

Effects of Ramadan fasting on anthropometric measures, blood pressure, and lipid profile among hypertensive patients in the Kurdistan region of Iraq

SAGE Open Medicine
Volume 8: 1–6
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DOI: 10.1177/2050312120965780
journals.sagepub.com/home/smo



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Abstract

Objective: This study was employed to assess the effects of Ramadan fasting on anthropometric measures, blood pressure, and lipid profile among hypertensive patients.

Method: This cross-sectional study was conducted among a representative sample, which was selected using a census survey of hypertensive patients (both gender, aged 25–50 years, on regular antihypertensive drugs (atenolol: 50 mg orally once a day)), during Ramadan month that was falling in April to May 2020. The patients were receiving care at Halabja hospital in the Kurdistan region of Iraq. All patients were assessed in two phase's baseline (a week before Ramadan) and end stage (a week after Ramadan), using anthropometric indices, physical examination, biochemical tests, and a structured questionnaire. Statistical analysis was performed using SPSS version 21.

Results: A total of 120 hypertensive patients were included in the study (50% females and 50% males), with a mean age of 37.5 ± 6.6 years. The major finding of our study was the significant decrease in blood pressure ($P < 0.001$). Furthermore, the body weight, body mass index, and waist circumference of the participants decreased after Ramadan fasting in a significant approach ($P < 0.001$ for all). However, for the lipid profile components, the total cholesterol, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol change persisted not statistically significant ($P > 0.05$), while only triglyceride decreased drastically after Ramadan fasting ($P < 0.001$).

Conclusion: Ramadan fasting could contribute in the improvement of blood pressure and lowers triglyceride levels, body weight, body mass index, and waist circumference of adult hypertensive patients.

Keywords

Anthropometric measures, blood pressure, Kurdistan, lipid profile, Ramadan fasting

Date received: 5 July 2020; accepted: 22 September 2020

Introduction

Hypertension and dyslipidemia are each considered biomarkers for metabolic syndrome, and predispose to increase the risk of cardiovascular disease (CVD),¹ but the two are seriously altered because their combined effects are multiplied rather than added.² It has been confirmed that CVD is the leading cause of death in the world, and most people with CVD have a high level of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglyceride (TG) and a low level of high-density lipoprotein cholesterol (HDL-C).³ In addition, a positive strong association between blood pressure

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(BP) and dyslipidemia has been reported in many epidemiological investigations;^{4–6} however, the outcome has frequently been conflicting with the population subgroup⁷ and other shows little significant.⁸ Because of being overweight, change in lifestyle, physical inactivity, unhealthy diet, and increased life expectancy, the prevalence of hypertension is anticipated to increase in developing and developed countries.⁴

Based on the previous research, there is a growing interest regarding the health implication of fasting during Ramadan. The estimated period of fasting time is different and it depends on the geographical location, starting from dawn to dusk. During this period, a healthy adult Muslim abstains from any kind of eating and drinking. Obviously, fasting influence the body through creating changes in human physiological parameters which may result in a variety of lipid profile and hypertension.⁹ Other shows no significant change before and after intermittent fasting in hypertensive patients under treatment; this may be due to different lifestyles and various dietary intakes in addition to duration of fasting.¹⁰ To estimate the beneficial effect of restricted dietary fat and saturated fat for CVD,¹¹ the effect of fasting has been reviewed extensively in metabolic regulation and improvement of lipid profile,^{12,13} and occasional BP.¹⁴ Decreased BP during the fasting period has been reported, but unfortunately, it increased after eating again in a previous study.¹⁵ A part of conflict and few studies regarding the effect of Ramadan fasting on the hypertensive patient under treatment, no study has investigated the effect of long-term fasting effect during spring in Kurdish Iraqi hypertensive Muslim patients under treatment. The purpose of this study was to assess the effects of fasting on anthropometric measures, BP, and lipid profile in diagnosed hypertensive patients.

