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Does Ramadan Fasting, along with Circuit Resistance Training Affect the Body Composition and Lipid Profiles of Healthy, Inactive Middle-aged Men?

Mostafa Rahimi[1*], Hojatallah Banitalebi[2], Parasto Haj Ghorbani[1]

1. Department of Sport Science, Shahrekord University, Shahrekord, Iran.
2. Department of Exercise Physiology, Shahed University, Tehran, Iran.

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ABSTRACT

Introduction: Physical activity and healthy nutrition are essential to a healthy lifestyle. Fasting during Ramadan also shows potential health benefits. However, the effect of combining fasting and physical activity on health outcomes in diverse individuals remains relatively unclear. Therefore, this study aimed to evaluate the effect of Ramadan fasting alone or with circuit resistance training on middle-aged men's body composition and lipid profile.

Methods: Thirty inactive and healthy adult males were randomly assigned to three groups in this study: fasting (30 days of Ramadan fasting), circuit resistance training (30 days of Ramadan fasting plus 12 training sessions), and the control group. A day before the commencement of the fasting month of Ramadan and one day after its conclusion, anthropometric and biochemical parameters were assessed utilizing established methodologies. The training program consisted of 12 sessions every other day, lasting between 30 and 45 minutes. This training protocol was performed at 5:00 PM. Data were analyzed with SPSS software and using the analysis of covariance (ANCOVA) test ($P \leq 0.05$).

Results: The results showed that compared to the control group, body weight (P=0.001), BMI (P=0.001), body fat % (P=0.001), and muscle mass (P=0.002) decreased significantly in the fasting and fasting combined with exercise groups. In contrast to the control group, the intervention groups exhibited non-significant reductions in total cholesterol (P=0.082), triglyceride (P=0.132), and LDL-C (P=0.123) levels. In addition, the HDL-C level in the fasting (P=0.001) and fasting combined with training (P=0.001) groups was significantly reduced compared to the control group.

Conclusion: Based on the results, integrating circuit resistance training with a one-month fast during Ramadan resulted in changes in body composition, including a reduction in body weight, BMI, body fat percentage, and muscle mass. However, a non-significant decrease in the blood lipid profile accompanied these modifications. HDL was also reduced following the implementation of exercise and fasting.

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Introduction

Behavioral risk factors, such as consuming unhealthy diets and reducing physical activity, have metabolic consequences that result in overweight and obesity. This, in turn, can lead to non-communicable diseases like metabolic abnormalities, cardiovascular diseases (CVD), stroke, type 2 diabetes, and other related conditions [1]. Additionally, imbalances in energy balance and hormones can result from overweight and obesity, which can also cause substantial alterations in adipose profile [2].

Dyslipidemia has been shown as a metabolic abnormality with a decrease in high-density lipoprotein cholesterol (HDL-C) and an increase in low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels [3]. The presence of one or more abnormal blood serum concentrations is the cause of dyslipidemia and is a decisive risk factor for the onset of CVD and other health problems [4]. Research has indicated that interventions associated with a healthy lifestyle, such as increasing physical activity and enhancing dietary habits, may improve lipid profile and decrease the incidence of diseases induced by an improper diet [5, 6]. Dietary intervention is regarded as a significant fitness and lipid profile modifier [7].

Intermittent fasting (IF) has attracted much attention as a method for improving metabolic

* *Corresponding authors:* Mostafa Rahimi, Department of Sports Science, Shahrekord University, Shahrekord, Iran. Tel: +989132811620, Email: m.rahimi@sku.ac.ir.

indices. IF refers to an eating pattern that reduces calorie intake for several days, may not be consumed frequently, or consumes very few calories throughout the day [8]. Based on the reports, IF improves body composition, lipid profile, and overall health [9]. Ramadan fasting (RF) is a form of IF practiced by millions of Muslim adults worldwide as a process in which calories and liquids are avoided for 12 to 22 hours [10]. The predominance of carbohydrates characterizes RF in the early morning hours as the primary fuel. However, fat becomes more important in the afternoon hours, and cells recycle unwanted items, which is associated with reducing inflammation and autophagy and improving metabolic indicators [11]. In addition, RF changes the secretion of hormones such as cortisol, insulin, leptin, and ghrelin by changing the sleep pattern and circadian rhythm, improving whole-body metabolic homeostasis, and reducing disease risk [12]. The health benefits of RF have been demonstrated in clinical trials. In this regard, research results have reported that RF improves body composition, improves lipid profile parameters, and reduces the risk of coronary artery disease [13].

