



The Effect of Fasting on Anthropometric Parameters and Blood Pressure Levels: A Report from Southern Iran

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ABSTRACT

Background: Ramadan is the fasting month among Muslims and the change in eating and sleep pattern can cause changes in human health.

Objectives: This study was carried out to determine the effect of fasting in Ramadan on the anthropometric parameters and blood pressure level.

Patients and Methods: This is a semi-experimental study conducted as before and after design on 93 staff of Shiraz University of Medical Sciences in 2014. The participants were selected through convenience sampling method. All the subjects were assessed for anthropometry parameters and blood pressure levels in two sections, before and after Ramadan. Data were presented as mean (SD) or number (%) for continuous or discrete variables, respectively. The data were analyzed via paired and independent t-test or Chi-square test. All the analyses were performed using the statistical Package for Social Sciences, version 17.0 (SPSS Inc., Chicago, IL, USA). P value less than 5% was considered significant.

Results: All the subjects completed the study. In this study, 93 subjects with an age range of 25 - 57 years and mean of age 37.2 ± 7.9 years participated. Among them, 49 cases (52.7%) were men. All the anthropometric parameters and blood pressure showed a significant difference; BMI: (26.1 ± 3.3 vs. 25.7 ± 3.2 , $P < 0.001$), waist circumference: (89.1 ± 11.1 vs. 87.5 ± 11.1 , $P < 0.001$), hip circumference: (101.4 ± 8.6 vs. 100.1 ± 8.5 , $P < 0.001$), systolic blood pressure (101.7 ± 12.9 vs. 99.4 ± 12.7 , $P = 0.041$), and diastolic blood pressure (72.3 ± 4.9 vs. 70.9 ± 5.3 , $P = 0.041$). In addition, decrease in body mass index ($P = 0.042$) and weight ($P = 0.03$) were significantly greater in men.

Conclusions: The data revealed that Ramadan can reduce anthropometric parameters and blood pressure levels. It was found that reduction in BMI and HC in men was significantly greater than women.

1. Background

Ramadan, the holy month in Islam, is the ninth lunar month of the Islamic calendar (1). In fact, it is the month of fasting in which the Muslims' life habits and behavior change (2). These changes include sleep cycle, physical activity, rest and eating patterns (2). In Ramadan, the times of consumption of main meals are before dawn and just after sunset (3). Fasting is a duty for healthy adult Muslims but it is not obligatory for children, menstruating women,

the sick, and travelers (4). The duration of daily fasting in Ramadan depends on two variables, geographical areas and seasons in which Ramadan occurs (5). Thus, the length of fasting can differ from 12 to 19 hours a day (5).

The changes in eating habits and sleep pattern can cause changes in the human body health including physiological and psychological changes (6). As a result, in Ramadan we can study the effects of fasting on human body health, especially metabolic changes.

Although previous studies have shown the positive effect of Ramadan on the cardiovascular risk factor as lipid profile (7), blood glucose level (8-10), and decrease in body fat (11),

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12), controversy is seen in different studies about the effect of Ramadan on body mass index (BMI) and blood pressure level (11, 13-21).

The factors that may play a role in the effects of Ramadan on human body can be physical activity, sleep pattern, smoking, duration of fasting, types of food consumption, sex, and educational level. As we observe, there is lack of information on these roles. In Ramadan, people experience a different lifestyle that most physicians recommend to their patients, especially as the first line treatment of many metabolic disorders like diabetes, hyperlipidemia and hypertension. In this month, people go on a special diet, quit smoking, change sleep habits and change their physical activity. As a result, this month can be a good time to evaluate the effect of changing lifestyle, specially diet, on parametric parameters.

2. Objectives

To find out the effect of Ramadan on anthropometric parameters and blood pressure level, we conducted this study on the healthy participants.

