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Full Length Research Paper

Effects of ginger supplementation and resistance training on lipid profiles and body composition in obese men

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This study was conducted to determine the effect of ginger supplementation and progressive resistance training on lipid profiles and body composition in obese men. Hence, 32 obese male (BMI≥ 30) were allocated in four groups. Ginger (GI; n=8); ginger plus resistance training (GIRT; n=8); placebo (PL; n=8); placebo plus resistance training (PLRT; n=8). The exercise groups supervised whole body progressive resistance training (PRT) of 3 sessions/wk in 10 wk. To identify total cholesterol, HDL-C and triglycerides levels, venous blood samples were obtained before and 48 to 72 h after last session of protocol. Body composition was assessed from the skin fold thickness measurements and body fat percent was then calculated by using the Siri equation. We observed a significant decrease for total cholesterol, body fat percentage, FM, WC, WHR ($P<0.05$) and significant increase for FFM ($P<0.05$) in the PLRT and GIRT groups after the 10 week period, while it remained unchanged in PL and GI groups. Furthermore, Mean BMI, HDL, LDL and triglyceride remained unchanged in all groups ($p>0.05$). For the base of these results suggested resistance training has been an effective therapeutic devise to favourable changes in lipid profiles and body composition in obese individual. Moreover, ginger consumption in 1 gr/day dose did not cause any significant effects.

Key words: Ginger, progressive resistance training, lipid profiles, body composition.

INTRODUCTION

Obesity has been increasing in epidemic proportions in both adults and children (Lavie et al., 2009) and has become one of the most important health problems throughout the world (Malekzadeh et al., 2005), so that, this is contributing to the overall cost of health care, but the financial concern is only a small part of the total burden of overweight and obesity created by excessive weight gain. Obese individuals are at greater risk of developing heart disease, hypertension, cerebrovascular disease, type 2 diabetes mellitus, osteoarthritis and many forms of cancer, gallstones, non-alcoholic fatty liver disease, sleep apnea, and asthma (Aronne et al., 2007). However, Obesity is an independent risk factor for hypertriglyceridemia and low HDL-cholesterol level (Malekzadeh et al., 2005). Hyperlipidemia is an important comorbidity of obesity and modifiable risk factor for arteriosclerosis, which causes coronary arterial disease (Matsuda et al., 2009). In Iran, only few studies focusing on the determination of lipid profile and the prevalence of dyslipidemia,which showed abnormal lipid profiles and a high prevalence of dyslipidemia (Fesharakinia et al., 2008).

The risk for the development of cardiovascular disease (CVD) is reduced in physically active people compared with their sedentary counterparts (Joseph et al., 1999). Accordingly, exercise, primarily aerobic training, is a low-cost therapeutic lifestyle change that has been recommended for improving lipid and lipoprotein levels in obese (Rosamond et al., 2008). While aerobic exercise

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has been extensively investigated and shown that, improves plasma lipoprotein and lipid profiles and thus reduces CVD (Halverstadt et al., 2007) the effects of progressive resistance training (PRT), that is, weight training, on lipids and lipoproteins in adults have been underwhelming. For example, previous randomized controlled trials addressing the effects of PRT on lipid and lipoprotein outcomes have reported conflicting findings with regards to total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), the ratio of TC to HDL-C (TC/HDL-C), LDL-C and triglycerides (TG) (Kelley and Kelley, 2009).

In addition to exercise training the use of herbal medicine as a pharmacologic modality in preventing alteration in lipid metabolism has received a wide attention from several researches. Ginger is an underground rhizome of plant *Zingiber officinale* belonging to the family Zingibeaceae and now, it is considered a common constituent of diet worldwide (Elshater et al., 2009). For centuries ginger has been an important ingredient in Chinese, Ayurvedic and Tibb-Unani herbal medicine (Badreldin et al., 2008). Ginger modifies lipid metabolism by inhibiting cellular cholesterol biosynthesis, increasing bile acid biosynthesis to eliminate cholesterol from the body and increasing fecal cholesterol excretion (Matsuda et al., 2009). Ginger has been shown to reduce the serum levels of cholesterol and triglycerides in fructose-induced hyperlipidemic rats (Kadnur and Goyal, 2005). Moreover, Alizadeh et al. (2008) indicated that, ginger has a significant lipid lowering effects in patients with hyperlipidemia. In contrast, in another study, non-diabetic patients with coronary artery disease showed no decrease in their blood lipid or sugar levels when treated with a daily dose of 4 g powdered ginger for a period of 3 months (Bordia et al., 1997).