On the other hand, exercise is considered a significant modifier in improving lipid profile and body composition along with RF. Lifestyle changes, including nutritional interventions and sports activities, can be effective in controlling body weight and metabolic health by shifting the energy balance from the positive to the negative side by reducing calorie consumption and increasing physical activity [4 ,14 ,15]. Physical activity along with RF increases lipolysis in fat and muscle tissue and can be a good solution for metabolic regulation. Recent studies have supported the positive effects of RF and exercise in improving body composition and health. The results of a recent study showed that RF combined with physical activity significantly improves body composition and cardiovascular health compared to RF alone [16].

Circuit resistance training (CRT) is one of the most popular exercises and has many benefits. Previous systematic reviews and meta-analyses reported that CRT improves body composition, muscle strength and endurance, cardiorespiratory fitness, and neuromuscular function [17, 18]. This approach involves performing one or multiple sets of various exercises consecutively with minimal rest. The specific number of exercises, intensity, weight, rest periods, duration of sessions, and duration of the training phase may differ based on the training goal [19]. However, the results of some studies are conflicting because a wide variety of these types of exercises can be designed and implemented [17, 18, 20].

The development of a healthy lifestyle is critical for individuals' well-being, and authorities place significant emphasis on the identification of appropriate nutritional solutions and physical activity. The results regarding the health effects of fasting alone or in conjunction with exercise are somewhat unknown and obscure. However, CRT exercises appear more appealing than conventional strength and aerobic exercises due to their greater variety and combination. Hence, this study was designed to ascertain the impact of CRT exercises and Ramadan fasting on middle-aged males' body composition indices and blood lipid profiles.

Materials and Method

This experimental and applied study was conducted with a pre-test and post-test design. The statistical population of this research was healthy, inactive middle-aged men (20-45 years old). The statistical sample consisted of 38 people who were randomly divided into the following groups: fasting (RF, n=14), fasting and circuit resistance training (RF+CRT, n=14), and control (C, n=10) groups.

The inclusion criteria were male gender, age 20 to 45 years old, no underlying diseases, no alcohol and tobacco consumption, no supplement use, and no regular exercise in the last six months. The exclusion criteria included not observing the principles of RF (more than two days), not participating in the exercise program (more than one session), and unwillingness to continue the study. According to this, eight subjects from the experimental groups were excluded from the study (five of these people had not fasted for more than two days, and three of the subjects did not participate in the training). Finally, statistical analysis was performed on 30 subjects (ten subjects in each group).

At first, the subjects completed individual and health history questionnaires. Before starting the research, the study's objectives were explained to the subjects, and informed consent was obtained. This study was implemented based on the ethical principles of working with human subjects and under the supervision of the Ethics Committee of Shahrekord University (IR.SKU.REC.1401.013). Blood samples were collected from all subjects two to three days before the commencement of RF and training and one day following the conclusion of the protocol, at 8 to 9 am, after the subjects had fasted for a minimum of eight hours overnight. Then, the samples were subjected to biochemical analysis following the preparation of serum samples by centrifuging them at 3000 rpm for ten minutes.

Anthropometry and body composition were evaluated the day before the study and two days after the RF and exercise protocol completion. Body composition was measured using the body tech device (MAGIC/ J0402/ Guangdong, China). Height, weight, and body mass index (BMI) were calculated separately using standard devices and procedures.

Fasting Protocol

The fasting protocol for the RF and RF+CRT groups consisted of 13:30 to 14:30 hours of fasting (about 5- 4:20 am to 6:30- 6:50 pm) and about 9:30 to 10:30 hours of unfettered access to food and fluids, seven days per week for four weeks. Amidst the investigation, the control group participants conducted their daily routines with unrestricted access to nourishment and water [10].

