

Effects of Ramadan Fasting on Blood Pressure and Lipid Profile

Maryam Sadat Amirkalali Sijavandi¹, Fatemeh Shahsavan¹, Farshad Askarizadeh², Mohsen Nematy³, Javad Heravian^{4,5}, Zahra Mahmodi⁶, Tahereh Rakhshandadi⁶, Mohamad Reza Sedaghat^{7*}

1. Nutrition Research Group, Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2. PhD Candidate of Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran
3. Associated Professor of Nutrition, Biochemistry and Nutrition, Endoscopic and Minimally Invasive Surgery, and Cancer Research Centers, Department of Nutrition, School of medicine, Mashhad University of Medical Sciences, Mashhad, Iran
4. Professor of Optometry, Refractive Errors Research Center, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran
5. Professor of Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran
6. MSc Student of Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran
7. Associate Professor of Ophthalmology, Cornea Research Center, Khatam-Al-Anbia Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

ARTICLE INFO

Article type:
Original Article

Article History:
Received: 22 Sep 2015
Revised: 30 Oct 2015
Accepted: 2 Oct 2015
Published: 5 Nov 2015

Keywords:
Blood pressure
BMI
Body weight
Fasting
Lipid profile

ABSTRACT

Introduction: Ramadan is a holy Islamic month during which Muslims abstain from eating, drinking, and sexual intercourse for 13-17 hours a day. The aim of this study was to assess the effects of Islamic fasting during Ramadan on lipid profile and blood pressure.

Methods: This study was carried out in two phases, i.e., a week before and a week after Ramadan. Overall, 89 healthy subjects, aged 20-50 years, were enrolled in this study. Blood samples were drawn for the evaluation of lipid profile in the morning, and subjects' blood pressure was measured in the afternoon, using a digital sphygmomanometer. Statistical analysis was performed, using SPSS version 16.0.

Results: A week after Ramadan, body weight and body mass index decreased in both genders, compared to a week before Ramadan ($P < 0.001$). Diastolic blood pressure in male subjects and systolic blood pressure in both genders remained unchanged ($P = 0.634$ and $P = 0.412$, respectively), whereas in females, diastolic blood pressure significantly decreased ($P = 0.002$). During Ramadan, no significant changes were observed in subjects' lipid profile, triglyceride level, low-density lipoprotein cholesterol (LDL-C), or LDL/high-density lipoprotein cholesterol (HDL-C) ratio; however, a substantial decline was reported in total cholesterol and HDL-C levels.

Conclusion: The decline in total cholesterol may reduce the risk of cardiovascular diseases, induced by decreased HDL-C concentration. However, further research is required to reach a more definitive conclusion.

► Please cite this paper as:

Amirkalali Sijavandi MS, Shahsavan F, Askarizadeh F, Nematy M, Heravian J, Mahmodi Z, Rakhshandadi T, Sedaghat MR. Effects of Ramadan Fasting on Blood Pressure and Lipid Profile. *J Fasting Health*. 2015; 3(3): 126-131.

Introduction

Muslim population is currently estimated at 1.6 billion people, accounting for 23.4% of the world's population. This number is speculated to reach 6.1 billion people by 2030 (26.4% of the world's population) (1). Ramadan is a holy Islamic month for Muslims, which necessitates 13-17 hours of fasting per day for a period of 29-30 days (2, 3).

During Ramadan, Muslims refrain from drinking, eating, smoking, and sexual intercourse from sunrise to sunset. By sunset (Iftar), they can resume eating and drinking until dawn (Sahar) (4-7). Obviously, fasting affects the body through making changes in physiological parameters. In the Islamic lunar

calendar, Ramadan may fall in different months of the year. The duration of this month varies in different seasons, which may result in variations in the findings of conducted studies (4, 8, 9).

Cardiovascular diseases account for 30% of all deaths around the world (10). Based on some previous studies, changes in blood pressure and lipid profile are positively correlated with the prevalence of cardiovascular diseases. These changes are in fact among the most prevalent cardiovascular risk factors (11-14).

