The Effect of Ramadan Fasting on Diabetic Patients With High Risk of Cardiovascular Disease

Abstract:

One of the common questions for patients with a history of cardiovascular disease is whether it is safe for them to fast during Ramadan. Yet, studies on the effects of Ramadan fasting on blood lipids, blood pressure, anthropometric parameters and other cardiovascular risk factors are scarce, and have given inconclusive results. The aim of this study is to investigate the effect of Ramadan fasting on cardiovascular risk factors, including biochemical indices, blood pressure and main anthropometric parameters. This prospective observational study was conducted at the CCU and medical wards at Madinat Zayed hospital, one of the Al Dhafra hospitals, under Seha Abu Dhabi. Fifty-six diabetic patients admitted with cardiovascular events, including 48 males and 8 females, with a previous history of cardiovascular events completed the study. Their ages ranged between 32 and 91 years with a mean of 54.0 ± 10 years. A non-significant slight biochemical modification with regards to the metabolic profile pre, during and post-Ramadan period was reported**:** eGFR, total cholesterol, LDL, and HDL were increased, yet triglycerides and creatinine were non-significantly lower during Ramadan. The findings also showed a non-significant decrease in the post Ramadan blood pressure values that could be attributed to the metabolic switch.

Keyword: Ramadan; Fasting; Diabetes; Cardiovascular

Introduction:

Ramadan is a month during which Muslims abstain from eating, drinking and smoking from dawn to sunset. During month of Ramadan, there are changes in the quality of food and eating patterns. It might be due to the consumption of more carbohydrates and sweet foods, mainly in the form of two large meals at dawn and sunset. It has been established that a given nutrient ingested at an unusual time can induce different metabolic effects. However, the physiological changes during Ramadan are not well known.

Fasting during Ramadan is essentially a radical change in lifestyle for the period of one lunar month that may affect cardiovascular risk in patients with coronary artery disease (CAD) and cerebro-vascular disease (CVD). The most common risk factors associated with increased risk of atherosclerotic heart disease or stroke are abnormalities in plasma lipids and some coagulation and hemostatic factors, hypertension and smoking. Cardiovascular diseases are the leading cause of death worldwide.

Lipid profiles are affected by factors such as changes in dietary habits, consuming different dietary fats, increased consumption of refined sugar, and reduced physical activity. Many studies reported a significant reduction in type 2 diabetic patients' weight during Ramadan. Others reported a non-significant reduction in weight of these patients.

Bouguerra et al. showed Ramadan fasting has a moderate effect on glycaemia and lipoprotein levels in type 2 diabetic patients when previous metabolic control was quite good, but fasting induced more deterioration when previous control was poor. Although another study in Iran showed a deterioration of glycemic control after Ramadan fasting in type 2 diabetic patients, it was more evident in patients using oral hypoglycemic medication than diet-controlled patients.

Fasting is not meant to create excessive hardship for individuals who are not able to do it, the Islamic practice exempts many people from fasting, including those who are ill and for whom fasting would be harmful. One of the common questions for patients with a history of cardiovascular disease is whether it is safe for them to fast during Ramadan. Yet, studies on the effects of Ramadan fasting on blood lipids, blood pressure, anthropometric parameters and other cardiovascular risk factors are scarce, and have given inconclusive results. In current study, the effect of Ramadan fasting on cardiovascular risk factors, including biochemical indices, blood pressure and main anthropometric parameters are investigated.

Methodology:

This prospective observational study was conducted at the CCU and medical wards of Madinat Zayed hospital, one of the Al Dhafra hospitals, under Seha Abu Dhabi.

The primary outcome measure was to observe any Major Adverse Cardiovascular Events (MACE), including a combination of all-cause mortality, and myocardial infarction during the time period studied, which was assessed as one month before Ramadan, during Ramadan and one month after Ramadan, corresponding the month of Ramadan to the Gregorian calendar, as the lunar calendar is 11–12 days shorter than the solar year.

Any diabetic Muslim patient admitted to the hospital during this time between the ages of 18-80 with cardiovascular events, baseline clinical characteristics including age, gender, cardiovascular risk factors, and primary as well as secondary cardiovascular diagnoses was included in the study.

Data Collection

Qualified nurses who can speak and write both English and Arabic were recruited to administer the questionnaires and perform anthropometric measurements.

A standardized questionnaire-based face-to-face interview was conducted by the nurses to fill out the questionnaires. The questionnaire was composed of:

(a) Sociodemographic data such as age, sex, nationality, marital status, education level, occupation, height, weight, and parental consanguinity

(b) Anthropometric data such as height and weight

(c) Lifestyle habits such as physical activity and smoking status

(d) Blood pressure measurements, and

(e) Laboratory investigations, such as blood glucose, glycated hemoglobin (HbA1c), low-density and high-density lipoprotein (HDL and LDL) cholesterol, cholesterol levels, triglyceride, urea, creatinine, bilirubin, albumin creatinine ratio, etc. Data related to anthropometry and laboratory tests was filled based on actual measurements.

