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The effect of endurance training accompanied by Ramadan fasting on lipid profiles and body composition in men

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Abstract

Background: The aim of this study was to investigate the effect of endurance training accompanied by fasting on lipid profiles and body composition in men.

Materials and methods: Twenty-six healthy male volunteer subjects participated in the study and were divided into fasting (F) and Endurance Training+ Fasting (ET+F) groups. ET+F group exercised 3 times per week on treadmill during Ramadan month while F group had fasting for one month. Anthropometric characteristics and blood sampling were collected in the morning after a 12-h overnight fast at before Ramadan, the end of Ramadan and 2 weeks after Ramadan.

Results: At the end of Ramadan, body mass index (BMI), waist to hip ratio (WHR) and body fat percent significantly reduced in both indices. In comparison with F group, BMI, body fat percent, triglyceride (TG) and very low density lipoprotein (VLDL) significantly decreased in ET+F at the end of Ramadan ($P<0.05$).

Conclusion: Endurance training accompanied by fasting improved lipid profiles, body composition and prevented the rise of TG and VLDL.

Keywords: lipid profiles, body composition, endurance training, fasting.

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Introduction

Obesity is related to many health complications including diabetes, high blood pressure, high blood cholesterol and triglycerides, arthritis, asthma, certain types of cancer and cardiovascular diseases (1). Several possible mechanisms have been identified as determinants of obesity, such as lipid disturbances and inflammatory disorders (2). The metabolism, amount and type of dietary fat, particularly lipoprotein, increase the risk of cardiovascular diseases so that, there is a linear relationship between mortality from cardiovascular disease in relation to cholesterol level (3).

Physical activity prevents cardiovascular diseases with reduction the incidence of obesity and high blood pressure and improves blood lipid profile, particularly decreasing low density lipoprotein (LDL), total cholesterol (TC), and triglycerides (TG), and increasing high density lipoprotein (HDL) (4). It seems that change in eating habits and lifestyle can reduce the risk of atherosclerosis and vascular diseases. The month of Ramadan is known as a useful strategy to improve eating habits and weight loss. Although, there are many physical and psychological benefits of fasting, however, its effect is not completely established in the body (5). It is clear physiological and biochemical changes dramatically occur during Ramadan resulted from alteration in eating and sleeping habits (6). Ramadan fasting is an excellent model of how dietary modifications may affect serum TC, TG, LDL and HDL (7).

Lotfi et al. (2010) reported Ramadan fasting has no effect on performance and weight in strength athletes (6). Al-Hourani et al (2009) indicated Ramadan fasting, reducing significantly TG, is a non-drug treatment to improve lipid profile (7). Mansi et al. (2007) measured glucose, TG, TC, LDL, HDL before Ramadan, the first, second and fourth weeks of Ramadan and after Ramadan and concluded significant increase and decrease in HDL and LDL,

respectively, in the month of Ramadan (8). Furuncuoglu et al. (2007) showed at the end of Ramadan fasting did not change body mass index (BMI) but decreased glucose, TG and TC significantly (9). Ziaee et al. (2006) assessed the influence of Ramadan fasting on body weight and lipid profile at 81 students. They found BMI, body weight, LDL, and glucose was significantly decreased, while HDL levels increased and did not significant change in TC, TG and VLDL (10). It appears these contradictory findings related to lipoprotein depends on reducing meal size and an increase of the food intake eaten at each meal and also how answering each person to starvation-induced biochemical alterations (11).

The decrease in physical activity in Ramadan month is one of the reasons in increase of LDL/HDL ratio. However, modification of diet and eating habits should not be overlooked (11-12). It is well known physical activity with adequate intensity will increase HDL and decrease LDL levels (3). Furthermore, it is clear lipid profile will change feeding habits, percentage of added fat to diet, the type of fat and simple sugar percent (13). However, it appears that moderate aerobic activity slightly affect plasma cholesterol and LDL while may increase HDL during weight loss (14).

Mechanisms determining changes in hormonal and biochemical parameters and consequent alterations in body composition with restricted intake of food are poorly understood, particularly if participants continue to engage in vigorous exercise. Bouhlel et al. (2006) found an increased oxidation of lipids in trained athletes who undertook sub-maximal exercise during Ramadan, with associated decreases in body mass and body-fat content. The underlying mechanisms remain unclear, and there is a need for studies examining the impact of Ramadan observance on lipid profiles and characteristics of body composition in response to exercise

training. Our primary hypothesis was that if Ramadan fasting in combination with endurance training may be more effect on cardiovascular risk factors (such as lipid profiles) in comparison with Ramadan fasting alone. Therefore, the aim of this study was to investigate the effect of endurance training accompanied by fasting on lipid profiles and body composition.

