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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

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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 (Coronary care unit) and medical wards of Madinat Zayed hospital one of 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 event completed the study. Their age ranged between 32 and 91 years with a mean of 54.0 ± 10 years. A non-significant slight biochemical modification with regard 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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1. INTRODUCTION

"Ramadan fastening is observed by most of the 1.8 billion Muslims around the world during which they abstain from eating, drinking, and smoking from dawn to sunset" [1,2].

"During the 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" [3,4]. Additionally, during Ramadan fluid intake, is significantly altered, and sleep is delayed and shortened [5-9]. These modifications to the circadian rhythms may result in unfavorable metabolic alterations and an increased risk of complications [10,11]. "It has also been established that a given nutrient ingested at an unusual time can induce different metabolic effects; however, the physiological changes in Ramadan are not well known" [12,13].

"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 cerebrovascular disease (CVD) [14-19]. 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" [13,20].

"Lipids profile are affected by factors such as changes in dietary habits, using different dietary fats, increased consumption of refined sugar, and reduced physical activity" [21]. "Many studies reported a significant reduction in type 2 diabetic patients' weight during Ramadan" [22,23]; "while some others reported a non-significant reduction in weight of these patients" [24].

"Bouguerra et al. showed Ramadan fasting has a moderate effect on glycemia 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" [23]. "Although, another study in Iran showed a deterioration of glycemic control after Ramadan fasting in Type 2 diabetic patients that were more evident in patients using oral hypoglycemic medication than diet-controlled patients" [25].

"Fasting is not meant to create excessive hardship for individuals who are not able to do that, the Islamic practice exempts many people from fasting, including those who are ill and fasting is harmful to them" [26,27].

"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 [28,5,6,7]. Most current instructions for diabetics wishing to fast during Ramadan are based on the opinions of experts" [29]. Therefore, in current research, the effect of Ramadan fasting on cardiovascular risk factors including biochemical indices, blood pressure, and main anthropometric parameters has been investigated.

2. METHODOLOGY

This Prospective observational study was conducted at the CCU and medical wards of Madinat Zayed hospital one of 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 studied time period which was assessed as 1 month before Ramadan, during Ramadan and 1 month after Ramadan. Corresponding to the month of Ramadan in the Gregorian calendar that have been established, as the lunar calendar is 11–12 days shorter than the solar year.

Any diabetic Muslim patient admitted to the hospital during this time whose age between 32-91 years with cardiovascular events, Baseline clinical characteristics include age, gender, cardiovascular risk factors, and primary as well as secondary cardiovascular diagnoses was included in the study.

2.1 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 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 was filled based on actual measurements.

Anthropometric measurements like Height was measured in centimeters using a height scale while the patient was standing barefeet and 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/ m^2.

2.2 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 10–15min of rest. Thereafter, the average of the two readings was obtained.

2.3 Lifestyle Habits

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

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

All lab investigations in this study were performed at 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 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 of patient 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 of Heart Failure) the sandwich principle immunoassay was used.
- Total and direct blood bilirubin using Colorimetric diazomethod.

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 diabetic medications.

2.4 Statistical Analysis

Statistical analyses were performed using the SPSS 21.0 software (IBM Company, Chicago, USA). Data were checked for normality before analysis by the Kolmogorov-Smirnov test and by examining normality plots. The values of metabolic profile of the study subjects were expressed as mean ± standard deviation (SD) and compared for time period using one way ANOVA test. The A p-value ≤0.05 was considered to indicate a statistically significant difference.

3. 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 mentioned in Table 1 and Fig. 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).

3.1 Lipids Profile

The values of total cholesterol, LDL, and HDL were increased but it wasn't statistically significant, contrary the levels for triglycerides were non-significant decreased during the studied time intervals. The day wise calendar chart for lipid profile is presented in Fig. 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 (Fig. 3).

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
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

