ORGINAL ARTICLE

The Effect of Aerobic Training and Ginger Extract on Lipid Profiles, Body Composition and Liver Enzymes in Obese Menopausal Women

Mostafa Farhadi[1], Hasan Matin Homaee*[1], Parvin Farzanegi Arkhazlou[2]

1. Department of Exercise Physiology, Central Tehran Branch, Islamic Azad University Tehran, Iran.
2. Department of Exercise Physiology, Sari Branch, Islamic Azad University, Sari, Iran

***Correspondence:**
Hasan Matin Homaee, Department of Exercise Physiology, Central Tehran Branch, Islamic Azad University Tehran, Iran.
Tel: (98) 218 807 4871
Email: hasanmatinhomaee@gmail.com

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Abstract

Objective: The beneficial effects of exercise and ginger extract have been reported to improve obesity-related indicators. The aim of this study was to evaluate the effect of aerobic training and ginger extract on lipid profiles, body composition and selected liver enzymes in obese menopausal women.

Materials and Methods: In this semi-experimental trial, 48 obese menopause women (age; 53-58 yr) were randomly divided into 4 groups including control, ginger extract, aerobic training and aerobic training -ginger extract. Aerobic training was performed 3 sessions a week, 60 minutes, with 50-70% maximum heart rate and for 24 weeks. The subjects consumed ginger extract three times a day in 500 mg capsule for 24 weeks. For analyzing the data, two-way ANOVA and Tukey's post hoc test was used with SPSS–23 and the significance level was *P*-value≤ 0.05.

Results: The results showed that 12 and 24 weeks of training, ginger and ginger - training significantly decreased ALT and AST in obese menopausal women (*P*-value= 0.001). Also, 12- and 24-weeks' ginger- training resulted to improve of body composition and lipid profile in obese menopausal women (*P*-value= 0.001).

Conclusion: According to the findings, regular aerobic training and ginger supplementation have a beneficial effect on body composition and improvement of some liver enzymes and lipid profiles in obese menopausal women. These changes were higher in the Ginger-training group after six months of intervention.

Keywords: Exercise, Ginger, Lipid profile, Liver enzymes, Obesity

Introduction

In menopause, due to the reduction of ovarian estrogen secretion, several pathophysiologic complications, including obesity and insulin resistance that are considered as risk factors for cardiovascular disease appear. (1). Reducing estrogen levels is associated with increased levels of total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL-C), and decreased plasma high density lipoprotein (HDL-C) levels in postmenopausal women (2,3). Menopause, also increases the risk of liver

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disease, include aspartate aminotransferase (AST), alanine aminotransferase (ALT) enzymes elevation (4).

Lifestyle modification such as increase of physical activity levels will be helpful in reducing obesity and cardiovascular disease during menopause. However, some studies also show that aerobic exercise has slight effect on TG or LDL and the ALT and AST levels, and its effects on HDL also is not significant (5). In this regard, Delbary et al. in 2017 after 8 weeks of aerobic training did not report significant change in the lipid profiles of over-weight postmenopausal women (6). However, in most studies, the role of regular aerobic training in reducing lipid profile and ALT and AST levels in postmenopausal and obese women has been reported (7,8).

On the other hand, the combination of some medicinal plants with a variety of exercises can result in synergistic results. Officinale Zingiber is a very common spice and one of the indigenous medicinal plants of Iran, which is also consumed worldwide. The use of Zingiber as a herbal medicine for the treatment of various diseases has a long history, including nausea, pain, dyspepsia and colds (9,10). The Zingiber is beneficial because of it's ingredients include essential oils, phenolic compounds, carbohydrates, proteins, alkaloids, glycosides, steroids, terpenoids, saponins, tannins, vitamins (A, E, and C) and gingerols. The rhizome also contains; the escaping oil and glycolipid A-C (11,12). zingiber not only plays an important role in increasing insulin sensitivity and glucose control, but also the effects of its long-term use on the reduction of plasma lipid levels and lipid peroxidation has been identified (13-15). However, Talaee et al. in 2017 showed that after a daily consumption of 3 g capsules of zingiber powder for 8 weeks, LDL-c and LDL-c to HDL-c ratio decreased in the experimental group, but there was no significant difference between the two groups. The zingiber plant, by increasing the activity of the Hepatic cholesterol 7 hydrolase enzymes, which restricts the bile acid biosynthesis, stimulates the conversion of cholesterol to bile acids and reduces lipid profile (16).

