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Research Article

Effect of Ramadan Fasting on Biochemical Parameters, Dietary Intake in Type 2 Diabetes Miletus in the State of Qatar

Dr. Ghazi Daradkeh[1]* Ph.D., Dr. Hassan Abuzaid[2] MD, Dr. Mohammad Abuhmaira[2] MD, Michelle Calapano[1], Hanna Acido[1], Marwa Rustom[1], Cheryl Cajayon[1], Anna Hernando[1] and Asmaa AL-Muhannadi[1]

[1]Dietetics & Nutrition Dep, AL - Khor Hospital, Hamad Medical Corporation, Qatar

[2]Medicine Dep, Al- Khor Hospital, Hamad Medical Corporation, Qatar

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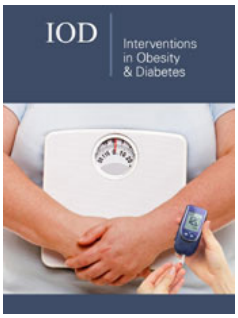

***Corresponding author:** Dr. Ghazi Daradkeh, Department of Dietetics and Clinical Nutrition, Al-Khor Hospital, Hamad Medical Corporation, Qatar, Mob: +97466256246/ E-mail: gdaradkeh@hamad.qa

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Abstract

Background: During Ramadan, type 2 diabetic Muslims abstain from eating and drinking from sunrise to sunset. This long fasting period may cause changes in blood glucose, glycosylated hemoglobin, lipid profile and other biochemical parameters, eating behaviors, and nutrient intake. The purpose of this study was to assess the effects of Ramadan fasting on nutrient intake, changes in blood sugar, lipid profile and, other biochemical parameters in type 2 diabetic patients who fasted Ramadan in the state of Qatar.

Methods: The study was conducted among 38 Muslim subjects with type 2 diabetes mellitus who undertook fasting during Ramadan. All subjects were subjected to a dietary assessment at three stages, i.e., Before Ramadan (BR), During Ramadan (DR), and After Ramadan (AR), by a trained dietician. The 24-hour dietary recall method was the tool for dietary assessment. Energy, macronutrients, sodium, and calcium intake were assessed using a 24-hour recall through a face-to-face interview in each stage. 5ml blood sample was collected to measure FBS, HbA1c, lipid profile, creatinine, BUN, sodium, and calcium were measured before, during and after Ramadan.

Results: Significant decrease in fasting blood sugar (P=0.03), HbA1c level (P=0.04), BUN (P=0.04), and creatinine (P=0.03). While the non-significant increases in lipid profile including total cholesterol, LDL-C, HDL-C and TG were noticed (P>0.05). There is no change was noticed in albumin, hemoglobin, and vitamin D. Daily consumption of energy, carbohydrate, and protein was significantly reduced during Ramadan ($p < 0.000$) when compared to before Ramadan. While fat, sodium, and calcium intake were significantly increased during Ramadan fasting ($p < 0.000$).

Conclusion: Ramadan fasting improve fasting blood sugar, HbA1-c, and some of biochemical parameters but has no effect on lipid profile. Reduce total energy and variations in macro and micronutrients intake during Ramadan fasting.

Keywords: Ramadan fasting; Energy; Intake; Dawn; Sunset

Introduction

Millions of healthy Muslims around the world avoid eating, drinking, and smoking from sunrise to sunset in the holy month of Ramadan in obeisance to God as Fasting is one of the five pillars of Islam each year. From dawn until sunset Muslims neither eat nor drink anything. Duration of fasting varies between 11 and 18 hours depending on the season and geographical location [1]. Fasting may last up to 18 hours or more in summer and northern latitudes. Muslims fasting is abstaining from oral intake including eating, drinking, oral medications as well as smoking, and intravenous fluids and nutrients [2]. As dietary patterns changed during Ramadan of about 25% of the world's population who is Muslim, the researchers are interested to study the effect of fasting on metabolic changes during and after Ramadan in healthy subjects [3,4] and in patients with diabetes [5,6], have been conflicting [7,8]. Climatic conditions, ethnicity, hours of fasting, cultural influences, physical activity,

and dietary patterns [7] are confounding variables that may cause variability in the results. Even Muslims with diabetes and other chronic diseases are exempted from fasting, when fasting may lead to harmful consequences. Many patients insist on participating in Ramadan fasting. Physicians working in Muslim communities often face a difficult task when advising patients with diabetes whether it is safe to fast, as well as recommending the proper dietary and drug regimens. Muslims eat two meals, before dawn and shortly after sunset during Ramadan fasting.

