

# Effects of Ramadan Fasting on Daily Life and Metabolic Condition in Patients with Type 2 Diabetes

## Tip 2 Diyabetli Hastalarda Oruç Tutmanın Hastaların Günlük Yaşam Rutinlerine ve Metabolik Durumlarına Etkisi

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**ABSTRACT Objective:** The objective of this study was to assess the effects of Ramadan fasting on daily life routines and metabolic conditions in diabetic patients. **Material and Methods:** The study sample consisted of 26 patients with Type 2 diabetes who fasted during Ramadan. Data on changes daily life routine and metabolic variables were gathered before and after Ramadan, within a 10 days period. **Results:** Almost all patients fasted during Ramadan although they had known that fasting had some negative effects on their health, and Islamic rules allow sick people not to fast. Most of the patients declared that they rearranged morning and evening medications according to fasting hours and skipped doses between dawn and sunset, changed diet routine and eating habits including food preference. In addition, some of them changed their sleep schedule and decreased daily physical activity level because of lack of energy caused by fasting. More than half of the patients experienced at least one episode of hypoglycemia during fasting period; all hypoglycemia experiences were mild episodes. However, there was no emergency admission due to fasting-related health problems. We found neither negative nor positive effects of Ramadan on metabolic control variables including weight, HbA1c, fructosamine, C-peptide, insulin, and lipid profile. **Conclusion:** Ramadan fasting has no negative effects on metabolic parameters in patients with Type 2 diabetes.

**Key Words:** Diabetes mellitus, Type 2; fasting; metabolism

**ÖZET Amaç:** Bu çalışmanın amacı, oruç tutmanın diyabetli hastaların günlük yaşam rutinleri ve metabolik durumları üzerine etkisini incelemektir. **Gereç ve Yöntemler:** Çalışmaya Ramazan ayında oruç tutan 26 Tip 2 diyabetli hasta alındı. Günlük yaşam rutinleri ve metabolik duruma ilişkin veriler Ramazan ayı öncesi ve bitimini takip eden 10 gün içinde toplandı. **Bulgular:** Açlığın sağlık üzerine olumsuz etkilerinin olduğunu ve İslam'ın hasta olanları oruç tutmaktan muaf tuttuğunu bilmelerine rağmen, hastaların neredeyse tamamı oruç tutmayı tercih etti. Hastaların çoğunluğu sabah ve akşam ilaçlarını oruçlu oldukları saatlere göre düzenlediklerini, imsak ve iftar arasındaki döneme denk gelen ilaç dozlarını atladıklarını, yiyecek tercihleri de dahil olmak üzere beslenme rutinlerini ve yeme alışkanlıklarını değiştirdiklerini ifade etti. İlave olarak, hastaların bazıları uyku saatlerini değiştirdiklerini, açlığa bağlı güçsüzlük nedeni ile günlük fiziksel aktivite düzeylerini azalttıklarını belirttiler. Hastaların yarısından fazlası oruç tuttukları dönemde, tümü orta şiddette olmak üzere, en az bir kez hipoglisemi atağı yaşadı. Ramazan boyunca hastaların hiçbiri oruç tutmaya bağlı olarak gelişen herhangi bir sağlık sorunu nedeni ile acil servise başvurmadi. Mevcut çalışmada oruç tutmanın beden ağırlığı, HbA1c, fruktozamin, C-peptid, insülin ve lipid düzeyleri üzerine olumlu ya da olumsuz etkisine rastlanmadı. **Sonuç:** Bu çalışmada, Tip 2 diyabetli hastalarda oruç tutmanın metabolik parametreler üzerinde olumsuz etkisi görülmemiştir.

**Anahtar Kelimeler:** Diabetes mellitus, Tip 2; perhiz; metabolizma

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Ramadan fasting is one of the five pillars of Islam followed by over billion of Muslims adults worldwide. Muslims do not eat or drink anything from dawn till sunset for one month during Ramadan, without restriction of the amount of food or drink consumed between dawn and sunset. Medications (oral, inhaler or injectable), tobacco or sexual intercourse are not allowed either, during Ramadan.<sup>1</sup>

According to Islamic laws, fasting is obligatory for all Muslim people during Ramadan except for children below 12 years of age, travelers, and women who are nursing a baby or menstruating. Sick people are also allowed to refrain from fasting, depending on their condition.<sup>1</sup> People with diabetes who use insulin secretagogues or injections also fall into the last category, and are exempted from fasting. Consequently, people with diabetes should not fast as their metabolic condition can be adversely affected. However, most patients, especially the ones with type 2 diabetes, usually insist on fasting.<sup>2</sup>