Circuit Resistance Training Protocol

The RF+CRT group performed the circuit resistance training protocol thrice a week for four weeks. The subjects performed essential warm-up and cool-down at the beginning and end of each session. The main training course consisted of a circular design with eight stations (exercise), 40 seconds of training, 20 seconds of rest, three repetitions, and 30-45 minutes. The activities included integrated resistance exercises (simultaneous upper and lower limb exercises, multi-joint movements, core stability exercises, coordination, and balance exercises). These exercises included Sit-to-stand with elbow flexion, Push-ups, Crunches with rotation, Dumbbell swing, Front pulldown with squat (Elastic bands), Good morning, Side-lying hip abduction, and Airplane. The Borg rating of perceived exertion (RPE) scale (6-20) was used to ensure the appropriate form of exercise and its intensity. The intensity of the exercise was set at the limit of 15-18 on the Borg scale [21].

Lipid Profile Assay

The serum lipid profile was evaluated using special kits for each factor and a photometric method (Byrex Fars kit for measuring TC and TG and Pars Azmoun kit for measuring LDL and HDL).

Statistical Analysis

In the statistical analysis of the data, mean statistics and standard deviation were used to describe the data. The Shapiro-Wilk test was utilized to check the normality of the data distribution. A one-way analysis of variance (ANOVA) was employed to assess differences among groups during the pre-test phase. The changes in the post-test phase were examined using the analysis of covariance (ANCOVA) test, with the pre-test variables being regarded as covariate variables. In addition, the dependent t-test was used to compare the group in the pre- and post-test phases. Statistical analysis was performed with IBM SPSS 25 software at a significance level of P<0.05.

Table 1. Between-group differences at baseline

Characteristics	C	RF	RF+CRT	P-value
Age (years)	28.6 ± 6.88	31.5 ± 8.24	26.9 ± 3.83	0.093
Height (cm)	176.3 ± 4.92	176.2 ± 6.12	176.5 ± 6.24	0.99
Weight (kg)	77.29 ± 13.05	78.55 ± 12.18	76.56 ± 9.57	0.93
BMI (kg/m2)	24.82 ± 3.73	25.31 ± 3.98	24.65 ± 2.5	0.886
Body fat (%)	21.62 ± 4.24	23.79 ± 6.22	20.33 ± 3.63	0.286
LBM (kg)	56.81 ± 7.06	55.99 ± 4.92	57.32 ± 5.58	0.88
Chol. (mg/dl)	170.1 ± 23.82	165.9 ± 33.09	156.1 ± 52.79	0.709
TG (mg/dl)	106.1 ± 39.37	98.7 ± 45.97	137.9 ± 84.38	0.315
LDL-C (mg/dl)	99.8 ± 19.92	97.9 ± 32.6	85 ± 34.98	0.494
HDL-C (mg/dl)	49.9 ± 6.66	48.2 ± 6.36	44.7 ± 3.31	0.203

C: Control Group, RF: Fasting Group, RF+CRT: Fasting + Exercise group. BMI: Body Mass Index; LBM: Lean Body Mass, Chol.: Cholesterol, TG: Triglyceride, LDL-C: Low Density Lipoprotein, HDL-C: High Density Lipoprotein. Data are presented as mean ± SD.

Results

The subjects were men aged 20 to 45 years with age 30±7 years, height 176.33±5.5cm, initial weight 77.46±11.32, and BMI 24.9±3.3Kg.m^{-2}. The baseline characteristics data are presented in Table 1. The One-Way ANOVA showed no significant difference between the groups for measured variables at the baseline (Table 1).

The data related to pre-test and post-test and differences between groups and within groups are presented in Table 2.

Table 2. Pre and post treatment characteristics for study participants.