Menopause is a period of women's life, and regular exercise can reduce complications and diseases, including liver disease. Physical activity may reduce cardiovascular risk factors and thereby reduce mortality by improving lipid profiles and liver enzymes, and reducing obesity (17). Therefore, there is a strong logical reason to pay attention to exercise in lifestyle improvement programs to prevent or treat obesity in postmenopausal women. As indicated, the results of the researches are contradictory in this area. Therefore, considering the potential benefits of zingiber and regular exercise training in reducing obesity and the probable outcome of their interactive effect, the purpose of this study was to investigate the effect of 24 weeks aerobic training and consumption zingiber extract on lipid profile, body composition and liver enzymes (ALT and AST) in obese menopausal women.

Materials and Methods

This is a quasi-experimental study. According to Morgan's table sampling, 48 postmenopausal women (aged 53.2±5.21 years) with the body mass index (BMI) 30-34 who were not medically treated announced their readiness to participate in the study. The sampling method of this study was targeted and available. The statistical population of this study was recruited from the referrers to Datis sports clubs, Tehran and randomly divided into 4 groups: control (n=8), zingiber extract (n=8), aerobic training (n=8) and aerobic training -zingiber extract (n=8). Subjects completed a health and wellness form to ensure lack of disease and personal satisfaction. The inclusion criteria of subjects include the following: they should not be smokers and do not have any particular illness at the beginning of the study. Also, exclusion criteria for subjects include thyroid and heart diseases and use of dietary nutritional supplements. In a separate session after the medical examinations, the purpose of the

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research and how it was implemented for the subjects was described. After filling in the personal information questionnaire and signing consent, the following day each subject invited to the site of test. Body composition was measured using a BOCA x1 Body Analyzer made in South Korea. After two days, the subjects were referred to the laboratory for blood lipid profiles (cholesterol, triglyceride, LDL-C and HDL-C), and liver enzymes. Then experimental groups performed 24 weeks of aerobic training and zingiber consumption intervention. At the end, anthropometric and blood samples were taken.
zingiber extract is given in the form of 500 mg capsule. Placebo capsules contain the same amount of empty flour. Both groups will appear to have the same capsules, and in fact their content only will be different. Both zingiber and placebo groups will take the 500 mg capsule three times per day for 6 months (18).
Subjects will be trained by their coach for 24 weeks'. The coach will not be aware of which groups use zingiber and which not. Walking and jogging with moderate severity will be considered. With a minimum time of 60 minutes per session for 3 times a week with an intensity of 50-70% of maximum heart rate. The exercise protocol with 15 minutes of warm-up includes walking, dynamic and static stretching, starts, and with 15 minutes of cooling down, including stretching in the standing and sitting position will finished (19). Heart rate was measured using a polar heart rate monitor made in Finland.
To evaluate the biochemical variables, blood sampling was performed after 12-14 hours of fasting and before, 12 weeks and 24 weeks after the intervention (48 hours after the last training session). At each stage, the laboratory attendants from the anticobital vein of the left hand 10ml blood were taken at rest and in sitting position. Blood samples were stored at -80 °C after centrifugation and serum separation until the tests were carried out. In order to prevent the effect of citrcadian rhythm, blood sampling was performed at a specific time of day (8.5 to 9.5) in the morning. Lipid indices (TG, TC, LDL-C, HDL-C) were measured by enzymatic method (calorimetry) and the kit of Technikan Company. The levels of AST and ALT enzymes were measured using an enzymatic method by means of an autoanalyzer of Keynesian biochemistry (calibrated with the BIOLAB kit made in France).
Shapiro Wilk test was also used to check the normality of the data distribution. For analyzing the data, two-way ANOVA and Tukey's post hoc test was used with SPSS–23 and the significance level was *P*-value≤ 0.05.