However, there have been no direct comparisons of the effects of PRT and ginger supplementation in obese men and women. Thus, we hypothesized that PRT protocol and ginger supplementation would improve the levels of fasting blood lipids profiles and anthropometric parameters and body composition in obese subjects. Therefore, this study was designed to assess and compare the effects of PRT and ginger consumptions on blood lipid-lipoprotein profiles and body composition in obese men.

MATERIALS AND METHODS

Subjects

In this randomized double-blind, placebo-controlled trial, thirty-two obese men (BMI≥30, aged 18 to 30 years) volunteered for participation in this study after receiving a detailed explanation of the study. All participants had to meet the following criteria before enrolment in the study:

(1) No participation in regular physical activity,
(2) No current chronic health problems,
(3) Non-smokers,
(4) No cardiovascular, metabolic or respiratory disease and
(5) No consumption of any antilipidemic supplements or drugs within the past 6 months. Informed consent was obtained from all subjects and the study was approved by the Research Ethics Committee of Mahabad Azad University.

Study design

In this study, interventions were made over a 10-week period and subjects were evaluated at baseline and at the end of the study. The 32 participating obese men were assigned to one of four homogenized groups: ginger alone (GI; n=8; age 23.6±3.3; BMI 31.2±0.6); ginger plus resistance training (GIRT; n=8; age 23.6±4.4; BMI 32.5±2.7); placebo alone (PL; n=8; age 25.3±2.2; BMI 32.2±2.3); placebo plus resistance training (PLRT; n=8; age 23.7±3.8; BMI 32.8±2.1). The groups were matched according to the age, physical status, body fat percent and BMI values. Thus, 16 obese men (GI and GIRT) only orally received 4 capsules of ginger rhizome powder four times a day for 10 weeks (Each capsule contained 250 mg of ginger- root powder sold under the trade name Zintoma (Goldaroo. Company, Tehran, Iran), while 16 men (PL and PLRT) received 1 g of maltodextrine (placebo) and participated in followed resistance training protocol for 10 weeks. Participants were instructed not to change their physical activity routines or dietary patterns during the course of the study.

Anthropometric measurements

All anthropometric measurements were performed by the same technician persons on the day that blood specimens were taken. Height, weight, waist and hip circumferences were measured while subjects were not putting on shoes. Waist circumferences were measured at the midpoint between the lower border of the rib cage and the iliac crest and hip circumferences were measured at the widest part of the hip region. BMI (body weight [kg]/height [m2]) and waist-to-hip ratio (WHR) were calculated. Fat density (fat mass) was predicted from the skin folds measurements taken on the right side of the body by using calliper (Baseline economy plastic "slim-guide" skin fold caliper) at the triceps, abdominal and super iliac sites after 10 h of fasting and body fat percent was then calculated by using the Siri equation (Siri, 1961).

Training protocol

The PRT programme utilized in this study has been previously reported in previous study (Levinger et al., 2009). In brief, RT was performed 3 days per week for 10 weeks, with 48 to 72 h of recovery between training sessions. The training consisted of seven exercises including chest press, leg press, lateral pull-down, triceps push-down, knee extension, seated row and biceps curl. In addition, participants performed one abdominal exercise (abdominal curl). Before beginning of training a warm-up for 5 min was performed. During the first 2 weeks of training participants performed two to three sets of 15 to 20 repetitions at 40 to 50% of one repetition maximum (This one repetition maximum (1RM) calculator uses the Brzycki Formula (Brzycki, 1995)) From weeks 3 to 6, participants performed each exercise for three sets, 12 to 15 repetitions at 50 to 75% 1RM. During the last 4 weeks, the number of repetitions was reduced to 8 to 12 while the intensity was increased (75 to 85% of 1RM). Each subject's 1RM reassessed every 3 weeks and at each session load training was adjusted accordingly. All training sessions were supervised by exercise physiologists.

Brzycki Formula: $$1rep\max = \frac{\text{Weight lifted}}{1.0278 - (0.0278 * \#of\ reps)}$$

Sampling protocol

Blood samples were collected from each subject at baseline and at 48 to 72 h after the last exercise session in an overnight 12-h fasting state. A 5mL blood sample was collected via venipuncture of an antecubital vein (made by SUHA, IRAN Co). The blood samples were allowed to clot at room temperature for 10 min and then centrifuged for 15 min at 0°C. The serum was then pipette into polystyrene tubes. The aliquots were frozen at −80°C for subsequent assays.

Triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were measured at baseline and at the end of 10 weeks. Total cholesterol, HDL-C and triglycerides levels were measured using by enzymatic assays, while LDL-C was calculated using the formula of Friedewald et al. (1972), where LDL-C=TC - [HDL-C + (TG/5)].

Statistical analysis

All results are reported as mean ± standard deviations. Treatment response and group interaction were assessed by the two-way analysis of variance (ANOVA). When differences were detected, a Tukey's post hoc test was performed to determine pair wise differences.