3. Patients and Methods

3.1. Subjects

This is a descriptive and pretest-posttest design study based on the data collected from the staff of Shiraz University of Medical Sciences. This study was done on 93 healthy Muslims in Ramadan 2015; they were selected through convenience sampling. The sample size was calculated according to a formula. The inclusion criteria were individuals who were apparently health, were in a normal metabolic state, and were fasting during Ramadan. The exclusion criteria included consumption of medication and fasting fewer than 10 days. The study was done in accordance with the Declaration of Helsinki and approved by the local ethics committee. A written informed consent was given to all the studied individuals.

3.2. Data Collection

Subjects were visited on two separate occasions, before and after Ramadan. The data gathering form contained information on the demographic data, medical history, anthropometry parameters (weight loss, BMI, wrist circumference [WC], hip circumference [HC]), and systolic and diastolic blood pressure levels. Anthropometric parameters calculations and blood pressure measurements were performed using a calibrated scale, standardized procedures and by one trained nurse. The study was run

in two stages: 1 - 5 days before Ramadan month and 1 - 3 days after the end of Ramadan.

3.3. Definition

BMI-BMI was calculated as body weight (kg) divided by squared height in meters (m²). Body weight was measured using a calibrated electronic scale (Seca Instruments Ltd., Germany). Height measurement was taken to the nearest 0.1 cm, using a portable stadiometer and without shoes, with the subject stretching to the maximum height and the head positioned in the Frankfort plane. Weight was measured by using Rassa weight scale with subjects removing shoes and in light clothing.

Waist circumference- Waist circumference was measured to the nearest 0.1 cm at the mid-point between the lower rib and the upper margin of the iliac crest in a horizontal plane by using a no stretching tape with an insertion buckle at one end.

Blood pressure- Blood pressure was measured by using aneroid sphygmomanometer. Prior to taking blood pressure readings, all subjects rested for 15 minutes in an air conditioned environment. And they did not smoke, did not have physical activity and did not drink tea or coffee 30 minutes before measuring blood pressure. Measurements were taken 2 times, on the right arm using an appropriate cuff size with short intervals between readings, and the average of them was used for analysis.

3.4. Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences software version 18.0 (SPSS Inc. Chicago, IL). Qualitative data were expressed as number and percentage and analyzed using Chi-square test. Quantitative data were presented as mean \pm standard deviation. First, we used With kolmogorov-smirnow test for checking normality and then pre- and post- Ramadan level of parameters was compared by Paired T-test. The independent samples Student T-test was used to comparing the two independent groups. A P value $<$ 0.5 was considered statically significant.

4. Results

In this study, 93 subjects with an age range of 25 - 57 years and mean age of 37.2 ± 7.9 years participated. Among them, 49 cases (52.7%) were men and 69 (74.2%) were married. Also most of the participants (61 cases, 65.6%) had Associate degree and Bachelor degree (Table 1).

Anthropometric parameters and blood pressure levels among the subjects during Ramadan were compared,

Table 1. Some Demographic Variables among the Studied Group

Baseline Characters		Mean/Number	SD/Percentage
Age (year), Mean \pm SD		37.2	7.9
Sex, n (%)	Men	49	52.7%
	Women	44	47.3%
	Single	24	25.8%
Marital state, n (%)	Married	69	74.2%
Education, n (%)	Diploma and below	18	19.4%
	M.A. and PhD degree	14	15.1%
	A.D. and B.A. degree	61	65.6%

Abbreviations: A.D, associate degree; B.A, bachelor of art; M.A., master of art; PhD, doctor of philosophy

as shown in Table 2. According to this Table, all of the anthropometric parameters evaluated in the current study showed a significant difference between before and after fasting ($P < 0.001$); BMI: (26.1 ± 3.3 vs. 25.7 ± 3.2 , $P < 0.001$), waist circumference: (89.1 ± 11.1 vs. 87.5 ± 11.1 , $P < 0.001$), and hip circumference: (101.4 ± 8.6 vs. 100.1 ± 8.5 , $P < 0.001$).

