Effects of Ramadan Fasting on Inflammatory Biomarkers and Body Composition in Healthy Subjects

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A R T I C L E I N F O	A B S T R A C T
	Introduction: During Ramadan, adult Muslims abstain from drinking and eating from sunrise to sunset. This religious practice influences individuals' lifestyle factors such as eating behavior, meal schedule, and sleep pattern. These changes may affect endocrine and neuroendocrine circadian patterns, and consequently, cardiovascular indices. This study was performed to investigate the effects of Ramadan fasting on serum high-sensitivity C-reactive protein (Hs-CRP) and homocysteine as the risk factors for cardiovascular disease and body composition in the Iranian population. **Methods:** Healthy volunteers who fasted at least during 20 days of Ramadan were included in the study. Body composition and biochemical markers were measured pre- and post-Ramadan fasting. For normally distributed parameters, paired samples t-test was performed for analyzing the differences between the results, and Wilcoxon Signed Ranks test was run for non-normally distributed parameters. All the data was analyzed by SPSS, version 11.5. **Results:** Fifty-one healthy participants with the mean age of 36±10 years were enrolled in this study. Our analyses showed a reduction in body mass index (BMI) and fat mass pre- and post-Ramadan fasting. However, lean body mass and total body water remained unchanged by fasting. Variation in the serum Hs-CRP and homocysteine were not statistically significant. The results were the same across genders. **Conclusion:** Our study demonstrated that Ramadan fasting may lower fat mass in fasting volunteers with no adverse effects on inflammatory biomarkers of cardiovascular disease.

Introduction

Ramadan fasting is one of the most important Islamic practices. Healthy Muslims are obliged to fast from dawn to dusk during Ramadan (1). This religious act may influence individuals' lifestyle during this month, as they abstain from eating, drinking, smoking, and sexual intercourse while fasting. These habitual changes have physiological and biochemical effects (2), which in turn, influence endocrine and neuroendocrine circadian patterns (3). Several studies pinpointed variations in the concentration and circadian rhythms of biological parameters (2-5) and cardiovascular risk factors (i.e., blood pressure, heart rate, vascular tone) during Ramadan (3,6,7).

All these habitual alterations along with sleep time changes lead to environmental signals, which may stimulate the immune system and central stress axis (8). Elevation of serum levels of high-sensitivity C-reactive protein (Hs-CRP) is associated with high risk of vascular events. Epidemiological studies suggested that serum level of Hs-CRP is a predictor of future cardiovascular events, such as myocardial infarction, among individuals without history of cardiovascular disease (9, 10).

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Homocysteine (Hcy) is a non-protein α-amino acid. It is a homologue of cysteine, differing by an additional methylene bridge. Hyperhomocysteinemia is linked to early development of cardiovascular disease and is an independent risk factor for atherosclerosis and endothelial malfunction in healthy subjects (11, 12). The current study was carried out to investigate the effects of Ramadan fasting on serum levels of Hs-CRP and Hcy (as inflammatory cardiovascular biomarkers) and body composition in the Iranian population.

Material and methods
Subjects
This is a before and after study that was conducted on 10-50-year-old healthy volunteers who fasted at least during 20 days of Ramadan. The exclusion criteria included history of endocrine and neuroendocrine problems, any kind of acute or chronic infection, smoking, pregnancy, breastfeeding, following a special nutritional regimen, and consumption of nutritional supplements.

Method
One week before Ramadan and one week after Ramadan, brachial blood samples were taken after at least 12 h fasting. After serum separation, the samples were frozen at –70°C before examination. Serum Hs-CRP and Hcy were analyzed for all the participants using standard methods at baseline and one week after Ramadan fasting (13). Body composition and anthropometric parameters, including body weight, body mass index (BMI), and abdominal fat mass, were assessed by Tanita BC 418 Body Composition Analyzer (Tanita, Tokyo, Japan), based on the standard protocol. Trained practitioners measured anthropometric parameters such as height and waist circumference in both phases. Prior to the study, approval of the Ethics Committee of Mashhad University of Medical Sciences and informed consent from the subjects were obtained.

Statistical analysis
Kolmogorov-Smirnov test was used to determine normal distribution of the data. Paired samples t-test was performed for analyzing the differences between results for normally distributed parameters and Wilcoxon Signed Ranks test for non-normally distributed parameters. The relationship between dichotomous and quantitative variables was assessed by independent samples t-test. Quantitative data was expressed as mean±SD for normally distributed parameters and med (Q1-Q3) for non-normally distributed parameters. All the analyses were conducted by using SPSS, version 11.5. P-value less than 0.05 was considered statistically significant.

Results
Subjects
This study was conducted in Ramadan 2015, Mashhad, Iran. Fasting duration ranged between 16 h and 16 h and 45 min. The mean of fasting days was 26.5 (range: 23 to 30 days). Fifty-one volunteers, including 16 (31.4%) males and 35 (68.6%) females, with the mean age of 35.92±10.06 years participated in the study.

