3/767	1/823	*0/046
	Control group	Combined Exercise and coffee group	-1/050	1/955	0/594
		Control group	-3/214	1/818	0/085
	Combined Exercise and coffee group	Control group	-2/164	1/854	0/251

Table 3 shows the results of the post-test covariance test after removing the pre-test effect. As can be seen, the effect of intervention in reducing fasting blood sugar in experimental groups in the post-test stage is significant (F = 2.332) (P = 0.49). This means that eight weeks of combined training with coffee consumption reduced fasting blood sugar (P <0.05).

Also, post-test results of waist size variables (F = 1.356, P = 0.272) and waist to pelvic ratio (F = 1.042, P = 0.988) in experimental groups compared to the group Control decreased (P = 0.001). The results of LSD post hoc test showed that in the variables of abdominal obesity, the rate of decrease in the combined exercise group was more than other groups and in the variable of fasting blood sugar, the rate of decrease in the combined exercise group with coffee consumption was higher than other groups. (Table 4).

Discussion

The aim of this study was to investigate the effect of combined exercise and coffee consumption on fasting blood sugar levels in middle-aged men with pre diabetes and overweight. Findings showed that there was a significant difference between fasting blood sugar levels in the experimental groups compared to the control group and the mean fasting blood sugar of the experimental groups decreased in the post-test. This result is consistent with some studies. For example, the results of Qalavand et al (2015), showed that aerobic and resistance training is effective in controlling blood sugar and lipid profile of men with type 2 diabetes (17).

Moeini et al (2014), investigated the effect of resistance exercise on fasting and non-fasting blood sugar in coronary patients. The results showed that resistance exercise reduces the average non-fasting blood (18). Yousefipour et al (2014), reported that eight weeks of aerobic activity reduced fasting blood sugar in people with type 2 diabetes (19). Posta et al (2017), stated that resistance training is effective in regulating blood sugar in patients with type 2 diabetes (20).

Exercise can increase daily energy intake and increase the oxidation of fats in skeletal muscle and mitochondria, hepatocytes, and as a result, increased metabolism of visceral fat stores in the visceral region also decreases insulin resistance. The result of this part of the study was inconsistent with the study of George (21). The cause of the mismatch could probably be the duration of exercise and the age group of the subjects, which was different from this study.

Another finding on the effect of combined exercise on abdominal obesity in middle-aged men with pre diabetes showed that there was a significant difference between the experimental groups compared to the control group in the factors of abdominal obesity including body mass index, waist circumference and waist-to-pelvic ratio. This result is consistent with studies conducted in this regard, such as the study of Kazemi et al (2016), Strasser et al (2013) (20), Taghian et al (2011), and Baharloo et al (2015), are similar. Kazemi et al (2016), in a study, stated that combined training (aerobic-resistance) reduces weight, fasting glucose and insulin levels, as well as the insulin resistance index (19).

Taghian et al (2013), showed that aerobic exercise reduces weight, fat percentage, body mass, waist to pelvic ratio (21). Baharloo et al (2015), reported that weight loss with aerobic exercise reduces the risk of diabetes (22). On the other hand, some results of some studies are inconsistent. Among them, Kazemzadeh et al (2016), stated that a periodic training period had no effect on fat percentage and BMI of young overweight men (23).

The reason for the discrepancy may be specific eating habits, lack of nutritional control, or the type of exercise protocol. Exercise can increase daily energy intake and increase the oxidation of fats in

skeletal muscle, mitochondria and hepatocytes, and as a result of increased metabolism of visceral fat stores, insulin resistance is also reduced (24). In the present study, combined exercise with coffee consumption had a significant effect on lowering fasting blood sugar and the combination of these two interventions was more effective than the two interventions of combined exercise and coffee consumption. In the abdominal obesity variable, the effect of combined exercise was more than other interventions. Antioxidants, such as coffee, can be helpful in reducing fat absorption, energy consumption, lipogenesis, breaking down and proliferating fat cells, or increasing energy consumption and breaking down fat. This reduces body mass index (BMI), and ultimately improves body composition. Caffeine can increase resting energy expenditure. Chow et al. Concluded that the chlorogenic acid in coffee and its anti-obesity properties could. They cause weight loss and visceral fat and adipose tissue (25).

Conclusion

Overall, the results of the present study indicate that combined exercise with coffee consumption can have a double effect on lowering fasting blood sugar and improving abdominal obesity. It is recommended that this type of combined exercise intervention be used to prevent and reduce the risk of type 2 diabetes in overweight pre-diabetic individuals.

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