In addition, the mean systolic and diastolic blood pressure levels also showed a significant difference; the mean systolic blood pressure was 101.7 ± 12.9 before Ramadan and then it changed to 99.4 ± 12.7 after this month ($P = 0.04$). Mean diastolic blood pressure level also showed a significant difference from 72.3 ± 4.9 to 70.9 ± 5.3 from before to after Ramadan, respectively ($P = 0.04$). Table 3 compares the effect of Ramadan on the parameters between men and women. Decrease in BMI ($P = 0.042$) and weight ($P = 0.03$) had a significant difference between men and women. The mean difference of BMI was $0.5 + 0.5$ in men compared with $0.3+0.4$ in women. Mean difference weight also showed a significant difference in men ($1.5 + 1.4$) compared to women ($0.8 + 1.0$).

The decrease of systolic blood pressure levels was slightly higher in men than women, but this decrease was not significant ($P = 0.750$). The decrease of diastolic blood pressure level was slightly higher in women than men; however, the mean difference was not also significant ($P = 0.743$). According to the results, no significant changes were observed in different educational levels and marital status ($P > 0.05$).

5. Discussion

Ramadan is a holy month in Islam when Muslims abstain from eating and drinking during the day. Changes in eating pattern in this month can cause some favorable changes. Some studies have shown the effect of Ramadan on lipid profile, blood sugar and other metabolic parameters (7-10). This study assessed the effect of fasting in Ramadan on anthropometric parameters and blood pressure levels.

There are lots of controversies in studies about the effect of Ramadan on BMI and weight loss parameters such as WC

and HC. Similar to the result of the current study, several researches have reported a decrease in BMI (1, 2, 12). Some studies have shown no significant changes in BMI (22-24), while some others have revealed an increase in BMI after Ramadan (15, 18, 25). These controversies can be the result of the time of measuring these parameters (immediately after Ramadan or not).

Some theories were mentioned for the results of decreasing BMI in Ramadan. Bouhleb et al. (2006) related the decrease in BMI to dehydration as fasting people cannot drink fluid during fasting. They believed that dehydration could both decrease the body mass and fat mass (11). Another reason suggested for BMI decrease was increased utilization and consumption of the stored and accumulative body fat during fasting (20, 26). El Ati et al. also claimed that reduction in food intake caused a change in calorie consumption, so weight loss was seen (27).

Although in the present study weight loss, BMI, WC, HC significantly decreased in both genders, the decrease in BMI and HC was significantly higher in men. In the study by Fakhrzadeh, weight and BMI significantly decreased among men and waist circumference reduced in women (14). Another study reported greater weight loss during fasting in men (5). This difference between genders can be due to variations of sex hormones and gonadotropins during Ramadan. Some studies showed that the levels of sex hormones and gonadotropins such as LH, FSH, prolactin and testosterone had variations in healthy single men during Ramadan, similar to other hormones (15, 18, 28-31). Another reason that was mentioned for the higher decrease in the men's BMI was the difference in the amount of activities. During Ramadan, men have their usual outdoor activities and work; on the other hand, most women are housekeeper and their activity is just limited to indoor, so women's activity level is lower than men (5). This theory was supported by another study investigating the impact of one month fasting on weight, BMI, and body composition of active and non-active men (25). This study indicated that weight, BMI, and waist-to-hip ratio was significantly reduced more in the active groups (25).

Table 2. Comparison of the Physiologic and Anthropometric Indices before and after Fasting

Variables, Mean \pm SD	Before Fasting, n = 93	After Fasting, n = 93	P value
Weight	71.6 \pm 12.4	70.4 \pm 12.0	< 0.001
Body mass index	26.1 \pm 3.3	25.7 \pm 3.2	< 0.001
Waist circumference	89.1 \pm 11.1	87.5 \pm 11.1	< 0.001
Hip circumference	101.4 \pm 8.6	100.1 \pm 8.5	< 0.001
Systolic blood pressure	101.7 \pm 12.9	99.4 \pm 12.7	0.041
Diastolic blood pressure	72.3 \pm 4.9	70.9 \pm 5.3	0.041

Table 3. The Effect of Fasting on the Physiologic and Anthropometric Indices Based on Sex