Variable	Time	C (n= 10)	RF (n= 10)	RF+CRT (n= 10)	B-G p. Value
Body Weight (kg)	Pre	77.29 ± 13.05	78.55 ± 12.18	76.56 ± 9.57	F= 31.36
	Post	78.49 ± 13.88	75.94 ± 11.78	74.16 ± 9.05	P= 0.001*
	W-G p. Value	0.013 ǂ	0.001 ǂ	0.001 ǂ	
BMI (kg/m2)	Pre	24.82 ± 3.73	25.31 ± 3.98	24.65 ± 2.5	F=31.77
	Post	25.20 ± 3.98	24.47 ± 3.82	23.81 ± 2.55	P= 0.001*
	W-G p. Value	0.013 ǂ	0.001 ǂ	0.001 ǂ	
Body Fat %	Pre	21.62 ± 4.24	23.79 ± 6.22	20.33 ± 3.63	F= 21.94
	Post	22.23 ± 4.41	22.24 ± 5.6	19.39 ± 3.66	P= 0.001*
	W-G p. Value	0.006 ǂ	0.001 ǂ	0.001 ǂ	
LBM (kg)	Pre	56.81 ± 7.06	55.99 ± 4.92	57.32 ± 5.58	F= 8.16
	Post	57.27 ± 7.38	55.28 ± 5.10	56.31 ± 5.45	P= 0.002*
	W-G p. Value	0.061	0.049 ǂ	0.005 ǂ	
Total Cholesterol (mg/dl)	Pre	170.1 ± 23.82	165.9 ± 33.09	156.1 ± 52.79	F= 4.09
	Post	183.2 ± 31.33	154.2 ± 26.68	147.1 ± 36.96	P= 0.082
	W-G p. Value	0.279	0.179	0.339	
TG (mg/dl)	Pre	106.1 ± 39.37	98.7 ± 45.97	137.9 ± 84.38	F= 2.190
	Post	122 ± 49.31	80.2 ± 31.18	127.9 ± 82.92	P= 0.132
	W-G p. Value	0.042 ǂ	0.047 ǂ	0.627	
LDL-C (mg/dl)	Pre	99.8 ± 19.92	97.9 ± 32.6	85 ± 34.98	F= 2.28
	Post	110.4 ± 29.5	93.6 ± 27.02	82 ± 22.5	P= 0.123
	W-G p. Value	0.239	0.673	0.719	
HDL-C (mg/dl)	Pre	49.9 ± 6.66	48.2 ± 6.36	44.7 ± 3.31	F= 12.21
	Post	49 ± 5.07	36 ± 8.06	34.4 ± 6.55	P= 0.001*
	W-G p. Value	0.764	0.001 ǂ	0.001 ǂ	

C: Control Group, RF: Fasting Group, RF+CRT: Fasting + Exercise group. BMI: Body Mass Index; TG: Triglyceride; HDL: High Density Lipoprotein. W-G: Within-group, B-G: Between-group. *: indicated significant difference between groups. ǂ: indicated significant within group pre-post difference.

The results showed in the between-groups comparison, there was a significant difference in body weight (F (2,26)=31.37, P<0.001, η=0.707), BMI (F (2,26)=31.77, P<0.001, η=0.710), and BF% (F (2,26)=21.94, P<0.001, η=0.628) variables. Post-hoc test showed that compared to the control group, body weight, BMI, and BF% significantly decreased in the RF (P=0.001) and RF+CRT (P=0.001) groups, but no difference was observed between the experimental groups (P=0.99 in body weight and BMI, P=0.68 in BF%). Moreover, the within-group comparison showed that the body weight (P=0.013), BMI (P=0.013), and BF% (P=0.006) increased in the control groups, but these variables significantly decreased in RF (P=0.001) and RF+ CRT (P=0.001) groups.

The result showed that LBM significantly differs between groups (F (2,26)=8.16, P=0.002, η=0.386). In comparison to the control group, LBM significantly decreased in RF (P=0.018) and RF+ CRT (P=0.002) groups, but there was no difference between fasting and RF+ CRT groups (P=0.99). Compared to the pre-test, LBM in the control group did not change (P=0.061), but in the RF (P=0.049) and RF+ CRT (P=0.005) groups, it significantly decreased in the post-test.

The analysis showed the total cholesterol did not change between groups (F (2,26)=4.9, P=0.082, η=0.240), so there were no differences between the control group with RF (P=0.070) and RF+ CRT (P=0.052) groups. Moreover, we did not observe changes within groups (Table 2). Likewise, TG had no differences between groups (F (2,26)=2.19, P=0.132, η=0.144). Nevertheless, within-group analysis showed TG increased in the control group (P=0.042) and decreased in the RF group (P=0.047). In addition, the LDL-C variable did not change significantly (F (2,26)=2.28, P=0.123, η=0.149). The point to consider is the significant change in the HDL-C variable (F (2,26)=12.21, P=0.001, η=0.484), and the posthoc test revealed that compared to the control group, RF (P=0.001) and RF+ CRT (P=0.001) significantly decreased HDL-C. Additionally, HDL significantly decreased in RF (P=0.001) and RF+ CRT (P=0.001) groups in posttest data compared to the pretest.