Based on a study by Do Prado Junior et al., individuals with an altered nutritional status are more likely to experience hypertension and changes in total cholesterol (TC), low-

* Corresponding author: Mohamad Reza Sedaghat. Associate Professor of Ophthalmology, Cornea Research Center, Khatam-Al-Anbia Hospital, Mashhad University of Medical Sciences, Mashhad, Iran. E-mail: SedaghatMR@mums.ac.ir

© 2015 mums.ac.ir All rights reserved.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

density lipoprotein (LDL), triglyceride (TG), and high-density lipoprotein (HDL) levels, compared to healthy individuals (12). However, despite the imposed limitations in drinking and eating during fasting, adequate nutritional intake during feasting (from sunset to sunrise) can maintain the nutritional balance of the body (15).

According to a study by Janghorbani, serum TG level decreased by the end of Ramadan, although this decline was not statistically significant; on the other hand, an increase was reported in TC and LDL concentrations (16). In another study by Salah Mansi in Jordan, increased HDL and decreased LDL levels were reported by the end of Ramadan. However, the reduced TC and increased TG levels were not statistically significant (17).

Additionally, Pirsahab et al. noted a significant increase in TC, LDL-cholesterol (LDL-C), and HDL-cholesterol (HDL-C), while a decline was reported in TG level, following Ramadan fasting. Moreover, increased systolic blood pressure (SBP) and decreased diastolic blood pressure (DBP) were reported in this study (15). On the contrary, based on previous research, both SBP and DBP decreased during Ramadan fasting (17), whereas SBP and DBP remained unchanged during Ramadan, as reported by a previous study (18).

Each year, many Muslims fast during the month of Ramadan. People are always concerned about the adverse impacts of fasting on body balance and changes in physiological parameters, which lead to repeated physician visits in this month. Despite the diversity of conducted studies in this area, the reported findings have been inconsistent. Therefore, in this comprehensive study, we aimed to investigate the effects of fasting on lipid profile and blood pressure in summer when the duration of fasting is prolonged. By conducting such studies, physicians are enabled to give proper medical advice to individuals.

Material and Methods

This study was performed in two phases, i.e., a week before and a week after Ramadan, in Mashhad, situated in northeast of Iran (June-July 2015). In total, 100 subjects within the age range of 20-50 years, who intended to fast during Ramadan, were recruited. The subjects

were selected by distributing posters in Mashhad University of Medical Sciences (MUMS). The ethical approval was obtained from MUMS Ethics Committee (grant number: 940149).

The inclusion criteria were as follows: 1) being a healthy adult; 2) 20-50 years of age; 3) intention to fast for at least 20 days during Ramadan; and 4) willingness to participate in the study. The exclusion criteria were as follows: 1) background conditions (e.g., diabetes mellitus and hypertension); 2) use of certain medications or special drugs; and 3) lack of involvement in the second phase of the study.

Finally, the study population was calculated to be 89 subjects (male: 51, female: 38). The mean age of the participants was 34.97 years (35.50 and 34.26 years in male and female subjects, respectively). In this study, the duration of fasting was approximately 17 hours a day in summer.

Blood samples were drawn for lipid profile measurements in the morning in both phases (with at least 12 hours of fasting). Biochemistry tests were performed by Hitachi 717 Analyzer (Japan). Blood pressure was measured in all the participants in the afternoon (16:00-19:00 pm), using a digital sphygmomanometer (Microlife, BP AGI-20, Japan).

Statistical analysis was performed, using SPSS version 16.0 (IBM Company, Chicago, USA). For normally distributed data, paired sample t-test was applied. Wilcoxon signed-rank test was performed for non-parametric data. In this study, P-value less than 0.05 was considered statistically significant.

Results

The present study was conducted on 89 participants (male: 51, female: 38) to investigate the effects of Islamic fasting in Ramadan on lipid profile, SBP, and DBP. As previously stated, the mean age of the participants was 34.97 years. Measurements were performed a week before and a week after Ramadan. Some anthropometric parameters including body weight (kg), height (m), and body mass index (BMI) (kg/m²) were calculated, as well.