Variables, Mean \pm SD	Mean Difference (Effect Size)		P value
	Men, n = 49	Women, n = 44	
Weight	1.5 \pm 1.4	0.8 \pm 1.0	0.031
Waist circumference	1.6 \pm 1.3	1.5 \pm 1.9	0.950
Hip circumference	1.7 \pm 1.7	1.1 \pm 2.0	0.160
Body mass index	0.5 \pm 0.5	0.3 \pm 0.4	0.042
Systolic blood pressure	2.6 \pm 11.6	1.9 \pm 7.7	0.750
Diastolic blood pressure	1.1 \pm 6.4	1.5 \pm 5.2	0.743

A study which was conducted on the effects of Ramadan on blood pressure levels revealed a significant decrease in systolic blood pressure, but no significant change in diastolic blood pressure was found (17). Some studies on the effects of Ramadan and fasting have demonstrated a decrease in both systolic and diastolic blood pressure (32-34). On the other hand, some studies have shown no change in blood pressure levels during Ramadan (14, 16, 19). Trepanowski JF conducted a study in the U.S. in 2010 and indicated a decrease in systolic and diastolic blood pressure among fasting Muslims (34). Janghorbani also reported that systolic and diastolic blood pressure had significantly reduced at the end of Ramadan compared to the beginning of the month (33). Similar to the results of these studies, our study demonstrated a significant decrease in both systolic and diastolic blood pressure levels after Ramadan. The reason for reduction of blood pressure during Ramadan can be reduction of weight during this month (32, 35, 36). Various researches have demonstrated that BMI and systolic and diastolic blood pressure were associated with each other (32, 37, 38). Also, Reisin et al. indicated that reduction of weight is related to a decrease in blood pressure (39). Another reason for decreased blood pressure during Ramadan is perhaps catecholamine release inhibition during hunger (40). Another reason mentioned as the result of change in the blood pressure was change in the sleep pattern. Sleeping in the middle of the day (siesta) was proved to make a change in blood pressure (40). Changing the time of medication consumption and avoiding salty diet due to reduction of thirst during fasting period were the other reasons that may contribute to reduction in blood pressure (40).

5.1. Limitations

Failure to control the potential confounders, such as physical activity, sleep duration, fasting duration, eating habits, and smoking, accounts for the controversies between different studies. Future studies must consider these factors. Also, the time of measuring the anthropometric parameter is important and it must be reported in future studies.

5.2. Conclusion

Our study revealed that fasting during Ramadan can improve physical health and reduce the anthropometric parameters. Also, we observed a significant reduction in systolic and diastolic blood pressure after fasting. Reduction in BMI and HC is higher in men than women. Therefore, further studies are recommended to manage other confounders and related factors.

5.3. Compliance with Ethical Standards

5.3.1. Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

5.3.2. Informed Consent

Informed consent was obtained from all individual

participants included in the study.

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Authors' Contribution

Leila Malekmakan, Mehrab Sayadi: design, data gathering and analysis, first and final draft; Maryam Pakfetrat and Badrosadat Moosavi: drafting; Hourii Mousavinezhad: Drafting and English Revision.

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The authors declare that they have no conflict of interest.