As a result of meal schedule changes, sleep and lifestyle habits changed as well [9-12]. The drug schedule during the daytime is changed because of fasting, which may influence DM patients. Obesity and type 2 Diabetes Mellitus (DM) have recently reached epidemic proportions in the countries of the Arabian Gulf because of changes in food consumption patterns [13]. The prevalence of DM in the state of Qatar as in several countries with large Muslim populations appears to be like the rates observed in western countries and is increasing by 10% per year because of rapid urbanization and socio-economic development [14]. A sedentary lifestyle with a minimum of physical activity and overconsumption of energy-dense food have been noticed among people living in Qatar in the past 20-30 years. Prevention or reduction of obesity, particularly abdominal obesity, is a main therapeutic goal in patients with type 2 DM [15]. Multimodality approach by adapting to a healthy lifestyle through diet modification, physical activity, and possible pharmacological therapy may be followed to optimally achieve weight reduction [16]. Glycemic and blood pressure control, improve insulin action, decrease fasting plasma glucose concentrations, as well as improved lipid concentrations, have been shown with a moderate weight loss of about 5% [17]. The effects of Ramadan fasting in these type 2 diabetic patients may upregulate critical anti-aging genes such as Sirtuin 1. Sirtuin 1 is defective in diabetes and low-calorie diets (fasting) and activators are involved in Sirtuin 1 activation. Sirtuin 1 is crucial to glucose homeostasis and insulin release from the pancreas. Sirtuin 1 is important to the circadian rhythm that determines hormones, glucose, and lipids [18]. There is a lack of data in Type 2 DM parameters during Ramadan fasting (Figure 1), despite a large number of Muslims worldwide meanwhile, these parameters including fasting blood glucose, glycated hemoglobin (HbA1c), and lipid profile among type 2 diabetic patients during Ramadan in the state of Qatar were the objectives of the current study.

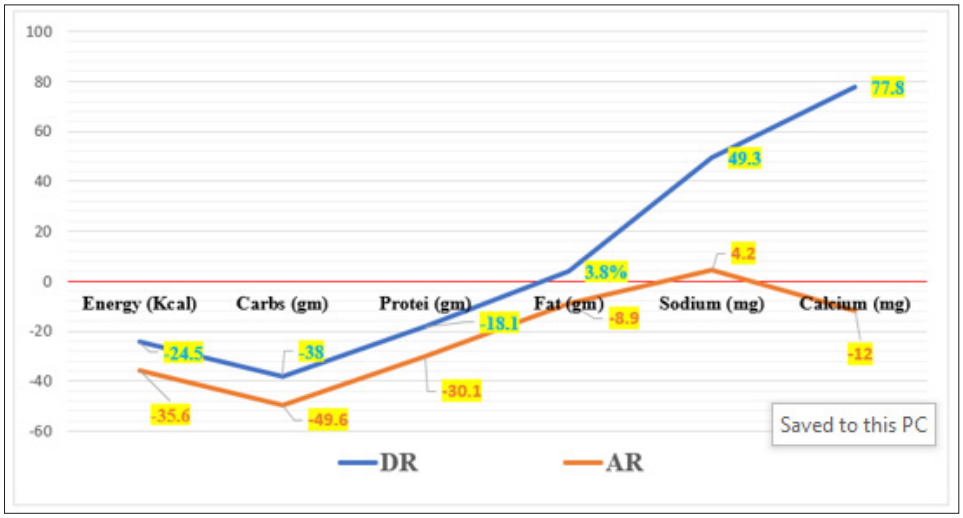

Figure 1: Progression of macro and micronutrients intake during and after Ramadan fasting.