The mean weight and BMI of the subjects before Ramadan are presented in Table 1. Our findings indicated a 0.97 kg decline in weight (1.06 kg in males and 0.87 kg in females) and a 0.33 kg/m²

decline in BMI. The mean weight, BMI, and blood pressure of both genders before and after Ramadan are presented in Table 2. The decline in weight and BMI was statistically significant in both genders ($P < 0.001$). As indicated in Table 2, changes in male participants were more significant than females. SBP remained unchanged in both genders, whereas a remarkable decline was reported in DBP in female participants.

Changes in lipid profile were evaluated during Ramadan (Table 3). TC level significantly decreased during Ramadan ($P = 0.040$). Moreover, HDL-C concentration significantly diminished in the participants ($P = 0.018$). In our study, in a week after Ramadan, a slight decline

was observed in the level of LDL-C ($P = 0.822$), whereas LDL/HDL-C ratio ($P = 0.370$) and TG level ($P = 0.186$) slightly increased, comparing a week before Ramadan; however, the changes were not statistically significant.

Table 1. Anthropometric data before Ramadan

	Male	Female
Number (frequency)	51 (57.3%)	38 (42.7%)
Age	35.50±8.93	34.26±9.40
Weight (kg)	84.68±14.40	68.07±13.71
Height (m)	1.74±0.06	1.60±0.05
BMI (kg/m ²)	27.71±4.57	26.34±5.22

Paired sample t-test was used for normally distributed data. The values are expressed as mean±SD

Table 2. Effects of Ramadan fasting on weight, body mass index (BMI), and blood pressure

	A week before Ramadan	A week after Ramadan	P-value
Weight (kg)	77.59±16.28	76.62±15.84	<0.001
Male	84.68±14.40	83.62±13.95	0.005
Female	68.07±13.71	67.22±13.23	0.012
Body mass index (kg/m ²)	27.12±4.83	26.79±4.73	<0.001
Male	27.71±4.57	27.37±4.45	0.005
Female	26.34±5.22	26.01±5.04	0.013
Systolic blood pressure (mmHg)	11.64±1.11	11.55 ± 1.01	0.412
Male	11.91±1.00	11.96±0.91	0.744
Female	11.28±11.77	11.01±0.90	0.085
Diastolic blood pressure (mmHg)	8.05±0.56	7.93±0.82	0.126
Male	8.11±0.47	8.16±0.87	0.634
Female	7.96±0.67	7.62±0.78	0.002

Paired sample t-test was used for normally distributed data. Values are expressed as mean±SD.

*Wilcoxon signed-rank test was used for the data, which were not normally distributed. The mean values are reported (95% CI).

Table 3. Effects of Ramadan fasting on lipid profile

	A week before Ramadan	A week after Ramadan	P-value
Cholesterol (mg/dl)	178.36±35.24	182.89±35.32	0.040
Male	182.25±36.21	185.68±35.45	0.255
Female	173.13±33.67	179.15±35.27	0.069
Triglyceride* (mg/dl)	123.07 (109.76-136.39)	133.96 (115.92-152.00)	0.186
Male	133.15 (114.85-151.45)	152.37 (123.56-181.17)	0.152
Female	109.55 (90.24-128.85)	109.26 (93.94-124.57)	0.700
LDL-C (mg/dl)	110.38±28.79	109.92±30.25	0.822
Male	115.70±28.59	113.47±28.22	0.375
Female	103.25±27.84	105.15±32.55	0.590
HDL-C (mg/dl)	42.76±7.94	41.53 ± 6.98	0.018
Male	40.88±7.08	39.66±5.92	0.076
Female	45.28±8.40	44.05±7.57	0.123
LDL/HDL ratio	2.62±0.69	2.66±0.68	0.370
Male	2.85±0.66	2.86±0.63	0.796
Female	2.31±0.60	2.39±0.65	0.348

Paired sample t-test was used for normally distributed data. Values are expressed as mean±SD.

*Wilcoxon signed-rank test was used for the data, which were not normally distributed. The mean values are reported (95% CI)

Discussion

This study was performed in two phases to assess the effects of Ramadan fasting on lipid profile, SBP, and DBP. The results showed a significant decline in weight and BMI in male and female participants. Based on the findings, changes observed in male subjects were more substantial than female subjects.