References

1. Al-Hourani HM, Atoum MF. Body composition, nutrient intake and physical activity patterns in young women during Ramadan. *Singapore medical journal*. 2007;**48**(10):906-10.
2. Ziaee V, Razaeei M, Ahmadijad Z, Shaikh H, Yousefi R, Yarmohammadi L, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore medical journal*. 2006;**47**(5):409-14.
3. Angel J, Schwartz N. Metabolic changes resulting from decreased meal frequency in adult male Muslims during the Ramadan fast. *Nutrition reports international*. 1975.
4. Azizi F. Islamic fasting and health. *Annals of nutrition & metabolism*. 2010;**56**(4):273-82.
5. Kul S, Savas E, Ozturk ZA, Karadag G. Does Ramadan fasting alter body weight and blood lipids and fasting blood glucose in a healthy population? A meta-analysis. *Journal of religion and health*. 2014;**53**(3):929-42.
6. Aadil N, Benyassine K, Benaji B, Benchekroun Y. EFFECT OF RAMADAN FASTING AND LIFE HABITS ON THE ANTIPYRINE TEST, URINE VOLUME AND pH. *International Journal of Pharmaceutical Sciences and Research*. 2016;**7**(4):1422.
7. Emami M, Rahimi H. Effects of Ramadan fasting on acute upper gastrointestinal bleeding due to peptic ulcer. *Journal of Research in Medical Sciences*. 2006;**11**(3):170-5.
8. AlMaatouq MA. Pharmacological approaches to the management of type 2 diabetes in fasting adults during Ramadan. *Diabetes, metabolic syndrome and obesity: targets and therapy*. 2012;**5**:109.
9. Karamat MA, Syed A, Hanif W. Review of diabetes management and guidelines during Ramadan. *Journal of the Royal Society of Medicine*. 2010;**103**(4):139-47.
10. Shephard RJ. The impact of Ramadan observance upon athletic performance. *Nutrients*. 2012;**4**(6):491-505.
11. Bouhlel E, Salhi Z, Bouhlel H, Mdella S, Amamou A, Zaouali M, et al. Effect of Ramadan fasting on fuel oxidation during exercise in trained male rugby players. *Diabetes & metabolism*. 2006;**32**(6):617-24.
12. Trabelsi K, Rebai H, El-Abed K, Stannard SR, Khannous H, Masmoudi L, et al. Effect of ramadan fasting on body water status markers after a rugby sevens match. *Asian journal of sports medicine*. 2011;**2**(3):186-94.
13. Chaouachi A, Chamari K, Roky R, Wong P, Mbazza A, Bartagi Z, et al. Lipid profiles of judo athletes during Ramadan. *International journal of sports medicine*. 2008;**29**(4):282-8.
14. Fakhrzadeh H, Larijani B, Sanjari M, Baradar-Jalili R, Amini MR. Effect of Ramadan fasting on clinical and biochemical parameters in healthy adults. *Annals of Saudi medicine*. 2003;**23**(3-4):223-6.
15. Gharbi M, Akrouf M, Zouari B. [Food intake during and outside Ramadan]. *Eastern Mediterranean health journal = La revue*