Methodology

Study participants

This cross-sectional study was conducted among a representative sample, which was selected using a census survey of hypertensive patients on regular antihypertensive drugs (atenolol: 50mg orally once a day), during Ramadan month that was falling in April to May 2020, with an average fast of 16 ± 1 h and maximum temperature was 42–48°C. Patients were receiving care at Halabja hospital in the Kurdistan region of Iraq. All patients were assessed in two phase's baseline (a week before Ramadan) and end stage (a week after Ramadan), using anthropometric indices, physical examination, biochemical tests, and a structured questionnaire. Patients came to the clinic in the morning for data collection. In addition, all measurements and attempts before and after Ramadan were made at the same time of the day and under the same conditions. Furthermore, a pilot study was carried out on 20 patients to enable the researcher to examine the tools of the study. The questionnaire and data collection process were modified according to the results of the pilot study.

Inclusion and exclusion criteria

Eligibility criteria for participants having hypertension were based on the Joint National Committee (JNC)-7 criteria,¹⁶ adults aged 25–50 years, both gender, and living in Halabja (Kurdistan region of Iraq). Individuals, who were using any kind of medications except antihypertension drugs (atenolol: 50mg orally once a day), were not included in this study. Participants with both types of diabetes, renal problems, history of bariatric surgery; participants who were taking weight loss medications; pregnant women; smokers or people who drink alcohol; and women with menstrual cycle during data collection were excluded. Furthermore, eligible individuals who did not follow at least 25 days of fast were also excluded from the study.

Sample and sampling technique

In the present study, a representative sample was selected using a census survey as all patients with the inclusion criteria in our hospital were selected for the study. A total of 156 individuals were invited to participate in the current study, of which 20 individuals did not respond to the invitation and 16 individuals did not meet the inclusion criteria pertaining to the current study. At the end, a total of 120 patients with hypertension were included in the present study (60 males and 60 females).

Biochemical assessments

Fasting blood samples were collected at baseline and at the end of the holy month of Ramadan intervention after 10h of overnight fasting to quantify serum levels of TC (mg/dL), TG (mg/dL), LDL-C (mg/dL), and HDL-C (mg/dL). The collected blood was allowed to stand for 30min at room temperature to allow complete clotting and clot retraction. Samples were then centrifuged at 3500r/min for 15min to extract serum.¹⁷ The serum was then used to determine the levels of TC, TG, and HDL-C. In addition, LDL-C was calculated using the Friedwald formula.¹⁸ A Mindray BS-300 chemistry analyzer instrument was used for blood chemistry analysis.¹⁹ The lipid profile components have reference ranges that are considered normal in clinical practice. In the present study, the following National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) cut-off values were used as the reference: TC < 200mg/dL, TG < 150mg/dL, LDL-C < 100mg/dL, and HDL-C > 40mg/dL in men and > 50mg/dL in women.^{20,21}

Anthropometric measurements

Weight (kg) was measured using a standard scale (seca); patients were asked to remove their heavy outer cloth, and weight was measured and recorded to the nearest 0.1kg. Height (m) was measured in all patients (patients barefooted

Table 1. Anthropometric data before Ramadan.

Variables	Total (n=120)	Male (n=60)	Female (n=60)	P value
Age (years)	37.5 ± 6.6	38.2 ± 6.8	36.9 ± 6.7	0.534
Weight (kg)	82.9 ± 15.5	83.3 ± 16.5	82.5 ± 14.9	0.873
Height (m)	1.5 ± 0.0	1.6 ± 0.1	1.5 ± 0.07	0.024
BMI (kg/m ²)	32.8 ± 5.1	31.7 ± 5.7	33.9 ± 4.3	0.076
WC (cm)	108.7 ± 10.1	110.0 ± 11.9	107.5 ± 8.05	0.030

BMI: body mass index; WC: waist circumference; SD: standard deviation.