Similar results were reported in a study by Fakhrzadeh (18). Moreover, in a study by Norouzy et al., measurements were performed a week before and a week after Ramadan. Weight and BMI significantly decreased in almost all subjects, although a more remarkable decline was reported in male subjects ≤ 35 years of age (19). Consistent with our findings, several studies have confirmed the effects of fasting on weight loss and BMI (20-23). However, in a study by Radhakishun on 25 obese adolescents, BMI remained unchanged after Ramadan and six weeks after the end of this month (24).

In our study, changes in SBP were not significant in neither of the genders, whereas DBP significantly decreased in female participants. In previous studies, similar findings have been reported regarding DBP in male subjects and SBP in both genders (18, 25, 26). In 2012, Nematy et al. carried out a study in Iran on 82 volunteers with at least one cardiovascular risk factor. A significant decline was reported in SBP, whereas DBP did not significantly change (27).

In a study by Salahuddin in 2014, both SBP and DBP remarkably decreased during Ramadan (28). However, Pirsahab indicated an increase in SBP and a decline in DBP in Kermanshah, Iran (15). This discrepancy between the present findings and the mentioned studies could be attributed to various factors such as seasonal changes and type of foodstuffs consumed during Ramadan.

Our results showed a statistically significant decline in cholesterol and HDL levels. We also observed an inconsiderable rise in LDL/HDL-C ratio and a decline in LDL concentration. TG level did not significantly change a week after Ramadan in comparison with the pre-Ramadan period. Boumediene et al. conducted a study to survey the effects of Ramadan fasting on serum components in obese women with type II diabetes. The results showed a significant decrease in HDL-C, TC, TG, and LDL-C levels during Ramadan fasting, compared to the non-

fasting period; these results were in line with the present findings (29).

Ziaee et al. found a significant decline in HDL and an increase in LDL level, although no significant changes were reported in neither TC nor TG concentration (20). In contrast with our findings, some studies have reported a remarkable rise in HDL level (30-32); however, in one previous study, no changes were reported in HDL concentration (16). Similar results were reported in a study by Trepanowski and Bloomer in 2010 on the effects of Ramadan fasting on TC level and LDL/HDL-C ratio (23). Additionally, some previous studies have reported consistent findings (18, 27, 33).

As discussed earlier, our findings showed a slight decline in LDL-C level and a slight increase in LDL/HDL-C ratio and TG level; however, the observed changes were insignificant. Many studies have confirmed the decline in LDL level, induced by Ramadan fasting (18, 33, 34), whereas contradictory findings have been reported in some studies (24, 35). Similar to some previous studies, in the present research, no significant rise occurred in TG level by the end of Ramadan (17, 36). Moreover, Shaheena in 2012 demonstrated a substantial decrease in TG and LDL levels, while no remarkable decline was observed in TC concentration; on the other hand, a significant increase was observed in HDL level by the 26th day of Ramadan (26).

Moreover, a meta-analysis on the effects of Ramadan fasting on healthy individuals in 2014 reported an increase in HDL concentration and a decline in LDL level, while TC, TG, and body weight remained unchanged in females. However, LDL and TC levels substantially decreased in males, while an insignificant reduction was reported in TG level and weight loss (37).

Conclusion

Based on our findings, body weight and BMI significantly decreased in both genders; this decline was more considerable in male participants. SBP in both genders and DBP in males remained unchanged, whereas decreased DBP was reported in females. Lipid profile measurements a week after Ramadan showed diminished levels of TC and HDL-C levels, while no changes were reported in TG level, LDL-C concentration, or LDL/HDL-C ratio during Ramadan, compared to a week before Ramadan.

This decline in TC level might diminish the risk of cardiovascular diseases, induced by the decreased concentration of HDL-C. The conflicting results on the effect of fasting on different parameters, especially lipid profile and blood pressure, may be attributed to seasonal changes in Ramadan, fasting duration, geographical and climatic differences, and even variations in eating habits. Therefore, further research is suggested to help researchers reach a more definitive conclusion by eliminating the confounding factors.

Acknowledgment

The authors would like to thank the Vice Chancellor for Research at MUMS for the cooperation and financial support.