Inflammatory biomarkers
As shown in Table 1, there were no statistically significant changes in the serum levels of Hs-CRP and Hcy after Ramadan fasting (P=0.23 and P=0.80, respectively). These comparisons were also conducted based on gender (Table 2), revealing no significant differences between inflammatory biomarkers during the experiment across genders.

Body composition
As demonstrated in Table 3, there was a statistically significant reduction in BMI, fat mass, and trunk fat after Ramadan fasting (P<0.001, P=0.03, and P=0.01, respectively). Nevertheless, lean body mass and total body water were unaffected by fasting in the studied population (P=0.36 and P=0.81, respectivel).

Table 1. Comparison of inflammatory biomarkers pre- and post-Ramadan fasting

Biomarkers	Pre-Ramadan Median (Q1-Q3)	Post-Ramadan Median (Q1-Q3)	*P*-value
Homocysteine (μmol/dl)	11.7 (9.7-13.9)	11.5 (9.5-13.7)	0.8
High-sensitivity C reactive protein (mg/dl)	1.3 (0.79-2.2)	1.5 (0.86-2.3)	0.23

Table 2. Comparison of changes in inflammatory biomarkers across genders

Biomarkers		Median (Q1-Q3)	P-value
Homocysteine (μmol/dl)	Men	1.7 (-3.3-11.7)	0.52
	Women	2.1 (-3.5-13.6)	
High-sensitivity C-reactive protein (mg/dl)	Men	-0.28 (-1.29-0.05)	0.67
	Women	-0.05 (-0.65-0.64)	

Median (Q1-Q3) for non-normally distributed parameters
Mann-Whitney (for non-normally distributed parameters*)*

Table 3. Comparison of body composition pre- and post-Ramadan

Body composition	Pre-Ramadan mean±SD	Post-Ramadan mean±SD	P-value
Weight	69.48±13.1	68.7±13.02	0.001>
Body mass index	25.5±3.7	25.15±3.7	0.001>
Total fat mass	19.8±7.6	19.31±7.6	0.03
Total body water*	34 (31.2-41.4)	33.5 (31.6-41.5)	0.81
Fat free mass	49.02±10.9	48.9±10.5	0.36
Trunk fat	10.24±4.2	9.95±4.29	0.01
Trunk fat free mass	27.37±5.1	27.3±4.75	0.69

mean±SD for normally distributed parameters
*Median (Q1-Q3) for non-normally distributed parameters
t-test (for normally distributed parameters)
Wilcoxon (for non-normally distributed parameters)

Discussion

Our results suggested that Ramadan fasting had no adverse effects on inflammatory markers of cardiovascular risk factors and might improve BMI, body fat mass, and trunk fat mass.

Similar to our study, Nematy et al. reported no changes in inflammatory markers pre- and post-Ramadan in the Iranian population. They demonstrated that Ramadan fasting significantly improve the 10-year risk for coronary heart disease and cardiovascular risk factors (13).

However, the study by Aksungar revealed a significant decline in Hcy after Ramadan fasting in healthy subjects (11). They concluded that reduction in Hcy leads to lower IL-6 and CRP levels during Ramadan in fasting individuals (11). Hammouda et al. studied the effects of Ramadan fasting on soccer players; by exercise in the evening, they revealed that energy restriction reduced lipid and inflammatory markers of cardiovascular health (14).

Reduction of trunk fat mass can improve the risk of cardiovascular events. Also, our study demonstrates that weight loss during Ramadan fasting is mostly associated with body fat loss, not just dehydration or loss of lean body mass. This finding is important to understand the effects of Ramadan fasting (as a lifestyle) on body composition.

There is a growing body of evidence suggesting the effects of fasting on body composition parameters, however, contradictory results were obtained in this regard (15, 16). Hammouda et al. similarly showed a significant decrease in BMI and total fat mass. They also reported no significant difference in lean body mass (14). Nevertheless, Sentil in a study investigating the dietary pattern of Muslims during Ramadan in diabetic patients, reported no significant reduction in BMI (17).

Controversial results obtained from different studies could be attributed to several facts. Ramadan can occur at any time of the year, making the duration of fasting differ between 11-18 hours which effects on the individual's life style such as sleep duration and their physical activities as important factors influence on inflammatory biomarkers. Another potential hypothesis may explain variation in findings would be the considerable variations in the habitual dietary and lifestyles that might involve in onset of inflammation. It should be considered that humidity and temperature in different seasons in which Ramadan falls are potential confounders in fasting studies (18).

Conclusion

Our findings indicated that Ramadan fasting can lower body fat and trunk fat mass with no adverse effects on inflammatory markers of cardiovascular risk factors. Reduction of trunk fat mass can improve the risk of cardiovascular events. Also, this study demonstrated that weight loss during Ramadan is mostly relevant to body fat loss rather than dehydration or loss of lean

body mass. This finding is important to understand the effects of Ramadan fasting (as a lifestyle) on body composition.

Limitations of the Study

We only had two measurement phases during the study; however, conducting these assessments in the middle of Ramadan would reveal more details.

Acknowledgments

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