The values are expressed as mean ± SD. The differences between means were tested by using the independent samples t test. A P value less than 0.05 was considered statistically significant.

and head upright); the height was reported to the nearest 0.5 cm. Furthermore, a stretch-resistant tape was used for measuring waist circumference (WC); WC (cm) was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest. The body mass index (BMI) was calculated as weight, divided by height squared (kg/m²).²²

Assessment of BP

BP was measured in the left arm (mm Hg) using a standard mercury sphygmomanometer with an appropriate cuff size during each interview (from the baseline to the end of study), while the patient with an empty bladder was seated after relaxing for at least 10 min in a quiet environment.²³

Statistical analysis

Statistical analysis was performed, using SPSS version 21. The normality of data was checked using Kolmogorov–Smirnov and Shapiro–Wilk tests ($P > 0.05$). The descriptive statistics of mean, standard deviation, and percentages were calculated for the entire sample. The differences between mean were tested by the independent samples t test and paired sample t test. In this study, a P value less than 0.05 was considered statistically significant.

Results

A total of 120 hypertensive patients (50% females and 50% males) were included in the study. The anthropometric data of the study population before Ramadan by sex are shown in Table 1. The results revealed that the mean age (years) for male patients was 38.2 ± 6.8 versus 36.9 ± 6.7 for females. In addition, for the following variables (height and WC), the difference was statistically significant in both sexes ($P < 0.05$).

In the present study, all measurements were performed in two phase's baseline (a week before Ramadan) and end stage (a week after Ramadan). The mean of anthropometric measure in both genders before and after Ramadan is presented in Table 2. The findings indicated a 3.5-kg decline in weight (3.9 kg in males and 3.2 kg in females) and a 2.4-cm reduction in WC (1.9 cm in males and 2.9 cm in females); the

reduction in WC in females was more than that in males, as well as a 1.4-kg/m² decline in the BMI (1.4 in males and 1.3 in females). Furthermore, the body weight, BMI, and WC of the participants decreased after Ramadan fasting in a significant approach in both sexes ($P < 0.001$ for all).

On the other hand, Table 3 shows the effects of Ramadan fasting on BP and lipid profile. BP either systolic or diastolic was significantly reduced at the end of fasting in both sexes ($P < 0.001$). Also, the TG level significantly decreased during Ramadan in both sexes ($P < 0.001$). Moreover, a reduction in the average values of TG (190.8 ± 74.9 versus 145.3 ± 38.5) and an increase in LDL-C (138.2 ± 54.9 to 139.3 ± 31.4) were observed at the end of the fast, but the differences were not statistically significant ($P > 0.05$). In addition, there was a non-significant change in HDL-C at the end of the fast ($P > 0.05$).

Discussion

To the best of our knowledge, this is the first study, which shows the effects of Ramadan fasting on anthropometric measures, BP, and lipid profile among hypertensive patients in the Kurdistan region of Iraq. The main findings of this study were the significant decrease in BP, body weight, BMI, and WC of the participants after Ramadan fasting. However, the TC, LDL-C, and HDL-C change persisted not statistically significant, while only TG decreased drastically after Ramadan fasting. High BP is a key factor in the development of CVD.²⁴ In the present study, the measurements of systolic and diastolic BP before and after Ramadan fasting shows a large decrease for both males and females in a statistically significant manner. In the literature, results similar to ours are observed. In a systematic review of five studies, Alinezhad et al.²⁵ observed a statistically significant change in systolic BP in three studies, while the other two studies showed non-significant changes; while for diastolic BP, three of the five studies showed non-significant change before and after Ramadan fasting and the other two studies reported a reduction in diastolic BP after Ramadan.²⁴

As for TG in mg/dL, there is a statistically significant decrease in the mean value before and after Ramadan fasting, indicating the effectiveness of Ramadan fasting in the reduction of higher TG levels in hypertensive patients.