Materials and Methods

This is a prospective observational study that was conducted among adults' Muslim type 2 diabetic patients, with no chronic diseases e.g.: renal, liver, or thyroid disease, non-pregnant, non-lactating and not receiving contraceptives women, following the dietetics clinics at Al Khor hospital - Hamad Medical Corporation - Qatar during holly Ramadan from May 2019 to June 2019. Of the total 95 eligible participants, 92 (96.7%) agreed and gave their consent to take part in this study. Ethical Committee and IRB from Medical Research Center (MRC) in Hamad Medical Corporation (protocol No.MRC-01-18-083) were obtained before commencing data collection. Three female participants were excluded because they got pregnant during the study. The confidence level of 95% and power of 80% were considered in the sample size calculation.

Data collection methods

Each participant was interviewed, and anthropometric measurements were performed by the clinical dietitians to collect the data by using a structured questionnaire including sociodemographic data such as age, sex, nationality, marital status, education level, occupation, and medical history. Anthropometric measurements: height, weight, BMI, waist circumference, hip circumference, waist-hip ratio (WHR), and waist-height ratio (WHtR). Biochemical investigations: blood glucose, Glycated Hemoglobin (HbA1c), Low-Density and High-Density Lipoprotein

(LDL & HDL), total cholesterol, triglyceride, urea, creatinine, albumin, …etc.

Anthropometric measurements

By using an electronic height scale (SECA, Germany) height was measured in centimeters with bare feet and with normal straight posture during standing. weighing scale (SECA), was used to measure weight in kilograms, (BMI) was calculated as the ratio of weight (kg) to the square of height (m). Overweight and obesity were considered when BMI is greater than 25kg/m2 and less than 30kg/m2 and greater than 30kg/m2 [19-21]. The standard method as midway between the lower rib margin and the iliac crest is used to assess Waist Circumference (WC). Medical body composition Analyzer Seca mBCA514 (Germany) was used to determine. Body composition based on actual measurements including Fat Mass (FM), Muscle Mass (MM), Fat-Free Mass (FFM), and Total Body Water (TBW), at least 2 hours fasting, and no exercise for 12 hours prior to the test each time was required.

Laboratory measurements

A blood sample of 10ml was collected through venipuncture from each participant during fasting into vacutainer tubes containing EDTA. The samples were kept at room temperature and transported within 2 hours to a central certified laboratory at AL-Khor General Hospital, HMC Doha Qatar. Blood glucose and lipid profile were measured by an autoanalyzer (Hitachi 747 autoanalyzer, Japan). Glycosylated Hemoglobin (HbA1c) was analyzed using a high-performance liquid chromatography method [22]. Plasma creatinine was analyzed using (kinetic colorimetric Jaffes method and enzymatic colorimetric method), Urea using (kinetic colorimetric assay), these tests were performed in a Roche COBAS 6000 analyzer [23], all the above-mentioned data were conducted over three stages of the study: the first stage Before Ramadan (BR), data had been collected 1-7 days prior to Ramadan; the second stage During Ramadan (DR) was conducted 14 days prior to the end of Ramadan and the third stage After Ramadan (AR) was done two weeks following the end of Ramadan. all data and questionnaires were coded accordingly. Finally, according to the purpose of the study, participants' anthropometry data, Biochemical Parameters, etc.

Dietary intake

24-hour recall was used to assess Nutrient intake in the three stages of the study one week prior to the study (Before - Ramadan), after two weeks of fasting (During - Ramadan) and two weeks later (after - Ramadan). Household measurements (slice, plates, glass, spoons, cups, etc.) and food models were used to estimate the correct quantities of each food item consumed. My Net Diary 2019 was used for nutrient analysis revised by a clinical dietitian.

Metabolic complications and hypoglycemia

No patients experienced severe hypo or hyperglycemia or any other acute metabolic complication during Ramadan fasting, but two patients had slight symptoms of hypoglycemia twice in the month of fasting. This frequency or severity of hypoglycemic events was like the non-fasting months.