Materials and methods

Subjects

Twenty-six subjects were included in this study. All subjects were healthy. Mean age was 25.2 ± 3.7 yr (range, 20–30 yr). The study protocol was approved by the Ethics Committee of Endocrine and Metabolism Center at Tehran University. All subjects signed an informed consent form after being informed on the purpose and procedures of the study. Subjects were asked to avoid doing severe physical activity for 48 hours before each sampling. Subject's characteristics have been showed in Table 1.

Dietary intake

Food intake was evaluated using 3-d food records at two weeks before Ramadan, the second week from Ramadan and two weeks after Ramadan. Subjects were asked to record the amount and type of food and beverage consumed for two consecutive weekdays and one weekend day, using standard household measures (cups, tablespoons, etc.). Trained interviewers reviewed the records along with the subject to clarify servings, recipes, and forgotten foods. Energy and nutrient intake calculated using the Nutritionist V Diet Analysis software.

Anthropometry and body composition

Anthropometric and body composition were measured in the morning, while were fasting, with the subject wearing light clothing, without shoes for two days before Ramadan, the end of Ramadan and two weeks after Ramadan. Body weight and height were measured by the same

observer using a scale and a wall-mounted stadiometer to the nearest 0.5 kg and 0.5 cm, respectively. Waist and hip circumferences were measured, and the waist to hip ratio (WHR), which provides valuable information about the distribution of body fat, was calculated as the ratio of waist and hip circumferences. Standard procedures were followed, and the average of the two measurements was taken. Skinfold thicknesses at four sites (biceps, triceps, sub-scapular, and suprailiac), using a calibrated Harpenden caliper (Holtain, Crosswell, UK) by a single trained observer. Readings were taken 2s after application of the calipers (16). Body densities were calculated using the equation of Durnin and Womersley (17): $\text{Body density} = 1.1765 - 0.0744(\log_{10} S)$ Where S is the sum of the four skinfold readings (in mm). Body fat was then estimated as $(4.95/D - 4.50)100$, where D is body density (17). BMI was also calculated.

Experimental design

Twenty-six subjects were voluntarily recruited and divided Fasting (F) (n=13) and Endurance Training + Fasting (ET+F) groups (n=13). During the investigation from F and ET+F group two and three people, respectively, deterred from continuing to participate in the experiment. ET+F group exercised on treadmill 3 days per week during Ramadan month. Participants in ET+F group had energy expenditure for 500 kcal per each of session at the first week of Ramadan. Energy expenditure increased at second, third and fourth weeks up to 600, 700 and 800 kcal, respectively. Energy expenditure calculated in order to subject's weight and different physical activity MET for each person using under formula (18):

$$\text{Kcal/min} = (\text{METs}) \times 3.5 \times (\text{Weight in kg}) / 200$$

Each of subjects warmed up at 4 and 6 km/h for 10 min and the rest of train session was running at 8 km/h. In the end of each train session, subjects cooled down

at 6 and 4 km/h for 10 min (Fig 1). Subject's heart rate (Polar S610, Polar Electro, Kempele, Finland) was recorded between 145 and 170 during running. Time of exercise in ET+F group was one hour after breakfast/Iftar. Exercise session latest was 2 days before the end of Ramadan. F

group did not have any regular physical activity during Ramadan. After Ramadan both F and ET+F groups returned to regular diet while ET+F group stopped exercise.