Table 2. Effect of Ramadan fasting on anthropometric measure.^a

Variables	No.	Before Ramadan	After Ramadan	Changes	95% CI difference	P value
Weight (kg)	120	82.9 ± 15.56	79.4 ± 15.56	3.5 ± 4.9 (-)	2.04–4.9	0.001
Male	60	83.3 ± 16.5	79.4 ± 16.4	3.9 ± 5.5 (-)	1.4–6.3	0.003
Female	60	82.5 ± 14.9	79.4 ± 15.3	3.2 ± 4.3 (-)	1.3–5.06	0.002
BMI (kg/m ²)	120	32.9 ± 5.1	31.5 ± 5.3	1.4 ± 1.8 (-)	0.8–1.9	0.001
Male	60	31.7 ± 5.7	30.3 ± 6.01	1.4 ± 1.8 (-)	0.6–2.2	0.001
Female	60	33.9 ± 4.3	32.7 ± 4.4	1.3 ± 1.8 (-)	0.5–2.1	0.003
WC (cm)	120	108.8 ± 10.12	106.3 ± 10.14	2.4 ± 3.3 (-)	1.4–3.4	0.001
Male	60	110 ± 11.9	108 ± 11.9	1.9 ± 3.7 (-)	0.3–3.5	0.020
Female	60	107.5 ± 8.1	104.6 ± 7.8	2.9 ± 2.8 (-)	1.7–4.2	0.001

CI: confidence interval; BMI: body mass index; WC: waist circumference; (+): increase; (-): decrease; SD: standard deviation.

The values are expressed as mean ± SD.

^aThe paired sample t test was used for normally distributed data.

A P value less than 0.05 was considered statistically significant.

Table 3. Effect of Ramadan fasting on blood pressure and lipid profile.^a

Variables	No.	Before Ramadan	After Ramadan	Changes	95% CI difference	P value
SBP (mm Hg)	120	132.3 ± 8.6	123.8 ± 8.2	7.5 ± 7.2 (-)	5.3 to 9.7	0.001
Male	60	134.5 ± 6.7	127.3 ± 6.5	7.3 ± 6.1 (-)	4.6 to 9.9	0.001
Female	60	130 ± 9.8	122.3 ± 9.09	7.3 ± 8.3 (-)	4.06 to 11.4	0.001
DBP (mm Hg)	120	83.4 ± 6.07	76 ± 6.4	7.4 ± 6.5 (-)	5.4 to 9.4	0.001
Male	60	84.3 ± 7.1	77.8 ± 6	6.5 ± 6.4 (-)	3.6 to 9.3	0.001
Female	60	82.5 ± 4.8	74.1 ± 6.3	8.4 ± 6.5 (-)	5.8 to 11.3	0.001
TC (mg/dL)	120	184.2 ± 49.14	181.06 ± 35.6	3.1 ± 30.3 (-)	-6.1 to 12.3	0.499
Male	60	189.6 ± 56.7	186.9 ± 34.7	2.8 ± 38.4 (-)	-14.3 to 19.8	0.721
Female	60	178.7 ± 40.8	175.3 ± 36.2	3.5 ± 20.2 (-)	-5.5 to 12.4	0.445
TG (mg/dL)	120	190.8 ± 74.9	145.3 ± 38.5	45.5 ± 56.1 (-)	28.4 to 62.6	0.001
Male	60	200.5 ± 81.4	152.3 ± 46.4	48.2 ± 60.8 (-)	21.2 to 75.1	0.001
Female	60	181.05 ± 68.4	136.2 ± 27.8	42.8 ± 52.4 (-)	19.6 to 66.03	0.001
HDL-C (mg/dL)	120	35.09 ± 14.5	35.3 ± 11.05	0.3 ± 11.7 (+)	-3.8 to 3.3	0.888
Male	60	32.7 ± 10.5	33.04 ± 6.4	0.3 ± 9.07 (+)	-4.3 to 3.4	0.901
Female	60	37.5 ± 17.6	37.6 ± 14.07	0.2 ± 14.1 (+)	-6.4 to 6.07	0.123
LDL-C (mg/dL)	120	138.2 ± 54.9	139.3 ± 31.4	1.1 ± 39.2 (+)	-13.02 to 10.8	0.851
Male	60	140.7 ± 66.4	144.1 ± 32.3	3.5 ± 51.5 (+)	-26.3 to 19.4	0.821
Female	60	135.7 ± 41.7	134.5 ± 30.4	1.2 ± 22 (-)	-8.5 to 11	0.835

CI: confidence interval; (+): increase; (-): decrease; SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol; TG: triglyceride; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol.