Physical activity

Most participants have maintained the same physical activity; with little increase in their activity due to the extended hours of praying after the sunset.

Statistical analysis

SPSS version 21 (IBM Corp., Armonk, New York, USA) was used for data analysis using SPSS version 21 (IBM Corp., Armonk, New York, USA). Proportions were reported for nominal or ordinal variables, while the numerical variables were reported as mean values and standard deviations or medians with minimum and maximum values. Paired t-tests for normal data distribution (parametric analysis) were used to compare the numerical variables that were measured at, before, during, and after Ramadan. One-way analysis of variance (ANOVA) and repeated ANOVA was used for two independent, K-independent, and K-dependent sample analyses, respectively. A P-value below 0.05 is used for statistical significance.

Results

The current study examined biochemical parameters and dietary intake before, during, and after fasting days of Ramadan among 38 Muslim subjects with T2DM in the state of Qatar. All participants included in the study were on anti-diabetic medications either in the form of monotherapy (n=13) or combination therapy (n=25). The study participants' descriptive characteristics are shown in Table 1. The participants were middle-aged (41.6±9.2 years) with a mean BMI of 27.8±5.1kg/m2. Baseline characteristics showed that 89.5% of patients were male and 10.5% were female, three fourth of participants 71.1% were young, age <45 years; Fifteen participants (39.5%) have acceptable weight BMI <25 and 34.2% were overweight, [19-21,24,25] while 26.3% were obese. 18.4% were smokers and two-third of participants were married and with secondary education or higher level. Mean biochemical characteristics among the participants before, during, and after Ramadan are shown in Table 2. On average, fasting blood glucose and HbA1c level were significantly lower during the holy month of Ramadan as compared with before Ramadan (7.39±0.57 vs. 5.58±0.73) & (5.39±0.40 vs. 5.21±0.40) respectively ($P<0.05$ for each). Findings of this study revealed that blood lipid profile including total cholesterol, increased significantly during fasting, as compared with before Ramadan and reduced slightly after Ramadan, this increase of the final level was much higher than its initial value ($p<0.05$). While LDL-C and triglyceride increased during Ramadan fasting, and HDL-C decreased. The difference between the levels of LDL-C, TG, and HDL-C was considerably different between the three stages of the study but it was not significant. During Ramadan, TG and LDL-C showed an insignificant increase nevertheless one month following Ramadan, decreased considerably which was even higher than the initial level. While HDL-C showed an insignificant decrease during Ramadan and return to the initial level [23,24]. In the current study serum, creatinine, and blood urea nitrogen showed a significant decrease during Ramadan fasting although

re-increased one month following the end of the fasting period did not reach the initial level. While albumin, hemoglobin, and vitamin D were insignificantly decreased during Ramadan and resumed to the initial level after one month following the end of Ramadan fasting. The macronutrient and energy intake of the participants for the 3 stages of Ramadan fasting are shown in Table 3. The total energy consumption per day was significantly reduced during Ramadan when compared to before Ramadan. During Ramadan, there was a decrease in carbohydrates and protein intake then again increased one month following Ramadan (P<0.000) but did not reach the initial level. While a significant increase in fat intake was noticed during Ramadan fasting and re- increased after one month of fasting but didn't reach the initial level, on the other hand, sodium and calcium intake were increased significantly during Ramadan fasting (p<0.000). The intake of different food groups is represented in Table 3.

Table 1: Baseline characteristics of subjects who took part (n=38).

Variables	n (%)
Gender	
Male	34 (89.5)
Female	4 (10.5)
Age group	
<45	27 (71.1)
≥45	11 (28.9)
BMI	
Acceptable (<25)	15 (39.5)
Overweight (25–30)	13 (34.2)
Obesity (≥30)	10 (26.3)
Marital status	
Married	22 (57.9)
Single	12 (31.6)
Divorce	04 (10.5)
Education level	
≥secondary	23 (60.5)
<secondary	15 (39.5)
Smoking status	
Smoker	7 (18.4)
Non-smoker	31 (81.6)

Table 2: Biochemical parameters Before Ramadan (BR), During Ramadan (BR), and After Ramadan (AR) fasting. Data are expressed as (Mean±SD) P-value obtained in the ANOVA for the comparison between groups, *P<0.05.