Ethical considerations

This study was approved by the ethics committee of Sport Sciences Research Institute of Iran. (IR.SSRC.REC.1398.053).

Results

Table 1 shows the mean and standard deviation of anthropometric characteristics of subjects in different groups. The results showed that the effect of time (*P*-value= 0.886) on ALT enzyme was more than time and exercise interaction (*P*-value= 0.7671), time and supplementation interaction (*P*-value= 0.526) and interaction of time, supplementation and exercise (*P*-value= 0.027).
Also, the results of the study showed that exercise (*P*-value= 0.004) and supplementation (*P*-value= 0.038) had a significant effect on the ALT of postmenopausal women, but the combined intervention of exercise and supplementation had no significant effect (*P*-value= 0.225) (Table 2). Also, the results of analysis of variance (2*3) showed that the effect of time, time and exercise interaction, time and supplementation interaction on the AST enzyme is significant in obese menopausal women (*P*-value= 0.001). However, the interactive effect of three factors on the AST enzyme in obese menopausal women had no significant effect (*P*-value= 0.061).

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Table 1. Mean and standard deviation of the anthropometric characteristics of the subjects at the time before, three months later and six months after the intervention

Variable	Group	Control	Supplement	Aerobic Exercise	Aerobic Exercise - Supplement
Height (cm)	-	157.8 (±3/44)	158.5 (±1.77)	159.2 (±5.67)	161.1 (±3.44)
Weight (kg)	Before	80.7 (±0.54)	81.2 (±7.71)	82.6 (±7.35)	88.4 (±5.15)
	Three months	80.4 (±7.45)	79.5 (±7.74)	79.3 (±7.57)	83.8 (±4.57)
	Six months	80.8 (±7.35)	76.4 (±6.73)	73.2 (±8.03)	75.3 (±4.32)
BMI (kg.m^{-2})	Before	32.0 (±1.54)	32.2 (±2.55)	32.4 (±2.42)	34.0 (±1.41)
	Three months	32.2 (±2.44)	31.6 (±2.58)	31.1 (±2.51)	32.2 (±1.21)
	Six months	32.4 (±2.75)	30.3 (±2.21)	29.3 (±2.21)	28.9 (±0.74)
Body fat (%)	Before	39.3 (±2.13)	36.5 (±2.27)	36.4 (±2.67)	36.6 (±3.22)
	Three months	39.2 (±2.20)	34.8 (±2.31)	33.3 (±2.53)	33.1 (±3.09)
	Six months	39.0 (±2.18)	33.5 (±2.48)	30.1 (±1.90)	29.1 (±2.30)
VO2max (mL.kg^{-1}.min^{-1})	Before	29.5 (±1.75)	27.0 (±1.76)	28.5 (±1.70)	27.8 (±1.88)
	Three months	29.5 (±1.77)	27.9 (±1.93)	30.3 (±1.83)	30.9 (±2.30)
	Six months	29.7 (±1.80)	28.8 (±1.90)	32.9 (±1.67)	33.5 (±1.90)

Table 2. Results of two-way analysis of variance test to evaluate exercises on research variables

Variable	Source	Sum of Square	df	Mean of Square	F	P	Effect size
ALT	Training	538.701	1	538.701	10.126	0.004	0.266
	Supplementation	252.040	1	252.040	4.738	0.038	0.145
	Training+ supplementation	81.974	1	81.974	1.541	0.225	0.052
AST	Training	379.334	1	379.334	14.513	0.004	0.266
	Supplementation	587.120	1	587.120	22.463	0.038	0.145
	Training+ supplementation	13.764	1	13.764	0.527	0.225	0.474
Cholesterol	Training	717.008	1	717.008	0.829	0.370	0.029
	Supplementation	498.591	1	498.591	0.576	0.545	0.020
	Training+ supplementation	369.578	1	369.578	0.427	0.519	0.015
Triglyceride	Training	996.011	1	996.011	1.449	0.239	0.046
	Supplementation	6447.498	1	6447.498	9.383	0.005	0.251
	Training+ supplementation	128.714	1	128.714	0.187	0.668	0.007
HDL	Training	403.850	1	403.850	5.488	0.026	0.164
	Supplementation	128.946	1	128.946	1.752	0.196	0.059
	Training+ supplementation	165.323	1	165.323	2.247	0.145	0.074
LDL	Training	5968.314	1	5968.314	44.398	0.026	0.613
	Supplementation	711.226	1	711.226	5.291	0.029	0.159
	Training+ supplementation	61.889	1	61.889	0.460	0.503	0.016
VLDL	Training	39.840	1	39.840	1.449	0.239	0.049
	Supplementation	275.900	1	275.900	9.383	0.005	0.251
	Training+ supplementation	5.149	1	5.149	0.187	0.668	0.007