The values are expressed as mean ± SD.

^aThe paired sample t test was used for normally distributed data.

A P value less than 0.05 was considered statistically significant.

Across the literature, many other studies have similar results with the present study.^{26,27} The criteria adopted for accepting of the subjects were strict, and only the pre-diagnosed hypertensive and on-medication patients were included in the final results of the study. Because of evidence that many drugs interact with antihypertensive drugs, intake of other medications may vary the status of BP;²⁵ the pregnancy may also induce hypertension in many various ways;²⁸ and in the same way, there is an established relationship between alcohol intake and hypertension, which points out alcohol intake elevates BP. However, this association is not yet elusive,²⁹

and for the sake of more accuracy and precision, individuals using drugs other than hypertension medications, people who drink alcohol or smokers, and pregnant women were all excluded from engagement in the study.

The blood specimens were withdrawn after overnight fasting, as the results of the fasting serum lipid profile test are more sensitive and reliable for the assessment of CVD.³⁰ Pre-Ramadan anthropometric measurements of the participants were taken that might help to determine the risks of high lipid profile values; literature shows that maintaining normal body weight may prevent the risk of CVD.³¹ The population included

in the study was overweight, while their weight after Ramadan diminished in a statistically significant way, which confirms the effectiveness and dependability of Ramadan fasting and body weight. The BMI and WC of the participants were measured as it has been proven that they are conversely correlated with HDL-C levels and are directly proportional to TG levels.³² The outcome mean BMI and WC values before Ramadan turned out to be higher than those after Ramadan in a statistically significant fashion; this reduction came as a result of the major variations in eating patterns of the people who fast and lower calorie intake. Generally, the females in the study were more overweight when comparing their BMI values to those of males; the reason could be referred to as the fact that males are more physically active than females. In most of the literature, there is a positive correlation between BMI and TC, TG, and LDL-C values.³³ While for HDL-C, the correlation to BMI is inversely related.³⁴ As the body values including weight and BMIs of the participants have changed during the Ramadan fasting, a considerable change in lipid profile values is expected as well. There is a minimal reduction in the mean TC value after Ramadan fasting, yet such small changes are not statistically significant as the P value is greater than 0.05. It is noteworthy to mention that the mean TC values in males are higher than those in females in both before and after Ramadan fasting. Similar results of TC and body weight could be observed in alike studies.³⁵ The LDL-C in mg/dL adopted TC's character. Although its mean values were slightly elevated after the fasting, the change was not statistically significant. This slight elevation in LDL-C results after Ramadan fasting is not seen in other similar studies; in fact, many other studies show a statistically significant decrease in LDL-C after Ramadan,^{26,27} yet, we observed reciprocal results in our findings. With a slight change in the mean HDL-C mg/dL value, this variable as well remains not affected, as the P value for this minimalistic change is not statistically significant.

The strength of the present study is that this is the first study, which shows the effects of Ramadan fasting on anthropometric measures, BP, and lipid profile among hypertensive patients in the Kurdistan region of Iraq. The main limitations of this study are its cross-sectional design, the causal relationship could not be determined, and the power analysis for sample size calculation was not done in this study, and it limits the generalizability of our results. Further future studies about the effects of dietary patterns and physical activity during Ramadan fasting on anthropometric measures including "body adiposity index (BAI)," "visceral adiposity index (VAI)," "Waist-Height Ratio (WHtR)," BP, and lipids profile among hypertensive patients are required.

Conclusion

We conclude that Ramadan fasting could contribute to the improvement of BP and lowers TG levels, body weight, BMI, and WC of adult hypertensive patients in Halabja city of the Kurdistan region of Iraq.

Acknowledgements

The authors thank the staff and participants in the Halabja hospital for their important contributions to the study.