Anthropometric measurements like height was measured in centimeters using a height scale while the patient was standing barefoot with normal, straight posture, whereas weight was measured in kilograms using a weight scale

BMI was calculated as the ratio of weight (kg) to the square of height (m). A person was considered obese if the BMI value was at least 30kg/m2 and overweight if BMI was greater than 25kg/m2 and less than 30kg/ m2.

Blood pressure measurements

Hypertension was defined according to the WHO, which is systolic blood pressure at least 130mmHg or diastolic blood pressure at least 85mm Hg or using antihypertensive medication. Two readings of systolic blood pressure and diastolic blood pressure were taken from the participant's left arm while seated and his/her arm at heart level, using a standard zero mercury sphygmomanometer after at least 10–15 minutes of rest. Thereafter, the average of the two readings was obtained.

Lifestyle habits

Smoking habit was classified in terms of past or current smoker or nonsmoker.

Patients were classified as physically active if they reported participating in walking or cycling for more than 30 minutes per day.

All lab investigations in this study were performed in the laboratory department in Madinat Zayed Hospital – Al Dhafra region in Abu Dhabi state:

- The blood and urine specimens were collected either in phlebotomy rooms in the laboratory department or in the CCU and medical wards of MZH then sent directly to the core lab, which operates 24 hours a day.
- Blood samples were collected through venipuncture from each participant following the standard procedures of preparation and collected in BD containers (EDTA tubes, SST tubes and Li Heparin tubes).

All parameters below were measured using Auto-analyzer (cobas® 6000 analyzer-c502 and e602 modules - Roche - USA):

- Fasting blood glucose was measured by hexokinase method
- Glycosylated hemoglobin (HbA1c) levels were analyzed based on TINIA Gen.2 method with automatic calculation to report HbA1c % using formula: (A1/HB)*91.5+2.15
- Fasting Lipid Panel: (Total cholesterol, Triglyceride and HDL-c) using enzymatic colorimetric tests.

- The LDL-c was calculated using Friedewald equation: LDL-c = Total cholesterol – (HDL cholesterol +Triglyceride*0.46)
- Renal function profile: U+E includes urea, creatinine, electrolytes (sodium, potassium, chloride and bicarbonate levels). The electrolytes were analyzed using ISE method.
- Urine albumin/creatinine ratio was determined by mg/mmol considering normal values ≤ 3.00 ; eGFR using CKD-EPI auto-calculation
- Troponin levels were performed using Trop. T high sensitive STAT kits, and for proBNP II (which is diagnostic for heart failure), the sandwich principle immunoassay was used.
- Total and direct blood bilirubin using Colorimetric diazo method.

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The presence of Diabetes Mellitus was determined by the documentation in the patient's previous or current medical record of a documented diagnosis of DM that had been treated with diabetes medications.

Results

Fifty-six volunteers, including 48 males and 8 females, with a previous history of cardiovascular event completed the study. Their age ranged between 32 and 91 years with a mean of 54.0 ± 10 years. The metabolic profile of the study volunteers is shown in Table 1 and Image 1 to visualize it. The age of the participants was similar in the three groups with no statistical significance (p-value=0.38). In addition, no significant difference was seen in metabolic profile (duration of diabetes, Glycated Hemoglobin, ACR, eGFR, creatinine and blood pressure (systolic/diastolic)) means recorded at different periods. eGFR level was the highest during Ramadan compared to other periods (86.16±31.56).

Table 1. Metabolic Profile of the study subjects

Parameters	Before Ramadan	During Ramadan	After Ramadan	P value (ANOVA)
AGE	58±14.02	53.88±11.32	52.40±13.58	0.38
DURATION OF DIABETES	4.45 ±2.30	2.64 ±1.5	6.50 ±2.5	0.91
HbA1c	8.57±2.32	8.04±2.48	7.89±1.90	0.62
eGFR	56.22±34.06	86.16±31.56	73.20±46.01	0.06
CHOLESTEROL	4.56±1.11	4.62±1.17	4.70±1.46	0.94
LDL	2.57±0.83	2.77±0.94	2.56±1.09	0.79
TG	3.06±4.13	1.96±1.09	2.61±1.85	0.54
HDL	0.95±0.19	0.99±0.21	1.02±0.23	0.69
BMI	26.57±6.93	27.44±8.26	28.49±5.79	0.67
BP(Systolic)	130.26±11.61	125.8±17.99	124.40±14.87	0.86