Parameters	Before Ramadan (BR) Mean±SD n=(38)	During Ramadan (DR) Mean±SD n=(38)	After Ramadan (AR) Mean±SD n=(38)	P-Value
Fasting blood glucose (mmol/l)	7.39±0.57	6.05±0.59	5.58±0.73	0.03*
HbA1c (%)	5.39±0.40	5.09±0.42	5.21±0.40	0.04*
Cholesterol (mmol/l)	4.48±0.75	4.73±0.73	4.70±0.84	0.02*
LDL-C (mmol/l)	2.71±0.77	2.89±0.69	2.76±0.86	0.42
HDL-C (mmol/l)	1.30±0.44	1.19±0.28	1.30±0.47	0.19
TG (mmol/l)	1.22±0.93	1.39±1.15	1.29±0.95	0.45
BUN (mmol/l)	5.43±1.39	5.77±0.95	4.57±1.05	0.04
Creatinine (mmol/l)	63.80±14.86	65.60±14.90	64.27±15.45	0.03
Albumin(mmol/l)	40.14±4.40	39.95±3.30	40.12±3.93	0.92
Hemoglobin g /dl	13.90±1.59	13.31±3.23	14.0±1.41	0.23
Vitamin D	23.42±14.40	23.10±13.52	23.17±11.25	0.11

Table 3: Energy and macronutrient intake of patients Before Ramadan (BR) During Ramadan (DR) and After Ramadan (AR).

Parameters	Before Ramadan Mean±SD n=(38)	During Ramadan Mean±SD n=(38)	After Ramadan Mean±SD n=(38)	P-Value
Energy (Kcal)	2557.19±732.40	1927.42±415.21	1639.94±465.33	0.000
Carbohydrates (gm)	379.14±98.47	235.00±63.69	291.92±80.84	0.000
Protein (gm)	83.78±23.54	68.42±24.38	78.00±23.12	0.000
Fat (gm)	78.39±14.30	81.03±17.84	71.14±12.02	0.001
Sodium (mg)	1360.25±810.84	2030.60±741.71	1417.85±755.29	0.001
Calcium (mg)	845.42±631.00	1502.00±674.72	743.21±534.10	0.000

Discussion

This study aimed to evaluate the impact of Ramadan fasting on food intake and biochemical parameters among type 2 diabetes mellitus Muslim patients in the state of Qatar. since we have found none or very limited previous information available from this region investigating the effect of Ramadan fasting in patients with type 2 DM. Strict compliance to healthy dietary modifications is a cornerstone in diabetes management. Meal patterns and fluid intake are markedly altered during Ramadan fasting periods of sleep as well are delayed and shortened. an undesirable change in metabolism may be happened because of these changes in meal and sleeping rhythm. The present study included a representative Muslim diabetic population in the State of Qatar where more than 95% of the Muslims fast regularly during the holy month of Ramadan. The positive impact of Ramadan fasting on blood glucose level and HbA1c have been reported by this study which means blood sugar significantly reduced ($P<0.05$). This was confirmed by HbA1c that showed significant improvement ($P<0.05$), which is consistent with the previous reports [1,4-7,13,14]. The rhythmic pattern of several hormonal variables including cortisol which has an influence on glucose tolerance is affected by the changes in sleep schedule and habits during Ramadan. It has also been argued that a given nutrient ingested at an unusual time can induce different metabolic effects [26]. Cortisol concentrations are biphasic during Ramadan fasting, unlike in non-fasting periods as reported by previous research, an increase in serum cortisol starting at 1200 hours that reached a plateau between 1600 and 2000 as reported [27]. Changes in levels of appetite-regulating hormones leptin, neuropeptide-Y, and insulin that play important roles in the long-term regulation of energy intake and expenditure may result because of sleep-wakefulness cycle alteration [28].