References

- Lazenby M, Khatib J, Al-Khair F, Neamat M. Psychometric properties of the Functional Assessment of Chronic Illness Therapy--Spiritual Well-being (FACIT-Sp) in an Arabic-speaking, predominantly Muslim population. *Psychooncology*. 2013; 22(1):220-7.
- Rouhani MH, Azadbakht L. Is Ramadan fasting related to health outcomes? A review on the related evidence. *J Res Med Sci*. 2014; 19(10):987-92.
- Azizi F. Islamic fasting and health. *Ann Nutr Metab*. 2010; 56(4):273-82.
- Nowroozzadeh MH, Mirhosseini A, Meshkibaf MH, Roshannejad J. Effect of Ramadan fasting in tropical summer months on ocular refractive and biometric characteristics. *Clin Exp Optom*. 2012; 95(2):173-6.
- Koktekir BE, Bozkurt B, Gonul S, Gedik S, Okudan S. Effect of religious fasting on tear osmolarity and ocular surface. *Eye Contact Lens*. 2014; 40(4):239-42.
- Kerimoglu H, Ozturk B, Gunduz K, Bozkurt B, Kamis U, Okka M. Effect of altered eating habits and periods during Ramadan fasting on intraocular pressure, tear secretion, corneal and anterior chamber parameters. *Eye*. 2010; 24(1):97-100.
- Heravian J, Nematy M, Yazdani N, Azimi A, Ostadimoghaddam H, Yekta A, et al. Comprehensive Evaluation of dehydration impact on ocular tissue during Ramadan fasting. *J Fast Health*. 2015; 3(1):11-8.
- Vasan SK, Karol R, Mahendri NV, Arulappan N, Jacob JJ, Thomas N. A prospective assessment of dietary patterns in Muslim subjects with type 2 diabetes who undertake fasting during Ramadan. *Indian J Endocrinol Metab*. 2012; 16(4):552-7.
- Shalaei N, Motaghedi Larijani A, Mohajeri SAR, Norouzy A, Nematy M, Sheikhol Vaezin F, et al. Changes in dietary intake during Ramadan in north east of Iran population. *J Fast Health*. 2013; 1(1):19-22.
- Thabane L, Kaczorowski J, Dolovich L, Chambers LW, Mbuagbaw L, CHAP Investigators. Reducing the confusion and controversies around pragmatic trials: using the Cardiovascular Health Awareness Program (CHAP) trial as an illustrative example. *Trials*. 2015; 16(1):387-94.
- Feldt-Rasmussen U, Wilton P, Jonsson P, KIMS Study Group. Aspects of growth hormone deficiency and replacement in elderly hypopituitary adults. *Growth Horm IGF Res*. 2004; 14(Suppl A):S51-8.
- do Prado Junior PP, de Faria FR, de Faria ER, Franceschini Sdo C, Priore SE. Cardiovascular risk and associated factors in adolescents. *Nutr Hosp*. 2015; 32(2):897-904.
- Chavan VU, Ramavataram D, Patel PA, Rupani MP. Evaluation of serum magnesium, lipid profile and various biochemical parameters as risk factors of cardiovascular diseases in patients with rheumatoid arthritis. *J Clin Diagn Res*. 2015; 9(4):1-5.
- Upadhyay RK. Emerging risk biomarkers in cardiovascular diseases and disorders. *J Lipids*. 2015; 2015:1-50.
- Pirsaheb S, Pasdar Y, Navabi SJ, Rezaei M, Darbandi M, Niazi P. Fasting consequences during Ramadan on lipid profile and dietary patterns. *J Fast Health*. 2013; 1(1):6-12.
- Janghorbani M. Effect of islamic fasting on body weight, blood pressure, electrolytes, blood cell count and certain serum biochemical variables in males. *J Kerman Univ Med Sci*. 1995; 2(4):183-92.
- Mansi KMS. Study the effects of Ramadan fasting on the serum glucose and lipid profile among healthy Jordanian students. *Am J Appl Sci*. 2007; 4(8):565-9.
- Fakhrzadeh H, Larijani B, Sanjari M, Baradar-Jalili R, Amini MR. Effect of Ramadan fasting on clinical and biochemical parameters in healthy adults. *Ann Saudi Med*. 2003; 23(3-4):223-6.
- Norouzy A, Salehi M, Philippou E, Arabi H, Shiva F, Mehrnoosh S, et al. Effect of fasting In Ramadan on body composition and nutritional intake: a prospective study. *J Hum Nutr Diet*. 2013; 26(Suppl 1):97-104.
- Ziaee V, Razaee M, Ahmadinejad Z, Shaikh H, Yousefi R, Yarmohammadi L, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore Med J*. 2006; 47(5):409-14.
- Al-Hourani H, Atoum MF. Body composition, nutrient intake and physical activity patterns in young women during Ramadan. *Singapore Med J*. 2007; 48(10):906-10.