Discussion

This study aimed to investigate the simultaneous effect of fasting and exercise on the body composition and lipid profile of healthy and sedentary men. According to the present study's findings, a significant reduction in body composition indicators (weight, BMI, body fat, and muscle mass) was observed after 30 days of RF alone or in conjunction with CRT training. The findings corroborated the results of Togba et al. (2019) regarding the impact of fasting on body composition. Specifically, they observed that RF decreased body fat percentage, body weight, and body mass in young men in good health [22]. Similarly, Nachvak et al. (2019) reported a significant decrease in body weight, lean body mass, and body fat percentage after RF in middle-aged men [23]. Some studies have shown that caloric restriction through RF does not significantly reduce the variables related to body composition, which contradicts the present study's results [24]. This finding is inconsistent with the results of Tinsley et al. (2020), who reported significant increases in body weight and lean body mass following eight weeks of caloric restriction [25]. The possible reasons for this contradiction in the findings may be differences in age, sex, eating habits, geographical conditions, and economic status [26].

In the context of the simultaneous effect of fasting and physical activity, the results of the present study were under the findings of Attarzadeh et al. (2013), which showed reduced body weight, BMI, and waist-to-hip ratio following four weeks of RF and aerobic training in women aged 20 to 45 [27]. Similarly, Wilson et al. (2018) reported a significant decrease in the variables of weight, fat mass, and absolute and relative muscle strength after eight weeks of intermittent fasting and intense intermittent exercise in obese rats [28]. The combination of RF, CRT, and RF alone in the present study caused a decrease in muscle mass, which indicates their contradictory effect on muscle mass, possibly due to the failure to adopt a suitable nutritional pattern for fasting people. Therefore, some studies have suggested that nutritional interventions can improve muscle mass during fasting. In this regard, Rodriguez et al. (2022) showed that nutritional planning and taking supplements along with proper rest can lead to the improvement of muscle mass during the fasting period [29].

Fat cells are the source of inflammatory cytokines such as interleukin one and 6. Excessive secretion of these cytokines is associated with inflammation, obesity, and other health problems. The results of the recent study showed that RF, with changes in the time of liquid consumption, reduction in the frequency of meals, and hormonal changes, reduces inflammatory cytokines and is a potential solution for mitochondrial adaptations, autophagy, and, as a result, improving body composition [30]. In addition, RF in the early morning hours is characterized by the predominance of carbohydrates as the primary fuel and is associated with decreased glycogen reserves. In the afternoon hours and approaching Iftar time, with a reduction of glycogen reserves, fat fuel and, finally, protein become more critical and are used as more essential fuels. These cases seem to be the primary mechanism for reducing body weight, body fat, and BMI [16].

Regarding the effect of CRT, some studies have shown that this type of training can improve body composition, muscle strength, and endurance. Of course, the changes depend on the circuit training type and the rest of the duration. The rest interval ≤1 minute had significant improvement in body composition [19]. Another point is that the combination of aerobic and strength in circuit training also affected its results, so it has been observed that this combined training decreased skinfold measurements, waist circumference, and waist-to-hip ratio [19]. Domingo et al. (2021) also reported that CRT reduces fat mass (average of 4.3%) and increases muscle mass (average of 1.9%) in studies on people aged 18 to 65 [18]. On the other hand, another meta-analysis study (Buch et al., 2017) in older and middle-aged adults reported that CRT, despite improving strength, had no apparent effect on LBM and aerobic capacity [17]. Therefore, the difference in the subjects' age and gender is another issue that should be considered when interpreting the results.