- de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit*. 2003;**9**(1-2):131-40.
16. Kassab S, Abdul-Ghaffar T, Nagalla DS, Sachdeva U, Nayar U. Interactions between leptin, neuropeptide-Y and insulin with chronic diurnal fasting during Ramadan. *Annals of Saudi medicine*. 2004;**24**(5):345-9.
 17. Mazidi M, Rezaei P, Chaudhri O, Karimi E, Nematy M. The effect of Ramadan fasting on cardiometabolic risk factors and anthropometrics parameters: A systematic review. *Pakistan journal of medical sciences*. 2015;**31**(5):1250-5.
 18. Meckel Y, Ismaeel A, Eliakim A. The effect of the Ramadan fast on physical performance and dietary habits in adolescent soccer players. *European journal of applied physiology*. 2008;**102**(6):651-7.
 19. Ramadan J. Does fasting during Ramadan alter body composition, blood constituents and physical performance? *Medical principles and practice : international journal of the Kuwait University, Health Science Centre*. 2002;**11** Suppl 2:41-6.
 20. Ramadan J, Telahoun G, Al-Zaid NS, Barac-Nieto M. Responses to exercise, fluid, and energy balances during Ramadan in sedentary and active males. *Nutrition*. 1999;**15**(10):735-9.
 21. Tayebi SM, Hanachi P, Niaki AG, Ali PN, Ghaziani FG-a. Ramadan fasting and weight-lifting training on vascular volumes and hematological profiles in young male weight-lifters. *Global Journal of Health Science*. 2010;**2**(1):160.
 22. Laajam MA. Ramadan fasting and non-insulin-dependent diabetes: effect on metabolic control. *East African medical journal*. 1990;**67**(10):732-6.
 23. Sulimani RA, Laajam M, Al-Attas O, Famuyiwa FO, Bashi S, Mekki MO, et al. The effect of Ramadan fasting on diabetes control in type II diabetic patients. *Nutrition Research*. 1991;**11**(2-3):261-4.
 24. Yucel A, Degirmenci B, Acar M, Albayrak R, Haktanir A. The effect of fasting month of Ramadan on the abdominal fat distribution: assessment by computed tomography. *The Tohoku journal of experimental medicine*. 2004;**204**(3):179-87.
 25. Hejazi K, Nikroo H, Attarzadeh Hosseini R, Nematy M. Comparing the Effect of Fasting and Physical Activity on Active and Non-active Males' Body Composition, Serum Osmolarity Levels and Some Parameters of Electrolytes. *SSU Journals*. 2012;**20**(3):371-82.
 26. Aziz AR, Wahid MF, Png W, Jesuvadian CV. Effects of Ramadan fasting on 60 min of endurance running performance in moderately trained men. *British journal of sports medicine*. 2010;**44**(7):516-21.
 27. el Ati J, Beji C, Danguir J. Increased fat oxidation during Ramadan fasting in healthy women: an adaptative mechanism for body-weight maintenance. *The American journal of clinical nutrition*. 1995;**62**(2):302-7.
 28. Abbas SM, Basalamah AH. Effects of Ramadhan fast on male fertility. *Archives of andrology*. 1986;**16**(2):161-6.
 29. Bakir S, AL-Attas O, Kordy M, Gader A, Muzrachi A, Mohammady I. The effect of Ramadan fast on the diurnal change of total calcium, parathyroid hormone and calcitonin. *Med J Cario Univ Gune*. 1994;**62**(2):485-90.
 30. Hosain R, Ismil R, editors. Effect of Ramadan on plasma renin, aldosterone and cortisol concentration in Malaysian Moslems. 2nd International congress on health and Ramadan; 1997.
 31. Sajid KM, Akhtar M, Malik GQ. Ramadan fasting and thyroid hormone profile. *JPMA The Journal of the Pakistan Medical Association*. 1991;**41**(9):213-6.
 32. Dewanti L, Watanabe C, Sulistiawati, Ohtsuka R. Unexpected changes in blood pressure and hematological parameters among fasting and nonfasting workers during Ramadan in Indonesia. *European journal of clinical nutrition*. 2006;**60**(7):877-81.
 33. Janghorbani M. Effect of islamic fasting on body weight, blood pressure, electrolytes, blood cell count and certain serum biochemical variables in males. *Journal of Kerman University of Medical Sciences*. 1995;**2**(4):183-92.
 34. Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutrition journal*. 2010;**9**:57.
 35. Adair LS. Dramatic rise in overweight and obesity in adult filipino women and risk of hypertension. *Obesity research*. 2004;**12**(8):1335-41.
 36. Capuano V, Bambacaro A, D'Arminio T, Vecchio G, Cappuccio L. Correlation between body mass index and others risk factors for cardiovascular disease in women compared with men. *Monaldi archives for chest disease = Archivio Monaldi per le malattie del torace*. 2003;**60**(4):295-300.
 37. Zibaenezhad MJ, Aghasadeghi K, Bagheri FZ, Khalesi E, Zamirian M, Moaref AR, et al. The effect of educational interventions on glycemic control in patients with type 2 diabetes mellitus. *Int Cardiovasc Res J*. 2015;**9**(1):17-21.
 38. Sayadi M, Zibaenezhad M, Ayatollahi SMT. Simple Prediction of Type 2 Diabetes Mellitus via Decision Tree Modeling. *International Cardiovascular Research Journal*. 2017;**11**(2).
 39. Reisin E, Abel R, Modan M, Silverberg DS, Eliahou HE, Modan B. Effect of weight loss without salt restriction on the reduction of blood pressure in overweight hypertensive patients. *The New England Journal of Medicine*. 1978;**298**(1):1-6.
 40. Perk G, Ghanem J, Aamar S, Ben-Ishay D, Bursztyn M. The effect of the fast of Ramadan on ambulatory blood pressure in treated hypertensives. *Journal of Human Hypertension*. 2001;**15**(10):723-5.