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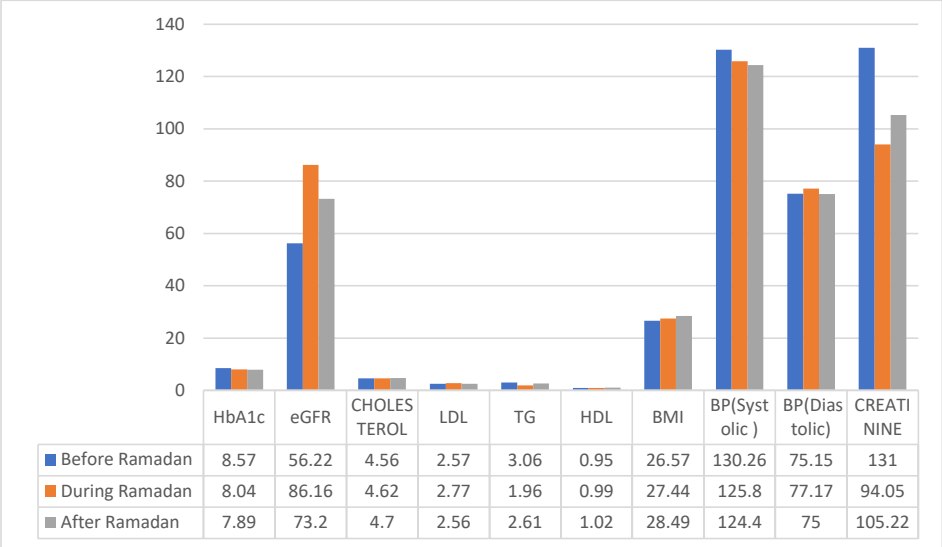
BP(Diastolic)	75.15±14.17	77.17±11.36	75±7.85	0.92
CREATININE	131±116.20	94.05±39.81	105.22±76.97	0.40



	HbA1c	eGFR	CHOLESTEROL	LDL	TG	HDL	BMI	BP(Systolic)	BP(Diastolic)	CREATININE
Before Ramadan	8.57	56.22	4.56	2.57	3.06	0.95	26.57	130.26	75.15	131
During Ramadan	8.04	86.16	4.62	2.77	1.96	0.99	27.44	125.8	77.17	94.05
After Ramadan	7.89	73.2	4.7	2.56	2.61	1.02	28.49	124.4	75	105.22

Image 1: Means of Metabolic Profile of the study subjects

Lipid profile

The values of total cholesterol, LDL and HDL were increased but it wasn't statistically significant, but the levels for triglycerides were non-significant decreased during the time intervals studied. The calendar chart for lipid profile is presented in **Figure 2.** March and May were the highest levels of lipids with a mean of 3.12 for HDL, 4.19 for cholesterol and 2.3 for LDL (Figure 3).