Before statistical comparison, all data sets were tested for normal distribution by a Kolmogorov-Smirnov test. A p value of < 0.05 was used to determine statistical significance. SPSS 16.0 (SPSS Inc., Chicago, IL, USA) software was used for all the statistical calculations.

RESULTS

The groups were homogeneous and at the beginning of the research no significant statistical differences were observed for age, BMI, WC and body fat percentage (p>0.05). Anthropometrics, body composition and blood lipid profiles pre- post exercise and supplement interventions were statistically compared and are shown in Table 1.

In all groups, baseline mean LDL-C and triglycerides were above the desirable levels (Normality rates were: TC < 200mg/dL, HDL> 40 mg/dL, LDL < 100 mg/dL and TG < 150 mg/dL.). In comparison with baseline values, mean cholesterol, body fat percentage, fat mass (FM) waist circumference (WC) and WHR decreased in the groups GIRT and PLRT (p <0.05) independently of GI and PL groups after 10 weeks. In addition, there was a mean increase in fat free mass (FFM) in the groups GRT, PLRT and (p<0.05), while, Mean FFM remained unchanged in two other groups (p>0.05). Also, Mean BMI, HDL, LDL and triglyceride remained unchanged in all groups.

DISCUSSION

The prevalence of overweight and obesity is increasing worldwide and it is likely to be associated with an increasing prevalence of dyslipidemia and cardiovascular disease (Poirier and Despres, 2003). Hence, this study sought to investigate the effects of progressive resistance training and ginger consumption on body composition and blood lipid profiles in obese men. Effects of PRT on lipid-lipoprotein profiles are uncertain and conflicting results have been reported (Kelley and Kelley, 2009). The most important finding of this study is that progressive resistance training (PRT) resulted in favourable changes to plasma total cholesterol (TC) levels for obese men in only 10 weeks, which value mean of TC in PLRT and GIRT groups were decreased from 181.1 to 159.1 and 189.7 to 169.9, respectively, whereas it remained unchanged in two other groups. Moreover, after 10 weeks of intervention, an increase in muscle mass percentage, corresponding to a gain of approximately 2 to 3 kg in muscle mass, was observed in the subjects engaged in resistance training combined or not with ginger supplementation. No alterations in BMI were observed. However, in both GIRT and PLRT, body fat percent, WC and WHR significantly decreased, while it remained unchanged in untrained groups. The fact that TC decreased after 10 week resistance training and occurred without concurrent changes in weight or diet is an indication that PRT can be used to modify lipoproteins in obese populations.

These findings are consistent with the results of Misra et al. (2008), Yang et al. (2006), Fahalmana (2002) and Kelly and kelly (2009). For instance, Misra et al. (2008) indicated that, 12 weeks of progressive resistance training (PRT) yield significant decreases in the levels of lipids profiles and improved body composition in patients with type 2 diabetes. Fahalmana et al. (2002) investigated effects 10 weeks of endurance and resistance exercise on plasma lipoprotein levels in elderly women and founded that, both aerobic training (AT) and resistance training (RT) groups experienced improved in blood lipid profiles at week 11 compared with week 0. Also, our results are similar to the data from Fenkci et al. (2006) who found a significant decrease in triglycerides and total cholesterol levels after 12 weeks of resistance exercise in obese women. There is also substantial evidence that regular resistance training can effectively alter body composition in both men and women. It has been shown to increase total fat-free mass, muscular strength and resting metabolic rate, and preferentially mobilize the visceral and subcutaneous adipose tissue in the abdominal region (Tresierras and Balady, 2009). We demonstrated a significant decline in lipid levels and body composition after progressive resistance training in obese men; however, seems that better effect has been seen on long-term resistance exercise protocol (Balducci et al., 2004).

Table 1. Anthropometrics, body composition and blood lipid profiles pre- post exercise and supplement interventions.