In fact, manipulation of diet, exercise, and medication may be implemented to achieve blood sugar levels. Blood sugar levels can skew because of changes in any one of these three things and create complications associated with hyperglycemia or hypoglycemia. As such fasting involves abstinence from food and water for 12 hours or more during the day from dawn to dusk, it is evident that advice regarding exercise and medication will have to be modified appropriately during this period [6,12,14,29,30]. Carbohydrate and FAT metabolism is influenced by fasting, resulting in changes in blood chemistry. There is no caloric intake during fasting, and the continual use of glucose in the body for various vital functions [31], leads to lowering of blood glucose level. The depletion of glycogen stores after prolonged fasting further decreases its level. Our study participants demonstrated lower levels of blood glucose during the month of Ramadan, which was consistent with the observations reported by earlier workers [11,31-34]. It is also obvious from the present study that the benefits of Ramadan dietary habits in terms of reduction in blood sugar and HbA1c may be helpful only if the diet pattern is framed according to the routine followed in Ramadan on regular basis [32]. Changes in the dietary regimen decreased activity, and some cultural parameters during Ramadan may explain the differences in lipid profile response to Ramadan fasting. In this study, the serum level of triglycerides had insignificantly increased in pre-and post-Ramadan testing, which is consistent with the previous report by Shoukry MI [33], who reported a significant increase in TG during Ramadan. Elevated blood TG levels observed may be due to the consumption of high-carbohydrate diets accompanied by less exercise during this month. There is a tendency for higher sugar consumption during Ramadan [4, 35-37]. Hallak and Nomani reported that the TG level on the 14th day of Ramadan correlated positively with sugar intake (g/day) during this month [38]. The increase in blood TG with high sucrose intake was also observed by Albrink & Ullrich [37]. Gumma et al observed an increase in blood TG level with Ramadan fasting in subjects on a high-carbohydrate diet [36]. The current study shows change in TG level during Ramadan was not related to body weight. Some studies reported that at the initial stages of weight loss there was an increase in blood TG level, which may have been due to mobilization of body fat [39-42]. An increase in TG level declines with increasing weight loss, a finding that may be due to its use as a source of energy. The results showed that in Ramadan fasting levels of LDL-C, total cholesterol, and TG were increased compared with prior to Ramadan. Moreover, the study did not find any positive effects of Ramadan fasting during the holy month of Ramadan on the status of DM concerning lipid profile – LDL-C, HDL-C, cholesterol, and triglyceride. This is consistent with that reported in other studies [6,11,12,30-33,43-48]. While, Asgary in Isfahan, Iran reported the level for cholesterol and TG decreased

significantly in fasting people following Ramadan [49] as well, Adlouni [48] showed that during Ramadan, there is a significant decrease in the levels of total cholesterol and TG. The difference in dietary habits and duration of fasting in different seasons and countries may explain the variation in lipid levels observed by different researchers. This study Howes urea and serum creatinine levels increased significantly during Ramadan and subsequently, this increase continued after Ramadan. which is consistent with the previous reports, Ziai [49] in Iran, Sadiya in UAE [50], and Schemahl [51] reported an increase in the levels of urea and creatinine during Ramadan fasting. They conclude that severe dehydration due to lack of water contributed to these changes.

During Ramadan, because of changes in the number and timing of meals, body metabolism can be adversely affected. In the current study, fruit and vegetable consumption increased during Ramadan which is inconsistent with the research conducted by Sadiya in UAE [52,53]. This difference can be explained by different dietary patterns in these two cultures. In the current study, fat intake decreased during Ramadan which was different from what was reported in former studies in Kuwait and US [54,55]. Many studies reported that extended fasting has no negative effects of on glucose regulation of patients with diabetes who are using certain medications. as well, no serious adverse event was observed, and they have failed to demonstrate the benefits of increasing the number of meals in patients with diabetes [11,12,43].

Conclusion

In conclusion, this study indicated that Ramadan fasting led to a significant decrease in glucose, HbA1c, total cholesterol, meal frequency, total energy, carbohydrates, and protein intake, while a significant increase in fat intake was noticed. An insignificant increase in LDL & TG and HDL decrease were reported.

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