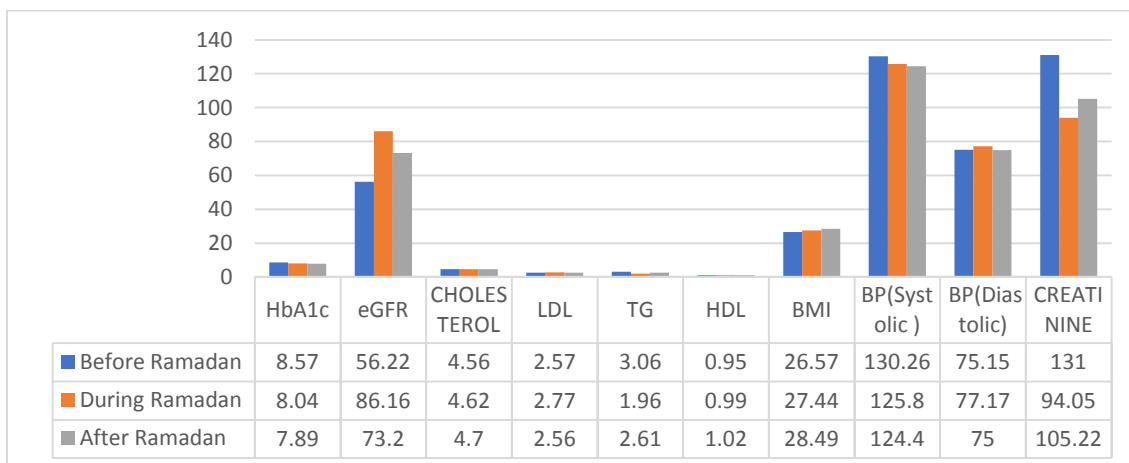|	HbA1c	eGFR	CHOLESTEROL	LDL	TG	HDL	BMI	BP(Systolic)	BP(Diastolic)	CREATININE
Before Ramadan	8.57	56.22	4.56	2.57	3.06	0.95	26.57	130.26	75.15	131
During Ramadan	8.04	86.16	4.62	2.77	1.96	0.99	27.44	125.8	77.17	94.05
After Ramadan	7.89	73.2	4.7	2.56	2.61	1.02	28.49	124.4	75	105.22

Fig. 1. Calendar plot showing metabolic parameters during Ramadan

Lipid Profile

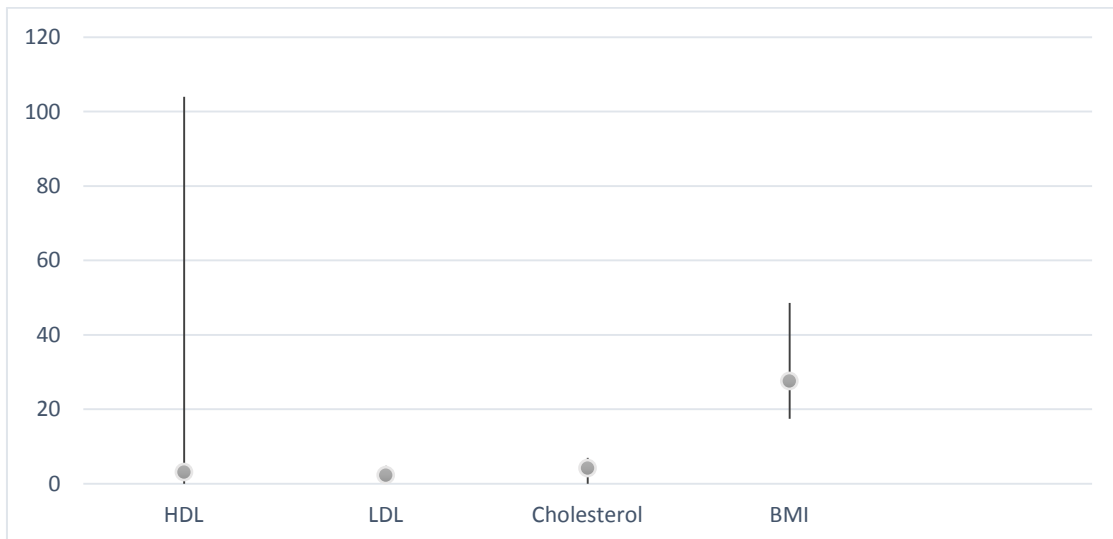**Fig. 2. Calendar plot for lipid profile**

Fig. 3. Mean and distribution of lipid profile (2021-2022)

4. DISCUSSION

This present 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 regard to the metabolic profile of the patients however 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 [30,31].

We also found a non-significant decrease in the post Ramadan blood pressure values which could be attributed to the metabolic switch (in

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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 to be 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 the sympathetic nervous system activity is triggered by insulin, adrenal glands produce norepinephrine, which binds to α-receptors in the blood vessels; consequently, vasoconstriction occurs [32]. Also, insulin acts downstream and enhances renal tubular sodium reabsorption, which confers more water retained in the circulation; as a result, blood pressure is raised [33,34]. Other human [35] and animal studies [34] associate this reduction to 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 subjects at the end Ramadan compared to levels before Ramadan. These results were in agreement with those reported by certain authors on healthy persons" [7]. The previous data concerning HDL-cholesterol explain clearly 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 be also explained by different food habits of the studied populations and the type of food consumed during Ramadan as there is a tendency towards increased intake of carbohydrate 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 on patients with cardiovascular disease during Ramadan was attributed to a hydration defect that is frequent in the summer period" [36].

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

5. CONCLUSION

Finally, non-significant slight biochemical modification with regard 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.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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