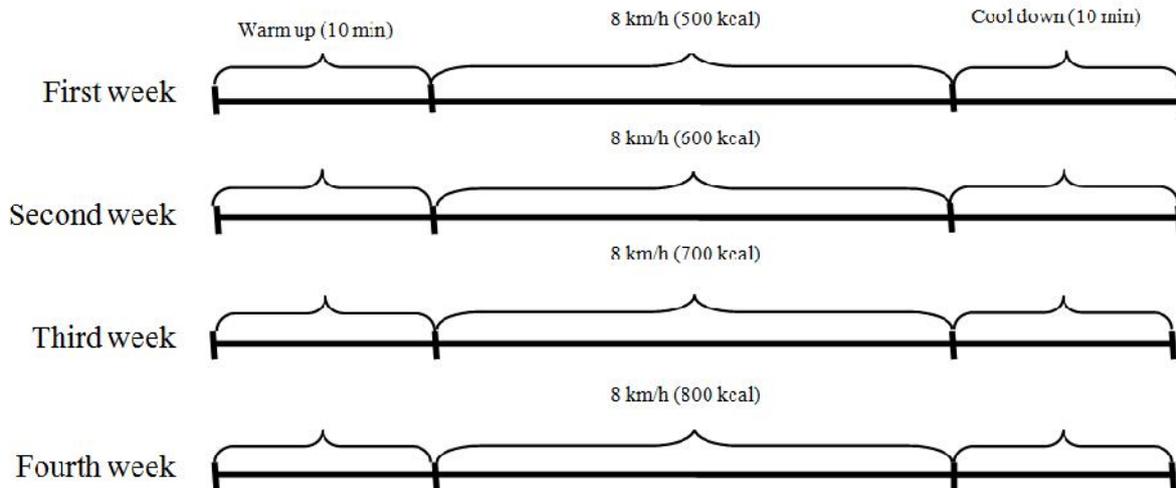


Figure 1: Training program in ET+F group during Ramadan

Results

Anthropometric characteristics are presented in Table 1. Weight, BMI and body fat percentage has decreased significantly at the end of Ramadan in both groups ($p < 0.05$).

Compared with before Ramadan values, the estimated daily energy intake was not reduced significantly during Ramadan ($p > 0.05$). However, diet fat percentage increased significantly both F and ET+F groups ($p < 0.05$; Table 2) during Ramadan than before Ramadan.

Lipid profile changes have been shown in Table 3. Compared to F group, serum TG (Fig 1) and VLDL (Fig 2) concentrations were significantly decreased in ET+F group at the end of Ramadan month. However, Cholesterol, LDL and HDL did not change between groups at any time. Serum TG during Ramadan month was not correlated with calorie intake ($r = 0.40$, $p > 0.05$) and diet fat value ($r = 0.48$, $p > 0.05$) alterations at ET+F group (data not shown).

Table 1: Anthropometric parameters of the F (n = 10) and ET+F (n = 10) groups before Ramadan, the end of Ramadan and 2 weeks after Ramadan month. Results expressed as means±S.D.

	F			ET+F		
	BR	ER	AR	BR	ER	AR
Weight, kg	77.4±16.2	76.5±16.5*	77.2±16.9	79.3±9.3	76.7±8.5* [§]	77.9±8.3
BMI, kg/m ²	25.7±4.4	25.4±4.5*	25.6±4.6	26.3±2.9	25.4±2.6* [§]	25.9±2.6
WHR	0.87±0.07	0.89±0.07	0.89±0.06*	0.87±0.05	0.87±0.04	0.88±0.04
Waist Circumference Maximum, cm	91.8±12.2	91.1±12.8	91.0±12.3	93.4±8.9	91.0±7.3	91.5±7.0
Body Fat Percentage, %	22.7±5.8	21.6±6.2*	22.2±6.3	26.1±4.7	23.6±4.6*	23.9±4.5*

* P<0.05 compared with BR. [§] P<0.05 compared with AR.

Note: BR, before Ramadan; ER, the end of Ramadan; AR, 2 weeks after Ramadan

Table 2: Dietary Intake of Participants before Ramadan, during Ramadan and 2 weeks after Ramadan month. Results expressed as means±S.D.

	F			ET+F		
	BR	DR	AR	BR	DR	AR
Energy, kcal/day	3342±532	2928±529	2780±1030	3295±651	2349±576	2592±771
Carbohydrate, g/day	501±105	359±107	412±139	438±70	282±66*	339±131
Fat, g/day	108±19	129±34	99±54	113±31	96±27	107±17
Protein, g/day	101±27	85±23	64±25	142±74	92±39	76±32
Carbohydrate, % of energy	59.7±3.9	48.6±7.2* [§]	60.5±8.9	53.2±9.2	48.5±6.7	51.2±4.2
Fat, % of energy	29.4±6.5	40.8±7.1* [§]	31.5±5.8	32.3±7.5	37.9±5.4* [§]	31.6±6.6
Protein, % of energy	10.9±4.2	10.6±5.6	8.0±4.3	14.5±7.3 [§]	13.4±3.4 [§]	7.3±5.7

* P<0.05 compared with BR. [§] P<0.05 compared with AR.