22. Dewanti L, Watanabe C, Sulistiawati E, Ohtsuka R. Unexpected changes in blood pressure and hematological parameters among fasting and nonfasting workers during Ramadan in Indonesia. *Eur J Clin Nutr.* 2006; 60(7):877-81.
23. Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutr J.* 2010; 9(1):57-66.
24. Radhakishun N, Blokhuis C, van Vliet M, von Rosenstiel I, Weijer O, Heymans M, et al. Intermittent fasting during Ramadan causes a transient increase in total, LDL, and HDL cholesterol and hs-CRP in ethnic obese adolescents. *Eur J Pediatr.* 2014; 173(8):1103-6.
25. Beltaifa L, Bouguerra R, Ben SC, Jabrane H, El-Khadhi A, Ben RM, et al. [Food intake, and anthropometrical and biological parameters in adult Tunisians during fasting at Ramadan]. *East Med Health J.* 2001; 8(4-5):603-11.
26. Kamal S, Ahmad QS, Sayedda K, ul Haque M. Effect of Islamic fasting on lipid profile, total protein and albumin on healthy Muslim male subjects of Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh. *Nat J Med Res.* 2012; 2:407-10.
27. Nematy M, Alinezhad-Namaghi M, Rashed MM, Mozhdehifard M, Sajjadi SS, Akhlaghi S, et al. Effects of Ramadan fasting on cardiovascular risk factors: a prospective observational study. *Nutr J.* 2012; 11(1):69-75.
28. Salahuddin M, Sayed Ashfak A, Syed S, Badaam K. Effect of Ramadan fasting on body weight, (BP) and biochemical parameters in middle aged hypertensive subjects: An Observational Trial. *J Clin Diagn Res.* 2014; 8(3):16-8.
29. Khaled BM, Bendahmane M, Belbraouet S. Ramadan fasting induces modifications of certain serum components in obese women with type 2 diabetes. *Saudi Med J.* 2006; 27(1):23-6.
30. Al-Shafei AI. Ramadan fasting ameliorates arterial pulse pressure and lipid profile, and alleviates oxidative stress in hypertensive patients. *Blood Press.* 2014; 23(3):160-7.
31. Lamine F, Bouguerra R, Jabrane J, Marrakchi Z, Ben Rayana M, Ben Slama C, et al. Food intake and high density lipoprotein cholesterol levels changes during ramadan fasting in healthy young subjects. *Tunis Med.* 2006; 84(10):647-50.
32. Roky R, Houti I, Moussamih S, Qotbi S, Aadil N. Physiological and chronobiological changes during Ramadan intermittent fasting. *Ann Nutr Metab.* 2004; 48(4):296-303.
33. Meo SA, Hassan A. Physiological changes during fasting in Ramadan. *J Pak Med Assoc.* 2015; 65(5 Suppl 1):S6-S14.
34. Adlouni A, Ghalim N, Benslimane A, Lecerf JM, Saile R. Fasting during Ramadan induces a marked increase in high-density lipoprotein cholesterol and decrease in low-density lipoprotein cholesterol. *Ann Nutr Metab.* 1997; 41(4):242-9.
35. Hallak MH, Nomani M. Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. *Am J Clin Nutr.* 1988; 48(5):1197-210.
36. 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. *J Relig Health.* 2014; 53(3):929-42.
37. Kul S, Savaş E, Öztürk ZA, Karadağ G. Does Ramadan fasting alter body weight and blood lipids and fasting blood glucose in a healthy population? A meta-analysis. *J Relig Health.* 2014; 53(3):929-42.