The second part of this study showed that 30 days of RF or RF together with CRT led to a non-significant decrease in total cholesterol, TG, and LDL-C levels and a significant reduction in HDL-C levels. The results of different studies about the effect of RF on lipid profile values are inconsistent, and the changes in blood lipids are not constant and are affected by other factors. Prasetya et al. (2021) found a slight decrease in total cholesterol, TG, and LDL-C following RF in non-athletic young men aged 19 to 40 [31]. Akhtar et al. (2020) indicated that RF significantly reduces the levels of total cholesterol, TG, and LDL-C in middle-aged men [32]. The possible reasons for these inconsistencies may be related to the quality and quantity of food consumed, the geographical area, and the degree of weight changes. Therefore, the weight loss of the participants in this study may not be enough to cause significant changes in lipid profile values [33].

The results of different studies regarding the combined effect of RF and exercise training on lipid profile values are different, and various factors are influential. The results of the present study were in line with the findings of Denna et al. (2019), who reported a non-significant decrease in total cholesterol, TG, and LDL-C levels after ten weeks of favorite physical activity and caloric restriction in the diet in healthy men [34]. Contrary to the present study's findings, Khan et al. (2012) showed that 30 days of RF and aerobic exercise increase total cholesterol and LDL-C levels in people over 20 with type 2 diabetes. These researchers stated that drug interventions, sleeping and waking patterns, and diet are of fundamental importance for diabetic patients. The biochemical changes caused by these interventions may have adverse effects [35]. In this regard, Attarzadeh et al. (2014) found a significant reduction in total cholesterol, TG, and LDL-C levels following 30 days of RF and four weeks of physical activity (two wrestling sessions, two wrestling technique review sessions, one aerobic training session, and one weight lifting) [36].

The noteworthy point in the present study was the significant reduction of HDL-C levels in both the RF and RF+CRT groups compared to the control group. The underlying mechanism of this reduction may be related to the type of diet consumed and its biochemical responses. In addition, some studies have stated that the circadian rhythm of RF is not the same as the circadian rhythm in a normal state, and this can lead to different hormonal responses [37]. Contrary to the results of the present study, ten weeks of circuit training using 50–60% of 1RM could increase HDL-C [19]. The duration of the exercise intervention was another influential factor that should be considered.

The reasons for heterogeneity in different studies can be personal approaches, the duration of calorie restriction and the duration of the protocol, age, sex, and fitness level of people. Moreover, some researchers have suggested that nutritional prescriptions should be adjusted based on factors related to the clinical conditions of each person, the amount of daily activity, and nutritional preferences [38]. Thus, intermittent energy restriction for 12 weeks consisting of 16 hours of calorie restriction with free access to only water and no food or caloric drinks, followed by an energy-restrictive diet tailored to each individual, significantly improved lipid profiles. The noteworthy point in this research was the prescription of nutritional patterns according to the individual characteristics of each person and the duration of the nutritional protocol [39]. On the other hand, the fasting duration is one limiting factor. Evidence from a study of animal models exposed to IF showed that IF has the potential to mediate interactions between diet, metabolism, and circadian rhythm. This ability of IF may be due to the 24-hour duration of its calorie restriction. Further, the results of this research stated that an unhealthy eating pattern may overshadow the results of IF. Regarding RF, changes in the sleep-wake cycle and biochemical responses related to it, the duration of fasting, and the amount of calories consumed should be considered [38]. In addition, the difference in the duration of studies and the difference in the type of exercise and nutritional protocol can be considered other essential factors. In this regard, a clinical trial investigated the effect of six months of caloric restriction alone and combined with aerobic exercise. They reported that some risk factors for cardiovascular diseases were significantly reduced. The amount of TG in both groups significantly decreased. The amount of LDL decreased in both groups, although this decrease was more significant in the combined group. In addition, the researchers stated that some of the metabolic benefits of the study occurred after six months [40]. In summary, various factors affect body composition and lipid profile, and more care should be given to interpreting the results and comparing studies.

Conclusion

Based on the results, inactive middle-aged men whose body composition (body weight, BMI, and body fat percentage) was improved and reduced through one month of Ramadan fasting or fasting combined with circuit resistance training. However, the blood lipid profile was not significantly affected. Lean body mass and HDL-C were decreased considerably after fasting and exercise interventions, which is an additional noteworthy finding of this research.

Conflicts of Interest

The authors declared no conflict of interest.

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