Note: BR, before Ramadan; DR, during Ramadan; AR, 2 weeks after Ramadan

Table 3: Lipid profile changes in F and ET+F groups before Ramadan, the end of Ramadan and 2 weeks after Ramadan month. Results expressed as means±S.D.

	F			ET+F		
	BR	ER	AR	BR	ER	AR
Cholesterol (mg/dl)	154± 17.8	148± 17.7	164± 22.0	146± 27.8	134± 27.1	163± 31.3
HDL (mg/dl)	46.2± 11.1	41.4± 5.1	49.3± 12.5	40.1± 4.4	37.4± 5.1	43.5± 4.0
LDL (mg/dl)	88.1± 14.6	79.2± 14.8	89.4± 18.8	82.1± 28.9	77.0± 21.7	94.8± 23.7

* Significant difference between groups (P<0.05)

Note: BR, before Ramadan; ER, the end of Ramadan; AR, 2 weeks after Ramadan

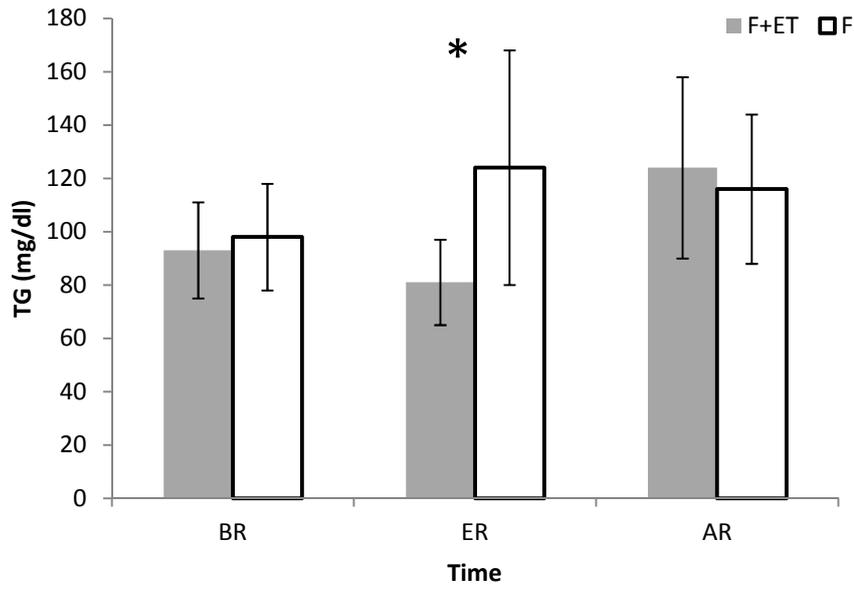


Figure 1: TG Changes (mean±S.D.) at BR, ER and AR. * Significant difference between groups (P<0.05)

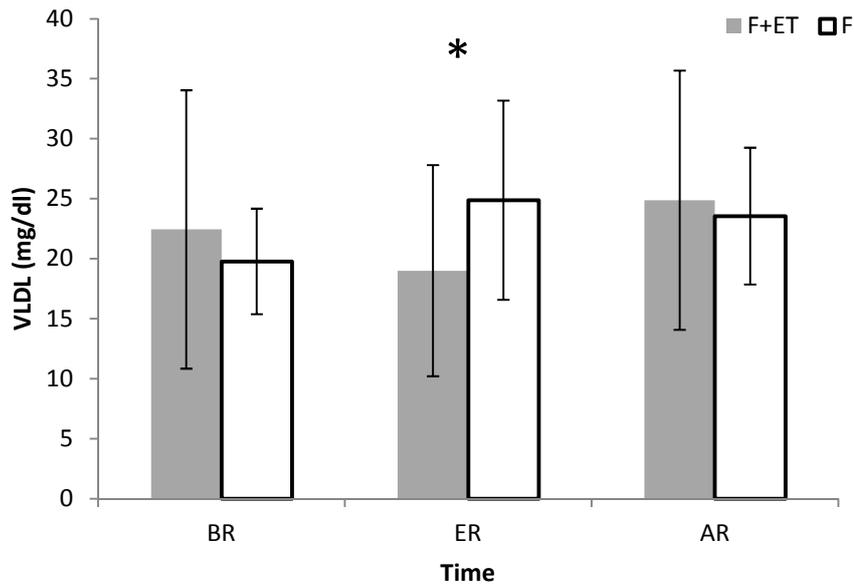


Figure 1: VLDL Changes (mean±S.D.) at BR, ER and AR. * Significant difference between groups (P<0.05)