Author contributions

H.A.M.F. (principal investigator) collected, analyzed, and interpreted the data and wrote the first draft of the manuscript. H.R.B., S.A.Q., K.K.H., and M.T. significantly contributed to the study design and the critical review of the manuscript. A.H.E.B. and A.E.A. remarkably contributed to the analysis and interpretation of data and the critical review of the manuscript. All authors approved the final manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

The study protocol was approved by the Ethics Committee of Halabja hospital, centers for control of communicable and non-communicable diseases (No. 2020-53). Furthermore, a written informed consent was obtained from the study participants.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Supplemental material

Supplemental material for this article is available online.

References

1. Peters SA, Wang X, Lam TH, et al. Clustering of risk factors and the risk of incident cardiovascular disease in Asian and Caucasian populations: results from the Asia Pacific Cohort Studies Collaboration. *BMJ Open* 2018; 8(3): e019335.
2. Chu NF, Wang DJ, Liou SH, et al. Relationship between hyperuricemia and other cardiovascular disease risk factors among adult males in Taiwan. *Eur J Epidemiol* 2000; 16(1): 13–17.
3. Mora S, Glynn RJ and Ridker PM. HDL particle concentration may better predict CVD event risk than HDL-c. *Circulation* 2013; 128(11): 1189–1197.
4. MacMahon SW, Macdonald GJ and Blacket RB. Plasma lipoprotein levels in treated and untreated hypertensive men and women. The National Heart Foundation of Australia Risk Factor Prevalence Study. *Arteriosclerosis* 1985; 5(4): 391–396.
5. Aziz KM. Association of serum lipids with high blood pressure and hypertension among diabetic patients. Mathematical regression models to predict blood pressure from lipids. An experience from 12-year follow up of more than 9000 patients' cohort. *Gen Med (Los Angeles)* 2007; 5: 297.
6. Satoh M, Ohkubo T, Asayama K, et al. Combined effect of blood pressure and total cholesterol levels on long-term risks of subtypes of cardiovascular death: evidence for cardiovascular