The results also show that the effect of time (*P*-value= 0.908) on AST enzyme was more than interaction of time and exercise (*P*-value= 0.770), time and supplementation interaction (*P*-value= 0.460) and time, supplementation and exercise interaction (*P*-value= 0.818). Also, the results showed that exercise (*P*-value= 0.004) and supplementation (*P*-value= 0.038) had a significant effect on the AST enzyme in postmenopausal women, but the combined intervention of exercise and supplementation did not have a significant effect (*P*-value= 0.225) (Table 2). The results showed that time, time and exercise interaction, and time and complement interaction affect the cholesterol level in obese menopausal women (*P*-value= 0.001), but the interactive effect of three factors on cholesterol in obese menopausal women has no significant effect (*P*-value= 0.075). The

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exercise, supplementation and interactive effect of exercise and supplementation did not affect the cholesterol level in postmenopausal women (*P*-value> 0.05) (Table 2). The results showed that the time, time and exercise interaction, and time and complement interaction affect the level of HDL in obese menopausal women (*P*-value= 0.001). The exercise had a significant effect on HDL in postmenopausal women (*P*-value= 0.026), but supplementation and exercise and supplementation interaction had no significant effect (*P*-value > 0.05) (Table 2).

The results showed that the effect of time, time and exercise interaction, and time and exercise interaction on LDL in obese menopausal women is significant (*P*-value= 0.001). The results of the study showed that exercise (*P*-value= 0.026) and supplements (*P*-value= 0.029) had a significant effect on LDL in postmenopausal women, but the exercise and supplementation interaction had no significant effect (*P*-value= 0.460) (Table 2).

The results showed that the time, and time and exercise interaction affect the level of triglyceride in obese menopausal women (*P*-value= 0.001). The supplementation had a significant effect on the level of triglyceride in postmenopausal women (*P*-value= 0.001), but exercise alone (*P*-value= 0.239) and exercise and supplementation interaction had no significant effect (*P*-value= 0.668) (Table 2).

The results showed that the effect of time, and time and exercise interaction on the level of VLDL in obese menopausal women is significant (*P*-value= 0.001). The supplement alone had a significant effect on the level of VLDL in postmenopausal women (*P*-value= 0.005), but the exercise alone (*P*-value= 0.239) and combined exercise and supplementation (*P*-value= 0.668) had no effect (Table 2).

Discussion

The results of this study showed that 12 and 24-weeks' aerobic exercise significantly decreased ALT and AST levels, and improved body composition and lipid profile in obese menopausal women. The exact mechanism of the protective effects of aerobic training on the reduction of liver enzymes has not yet been fully determined; however, it has been shown that aerobic exercise improves visceral fat significantly and may also decrease the amount of fatty liver (20).

In addition, regular aerobic exercise reduces levels of triglycerides, cholesterol and LDL and also increases HDL levels. These positive metabolic changes caused by aerobic exercise may ultimately lead to liver improvement, which can be detected by lowering serum levels of liver enzymes. As in the present study, it was shown that after the intervention period, the level of liver enzymes was reduced, probably due to decreased hepatic cell damage following exercise. Regular aerobic exercise also improves the body's antioxidant capacity, which may decrease cellular damage in the liver cells (21-23).