Anthropometrics	PL		PLRT		GIRT		GI	
	Pre	Post	Pre	Post	PRE	Post	Pre	Post
Waist (cm)	104.91±2.3	105.0±3.2	108.25±4.8	105.0±6.07*	108.0±5.3	102.75±3.6*	106.95±3.1	105.69±2.5
WHR	1.05±0.04	1.05.07	1.06±0.03	1.04±0.03*	1.02±0.05	1.0±0.05*	1.08±0.04	1.07±0.4
Body composition								
BMI (kg/m2)	32.2±2.3	32.3±2.4	32.8±2.1	32.5±2.0	32.5±2.3	32.2±2.8	31.2±0.6	30.7±0.7
Body fat (%)	26.0±2.9	25.9±2.8	26.6±3.5	23.5±3.3*	27.7±3.6	22.7±2.8*	25.6±2.20	25.2±3.1
FFM (kg)	74.4±8.7	74.8±9.3	74.5±8.4	76.2±6.6*	71.4±8.7	74.8±9.3*	67.4±3.6	68.3±3.3
FM (kg)	26.2±2.3	25.2±2.2	27.3±1.6	25.1±2.6*	27.5±2.9	23.4±2.8*	25.8±2.1	24.6±2.3
Lipid profile								
Total cholesterol (mg/dL)	192.5±29.1	193.2±30.4	181.1±24.2	159.1±16.6*	189.7±41.4	169.9±33.1*	186.0±24.9	175.1±23.0
LDL (mg/dL)	116.9±23.7	118.8±25.0	104.2±34.7	90.8±23.8	112.5±31.6	98.8±32.1	108.6±19.9	100.4±25.3
HDL (mg/dL)	42.2±8.5	42.5±7.2	45.0±1.2	48.0±6.6	43.2±4.5	47.6±4.0	46.6±7.9	47.8±9.0
TG (mg/dL)	169.9±38.1	172.0±35.1	159.6±63.9	146.3±72.7	145.0±23.0	139.5±3.2	153.6±54.5	142.7±28.4

Values are mean ± SEM. * P<0.05 vs. baseline.

Nevertheless, the results of this study are in disagreement with those of Marques et al. (2009) who reported that, following resistance training program no significant changes were observed on lipid profile in resistance training groups. Likewise, Maesta et al. (2007) and Vincent et al. (2006) declared that resistance exercise have no effects on lipids and lipoproteins in overweight and obese adults . The differences in the participant's age, body status, BMI and training intensity, number of exercise stations and lengths of protocol may account for the discrepancy between our results (lipid profiles) and findings of these researches.

Furthermore, there is a deficient of well-controlled studies investigating the effect of ginger consumption on lipid profile and a few studies have focussed on the effect of ginger on blood lipids in animals and humans. According to the present study, ginger supplementation seems to exert no effect on blood lipid profiles and body composition in obese men, as these findings are in agreement with some previous studies (Bordia et al., 1997; Srinivasan and Sambaiah, 1991; Verma et al., 2004). For example, Bordia et al. (1997) reported that ginger consumption have no effect on blood lipid profiles in patients with coronary artery disease when it was given in powdered form (4 g) daily for a period of 3 months. In another study, air dried ginger powder (0.1 g/kg per os for75 days) did not lower blood lipids to any significant extent in rabbits by cholesterol feeding (0.3 gr/kg per os) (Verma et al., 2004). But hypolipidaemic effects of ginger extract were also demonstrated in some other studies (Alizadeh et al., 2008; Kadnur and Goyal, 2005). Elshater et al. (2009) revealed that post-treatment with ginger extract for 6 weeks to diabetic rats produced significant reduction in the levels of plasma cholesterol, triglycerides and LDL-cholesterol and significant elevation in the HDL-cholesterol when compared with diabetic group. In another study, alizadeh et al. (2008) investigated the effect of 45 days ginger capsules on the lipid levels in patients with hyperlipidemia and indicated that ginger has a significant lipid lowering effect compared to placebo. Moreover, Bhandari et al. (2005) showed that ethanolic extract of ginger caused significant decrease in serum total cholesterol and triglycerides levels and increased HDL-cholesterol level as compared to diabetic rats. Akhani et al. (2004) illustrated that, the reduction in serum lipid levels with ginger might be due to its antagonistic action on streptozotocin receptors, thereby increasing insulin levels.

Also, Fuhrman et al. (2000) reported that, the decreasing levels of plasma lipids following the intervention with ginger could have possibly resulted from the inhibition of cellular cholesterol biosynthesis after the consumption of the extract. It seems that one possible reason for this discrepancy between these and the present findings may be explained by differences in amount of given dose and length of supplementation, which most of study that investigated effect of ginger on lipid profiles given high dose (3 to 4 gr/day) of this supplement (Alizadeh et al., 2008) but we given a low dose (1 gr/day) of ginger to obese men.

Conclusion

In conclusion, the results in the present study allow us to conclude that, progressive resistance training for 10 week resulted significant improvement in body composition, anthropometric parameters and total cholesterol in obese men. Therefore, according to the results of this and previous studies, it can be concluded that, resistance training has been an effective therapeutic devise to favourable changes in body composition and lipid profile and thus a reduction cardiovascular risk factors in obese individual. Moreover, ginger supplementation of the diet in doses of 1 gr per day did not improve the blood lipid profiles and body composition in obese men. Hence, we believe that further studies with larger doses and different protocols should be performed in order to identify the beneficial effect of combining dietary measures and physical training and to identify the most appropriate programme for the management of obesity and its complications.

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