Discussion

Weight, BMI and body fat percentage were significantly decreased at the end of Ramadan in both F+ET and F group. For weight loss and BMI, this result is in agreement with Al-Hourani et al (2007), Haghdoost et al (2009), Mansi et al (2007), Tayebi et al (2010), Ziaee et al (2006) and Bouhleb et al (2006) (10, 18-22) but others did not see any changes (23-24). It has been reported that weight reduces about two kilograms (25-26). The fasting-induced weight loss in overweight people is more than those with normal weight (27). Fluid intake is reduced during Ramadan (28). Thus, it is likely that part of the observed weight loss is due to dehydration. However, it is unclear whether or not there is a chronic dehydration in Ramadan (29). Ramadan fasting is considered as an appropriate diet that may have an impact on TC, TG, LDL, HDL and glucose. In addition to, previous studies have indicated endurance exercise is effective in improving the lipid profile (30). Physical activity can reduce and increase serum TG and HDL through increased lipolytic activity, respectively (30). Several studies have shown physical activity by altering the weight change will indirectly be caused these changes. However, the present results represented TC and LDL did not change both F+ET and F group. Increased cholesterol can increase the risk of atherosclerosis. Yousef Boobes et al (2009) and Mansi et al (2007) reported lower levels of TC during Ramadan (24, 20). Conversely, Haghdoost et al (2009) and Yarahmadi et al (2003) reported higher levels of TC (19, 31). Previous studies have shown that aerobic exercise has little impact on the levels of plasma TC and LDL (14).

Furthermore, HDL function is to prevent the deposition of cholesterol in the arteries, so that, the increase in HDL can reduce cardiovascular diseases. However, the present results represented HDL did not change in none of the groups although that increased two weeks after Ramadan. Mansi

et al (2007) reported an increase in HDL during Ramadan (20) but Haghdoost et al (2009) and Yousef Boobes et al (2009) indicated a decrement in HDL (19,24). In the present study, no significant difference was observed in HDL between the groups. Our data indicated serum TG and VLDL did significantly change at the end of Ramadan in ET+F group compared with F group. Environmental and genetic factors are important in plasma TG concentration (32). Several studies have shown a decrease in TG levels (19, 20, 33) while others have reported to increase TG levels (34). TG level decreased at the first week but is increased at the end of Ramadan month. Contradictory findings may be related to differences in subject training status, diet, caloric intake, food composition, and the content of food fat because many of these changes has been reported in association with diet (4, 6). Previous studies have shown that VLDL and TG levels will simply change by eating habits, the content of food fat, and the kind of dietary fat (13). In this study, amount of dietary fat have increased during fasting Ramadan in both groups than before Ramadan that can possibly be one of the mechanism increasing TG and VLDL levels during Ramadan month. Despite an increase in amount of dietary fat, endurance exercise along with fasting could significantly reduce TG and VLDL levels. A change in levels TG is highly variable as a result of physical activity (14). Lipolysis and fatty acids oxidation will increase with exercise training. This increases the activity of metabolic enzymes are involved in CHO and TG metabolism (35). However, TG and VLDL levels have been returned the basic levels two weeks after Ramadan month. Cessation of exercise leads to loss anatomical, physiological and functional adaptations (36-37). With the cessation of exercise will increase respiratory exchange ratio or the ratio of carbon dioxide to oxygen (38). This suggests that energy substrate is

shifted toward carbohydrate oxidation while prevents fat oxidation (38). It is likely one of the mechanism that causes to return TG and VLDL to basic levels. Indeed, it suggests that endurance training accompanied by Ramadan fasting can reduce TG and VLDL levels and cessation of training will loss these adaptations. In

conclusion despite an increase in amount of dietary fat, endurance training (energy expenditure at least 500Kcal) accompanied by Ramadan fasting can improve body composition and lipid profiles (especially TG and VLDL) better than Ramadan fasting alone.

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