However, the present study did not investigate the antioxidant status, which is one of the limitations of this research. The results of some studies are opposite to the results of this study (5,6). Uadia et al. in 2016 showed that exercise training and flexibility (2 hours daily for 6 weeks) did not have a significant effect on plasma levels of ALT, ALP, and bilirubin in each two men and women (5). Delbary et al. in 2017, after 8 weeks of aerobic exercise, did not see any significant change in the lipid profiles of over-weight postmenopausal women (6). The contradiction in the reported research can be attributed to factors such as exercise type and the length of the exercise period. Also, the heterogeneous results affected by Different conditions of subjects' in terms of physical fitness. Therefore, aerobic training in this study seems to be a suitable way to reduce the risk of liver cells damages in obese menopausal women.

Also, the results of this study showed that 12 and 24 weeks zingiber extract significantly decreased ALT and AST levels, and improved body composition and lipid profile in obese menopausal women. Limited studies are available on the effect of zingiber extract on lipid profiles and liver enzymes. It has been

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shown that 12 weeks of treatment with zingiber extract reduce serum total cholesterol, triglyceride and low-density lipoprotein in human (14) and animal studies (15). The results of this study also suggest that supplementation of zingiber extract can reduce hepatic damage and leakage of enzymes from hepatocytes. These results indicate that zingiber extract may prevent liver damage in obese menopausal women. The exact mechanism of the effect of the compounds of zingiber extract is still not well known. As noted above, the zingiber plant stimulates the conversion of cholesterol to bile acids and decrease the cholesterol and lipid profile by increasing the activity of the hepatic cholesterol 7 hydrolase, a restriction enzyme in bile acid biosynthesis (24).

Therefore, the reduction of liver enzymes and plasma lipid profiles may be related to the activation of the hepatic Cholesterol 7 alpha-hydroxylase by the zingiber extract and its lipid effects. In addition to the effect of zingiber on increasing bile secretion, increased cholesterol and phospholipid excretion through stool also can reduce plasma lipid profiles after zingiber consumption (25).

The zingiber also reduces liver VLDL production, which is another justification for reducing triglyceride and total serum cholesterol (26). Another mechanism of zingiber action on lowering blood plasma lipids may be by increasing the amount and activity of lipoprotein lipase, which causes degradation and reduce of the plasma lipids in the blood (27). It is also possible that the decreasing liver damage enzymes are due to herbal antioxidant compounds such as phenolic compounds. Since zingiber has a large amounts of antioxidants and flavonoids, it is likely to have the protective effects in the removal of free radicals in the liver tissue. The zingiber consumption increases the activity of antioxidant enzymes and eliminates free radicals (28-31).

The zingiber extract contains compounds such as alkaloids and flavonoids that can maintain the stability of the cell membrane through their antioxidant activity and improve the tissue damage (32). Therefore, it seems that zingiber rhizome extract also protects liver tissue against obesity due to flavonoids and terpenoid compounds. However, contrary to the results of this study, Talaee et al showed no significant difference in LDL-c and LDL-c to HDL-c ratio in the experimental and control groups after daily intake of 3 grams of capsules containing zingiber powder for eight weeks (16).

The reasons of heterogeneous results in this study compared with the present study are the type of subject, the amount of daily supplementation, the type and severity of physical activity and the duration of the subjects' exercise. The findings of this study showed that co-administration of regular aerobic exercises and zingiber supplementation for six months had more and more beneficial effects on body composition and improvement of some liver and lipid profiles in obese menopausal women. Long-term consumption of zingiber supplementation and aerobic exercise may be more beneficial for obese menopausal women who are prone to increased obesity and in danger of independent risk factors for developing liver disease. Aerobic training was the strengths of the present study; this is because this type of exercise can have different responses and adaptations than other training programs. One of the limitations of this research is the lack of measurement of other indicators of liver damage. However, further research is needed in this area.

Conclusions

The results of this study showed that the combined intervention of regular aerobic exercises and zingiber supplementation have a beneficial effect on the body composition and improvement of some liver indices and lipid profile in obese menopausal women. These changes in zingiber -training group after six months of intervention period was higher. Therefore, it is recommended that a combination of aerobic exercise and zingiber

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be used as a preventive method for liver damage. It is suggested that in the future a study on the various protocols of aerobic exercise and zingiber on the structure and function of the liver tissue should be done.

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Conflict of Interest
The authors declare that there are no conflicts of interest.

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