Figure 1 Calendar plot showing metabolic parameters during Ramadan

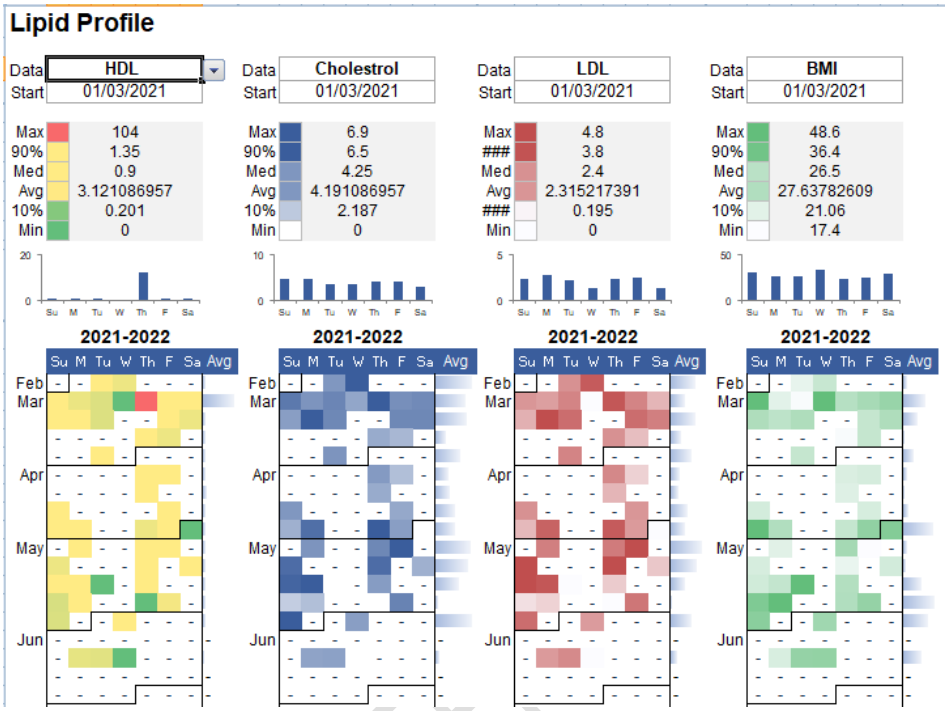


Figure 2. Calendar Plot for Lipid Profile

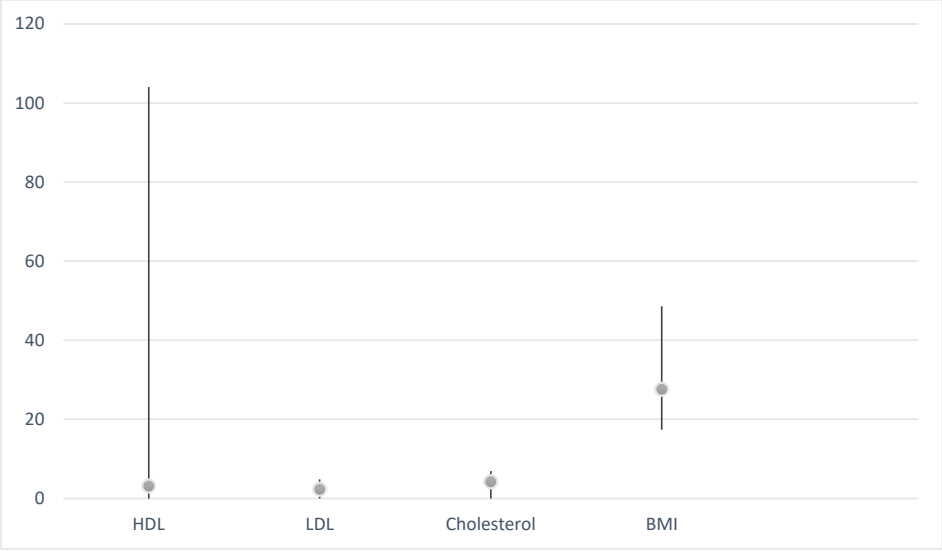


Figure 3: Mean and distribution of Lipid Profile (2021-2022)

Discussion

This study evaluated the effect of holy Ramadan fasting on the metabolic health of patients with cardiovascular risk factors.

The findings revealed slight biochemical modifications with regards to the metabolic profile of the patients, but the changes were not significant during any given time interval. We showed non-significant changes in the glycated hemoglobin pre, during and post-Ramadan period. This is in accordance with the previous studies.

We also found a non-significant decrease in the post Ramadan blood pressure values, which could be attributed to the metabolic switch (in which the body switches to use ketones for energy instead of glucose after 8–12 hours of fasting) described in a recent review on intermittent fasting. Insulin drop during the metabolic switch is suggested as the key reason behind reduced blood pressure after fasting. Blood pressure is inversely correlated with parasympathetic nervous system activity and correlated with sympathetic nervous system activity. When sympathetic nervous system activity is triggered by insulin, adrenal glands produce norepinephrine, which binds to α-receptors in the blood vessels. Consequently, vasoconstriction occurs. Also, insulin acts downstream and enhances renal tubular sodium reabsorption, which confers more water retained in circulation. As a result, blood pressure is raised. Other human and animal studies associate this reduction with the release of brain-derived neurotrophic factor, which elevates parasympathetic nervous system activity and improves insulin sensitivity.

As seen in this study, LDL-cholesterol was lower in the serum after Ramadan compared to levels before Ramadan. Also, HDL-cholesterol levels were higher in the serum at the end of Ramadan compared to levels before Ramadan. These results were in agreement with those reported by other authors on healthy persons. The previous data concerning HDL-cholesterol clearly explain the beneficial effect of Ramadan fasting on serum lipids of diabetics.

Serum total cholesterol and triglyceride levels decreased non significantly ($P > 0.05$) towards the end of the study. The increase in the glucose levels during the fasting undoubtedly reduced the catabolism and the significant mobilization of the triglycerides from peripheral tissues to plasmatic circulation. These results may also be explained by different food habits of the populations studied and the type of food consumed during Ramadan, as there is a tendency towards an increased intake of carbohydrates and fat.

At kidney level, we noted a discrete transient increase of creatinine during Ramadan compared with the basic state. At the same time, there was a transient and significant decrease of clearance

in both the overall population and diabetic patients. The same findings were noted in a Tunisian study performed in 2013 on athletes whose decrease in kidney function during Ramadan was attributed to a hydration defect that is frequent in the summer period.

This study, however, presents some limitations such as the small sample size and the fact that the participants were recruited from a single center, which affects the generalizability of the results.

Conclusion

Finally, non-significant slight biochemical modification with regards to the metabolic profile pre, during and post-Ramadan period was reported**:** eGFR, total cholesterol, LDL, and HDL were increased, yet triglycerides and creatinine were non-significantly lower during Ramadan. Findings also showed a non-significant decrease in the post-Ramadan blood pressure values, which could be attributed to the metabolic switch.

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