- prevention from observational cohorts in Japan. *Hypertension* 2015; 65(3): 517–524.
7. Castelli WP and Anderson K. A population at risk: prevalence of high cholesterol levels in hypertensive patients in the Framingham Study. *Am J Med* 1986; 80(2): 23–32.
 8. Stamler J, Rhomberg P, Schoenberger JA, et al. Multivariate analysis of the relationship of seven variables to blood pressure: findings of the Chicago Heart Association Detection Project in Industry, 1967–1972. *J Chronic Dis* 1975; 28(10): 527–548.
 9. Perk G, Ghanem J, Aamar S, et al. The effect of the fast of Ramadan on ambulatory blood pressure in treated hypertensives. *J Hum Hypertens* 2001; 15(10): 723–725.
 10. Erdem Y, Özkan G, Ulusoy Ş, et al. The effect of intermittent fasting on blood pressure variability in patients with newly diagnosed hypertension or prehypertension. *J Am Soc Hypert* 2018; 12(1): 42–49.
 11. Forouhi NG, Krauss RM, Taubes G, et al. Dietary fat and cardiometabolic health: evidence, controversies, and consensus for guidance. *BMJ* 2018; 361: k2139.
 12. Daoud E, Scheede-Bergdahl C and Bergdahl A. Effects of dietary macronutrients on plasma lipid levels and the consequence for cardiovascular disease. *J Cardiovasc Develop Disease* 2014; 1(3): 201–213.
 13. Khaled MB and Belbraouet S. Ramadan fasting diet entailed a lipid metabolic disorder among type 2 diabetic obese women. *Am J Appl Sci* 2009; 6(3): 471–477.
 14. Sabour H, Norouzi-Javidan A, Soltani Z, et al. The correlation between dietary fat intake and blood pressure among people with spinal cord injury. *Iran J Neurol* 2016; 15(3): 121.
 15. Khan NN, Siddiqui S, Ali S, et al. Effect of physical activities and obesity on Ramadan fasting among hypertensive patients. *J Fast Health* 2016; 4(4): 156–162.
 16. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. *Hypertension* 2003; 42(6): 1206–1252.
 17. Gebrie A, Gnanasekaran N, Menon M, et al. Evaluation of lipid profiles and hematological parameters in hypertensive patients: laboratory-based cross-sectional study. *SAGE Open Med* 2018; 6: 2050312118756663.
 18. Martin SS, Blaha MJ, Elshazly MB, et al. Comparison of a novel method vs the Friedewald equation for estimating low-density lipoprotein cholesterol levels from the standard lipid profile. *JAMA* 2013; 310(19): 2061–2068.
 19. El Bilbeisi AH, Hosseini S and Djafarian K. The association between physical activity and the metabolic syndrome among type 2 diabetes patients in Gaza strip, Palestine. *Ethiop J Health Sci* 2017; 27(3): 273–282.
 20. Expert Panel on Detection E. Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). *JAMA* 2001; 285(19): 2486.
 21. El Bilbeisi AH, Hosseini S and Djafarian K. Prevalence of metabolic syndrome and its components using two proposed criteria among patients with type 2 diabetes in Gaza Strip, Palestine. *BAOJ Nutrition* 2018; 4: 054.
 22. Hao W and Friedman A. The LDL-HDL profile determines the risk of atherosclerosis: a mathematical model. *PLoS ONE* 2014; 9(3): e90497.
 23. Yuki M, Hirano T, Nagata N, et al. Clinical utility of diagnostic laboratory tests in dogs with acute pancreatitis: a retrospective investigation in a primary care hospital. *J Vet Intern Med* 2016; 30(1): 116–122.
 24. El Bilbeisi AH, Hosseini S and Djafarian K. Association of dietary patterns with diabetes complications among type 2 diabetes patients in Gaza Strip, Palestine: a cross sectional study. *J Health, Populat Nutrition* 2017; 36(1): 37.
 25. Alinezhad-Namaghi M and Salehi M. Effects of Ramadan fasting on blood pressure in hypertensive patients: a systematic review. *Journal of Fasting and Health* 2016; 4(1): 17–21.
 26. El Bilbeisi AH, Hosseini S and Djafarian K. Dietary patterns and metabolic syndrome among type 2 diabetes patients in Gaza Strip, Palestine. *Ethiop J Health Sci* 2017; 27(3): 227–238.
 27. Salim I, Al Suwaidi J, Ghadban W, et al. Impact of religious Ramadan fasting on cardiovascular disease: a systematic review of the literature. *Curr Med Res Opin* 2013; 29(4): 343–354.
 28. Temizhan A, Tandogan I, Dönderici O, et al. The effects of Ramadan fasting on blood lipid levels. *Am J Med* 2000; 109(4): 341–342.
 29. Ismail WI and Haron N. Effect of Ramadan fasting on serum lipid profile among healthy students in UiTM. *Inint Conf Biol Chemical Environ Sci* 2014; 2014: 51–53.
 30. Maas R and Böger RH. Antihypertensive therapy: special focus on drug interactions. *Expert Opin Drug Saf* 2003; 2(6): 549–579.
 31. Gudeta TA and Regassa TM. Pregnancy induced hypertension and associated factors among women attending delivery service at Mizan-Tepi University Teaching Hospital, Tepi General Hospital and Gebretsadik Shawo Hospital, Southwest, Ethiopia. *Ethiop J Health Sci* 2019; 29(1): 831–840.
 32. Husain K, Ansari RA and Ferder L. Alcohol-induced hypertension: mechanism and prevention. *World J Cardiol* 2014; 6(5): 245.
 33. Nigam PK. Serum lipid profile: fasting or non-fasting? *Ind J Clin Biochem* 2011; 26(1): 96–97.
 34. Ayisi Addo S, Nti C, Vuvor F, et al. Impact of successful weight loss maintenance on serum lipids and glucose concentrations of previous participants of a weight loss programme in Accra, Ghana. *J Nutr Metab* 2019; 2019: 4729040.
 35. Kolotkin RL, Crosby RD, Gress RE, et al. Two-year changes in health-related quality of life in gastric bypass patients compared with severely obese controls. *Surg Obes Relat Dis* 2009; 5(2): 250–256.