A report from a large epidemiologic survey (Epidemiology of Diabetes and Ramadan-EPIDIAR), which is a multicentered study conducted in 13 countries including Turkey and included 12,243 patients with diabetes, showed that 42.8% of patients with type 1 diabetes and 78.7% with type 2 diabetes fasted for at least 15 days during Ramadan.<sup>3</sup> Ahmadani et al. reported that the prevalence of fasting was 96.3% among type 2 diabetes patients, and Peeters et al. reported that 72.5% of Turkish patients with diabetes fasted during Ramadan in Belgium.<sup>4,5</sup>

Type 2 diabetes has become a global epidemic, and Islamic population, which constitute about 23% of the world population in 1999, is increasing.<sup>6,7</sup> The prevalence of diabetes is similar in countries with large Muslim populations and in Western countries, and it increases by 10% per year as a result of urbanization and socioeconomic development.<sup>8</sup> Finally, most of the patients with type 2 diabetes insist on fasting despite the recommendations of health professionals.<sup>3-5</sup> Indeed, concerns are raised with regards to the safety of fasting

in diabetic patients.<sup>3</sup> Therefore, the studies investigating the effects of Ramadan fasting in patients with diabetes are important. Thus, health professionals can find answers for questions regarding possible effects of fasting on patients' health, and then they can handle situations where patients with diabetes insist on fasting.<sup>9</sup>

The number of studies investigating the effects of Ramadan among people with diabetes is limited worldwide. Although, Turkey is a large Muslim country with approximately 76 billion people, as our knowledge, there are only three studies on this subject.<sup>10-12</sup> Therefore, we planned this study to assess the effects of fasting on patients' life style, medication schedule, perceived hypoglycaemia/ hyperglycaemia episodes, and other diabetes related control parameters including weight, HbA1C, fructosamine, C-peptide, insulin, and lipid profile.

## MATERIAL AND METHODS

The study was carried out at the Diabetes Outpatient Clinic of a University Hospital, in 2011. We invited type 2 diabetic patients who were planning to fast during Ramadan to attend the study. Inclusion criteria were: having diagnosed with diabetes for at least one year, having a good metabolic control as measured by means of HbA1c, and having no communication problems for the interview. Twenty-six patients who met inclusion criteria constituted the study group. The duration for daily fasting was approximately 15-16 hours. We considered that a HbA1c level <7% indicated good metabolic control.<sup>13</sup> The study was conducted in accordance with Helsinki Declaration, and it was also approved by the Institutional Academic Board. Before the study, the aim of the research was explained and written informed consents of the participants were obtained. The confidentiality was guaranteed for all patients.

Basic characteristics of the samples were gathered by a questionnaire prepared by the researchers. The questionnaire consisted of socio-demographic variables including gender, age, ed-

educational status; disease-related variables such as duration of diabetes, medical diabetes treatment including medication schedule, eating habits, food preference, daily physical activity, presence of long-term diabetes complications, presence of experienced hypoglycemia and hyperglycemia; and variables related to fasting including receiving any consultation by a religious authority, or receiving any information or recommendation by a health professional on fasting, and having any perceived pressure from their social environment to fast. In addition, we asked changes in sleeping habits because of fasting with a single question.

Effects of Ramadan on health investigated by any changes in patients' life style including diet routine, eating habits, food preference, daily physical activity, sleeping habits, and medication schedule; perceived hypoglycemia/hyperglycemia episodes; and any history of emergency admission because of fasting-related problems as well as metabolic parameters including weight, HbA1C, fructosamine, C-peptide, insulin, and lipid profile. Data were gathered before and after Ramadan, within a 10 days period.

The statistical analysis was performed using SPSS version 19.0 (SPSS, Chicago, IL). Data are presented the 'mean±standard deviation (SD)' unless otherwise indicated. Values before and after Ramadan were compared using paired samples t test.

## RESULTS

Descriptive properties of the patients are shown in Table 1. The study population had a mean age of 57.8 (range= 45-72) years and consisted of 18 females (69.2%) and 8 males (30.8%). The majority of them (46.2%, n=12) had education at the primary school level. Mean duration of diabetes was 8.9 years with a range between 1-30 years. Most of the patients were on oral antidiabetic (OA) treatment (65.4%, n=17), and 69.2% (n=18) of them had a moderate activity level. The percentage of long-term diabetes complications was as follows: hypertension (69.2%, n=18), neuropathy (11.5%, n=3), and coronary artery disease (7.7%, n=2). There

**TABLE 1:** Demographic and clinical characteristics of the patients.

	Mean years±SD
Age	57.8±7.0
Duration of diabetes	8.9±7.1
	% (n)
<b>Gender</b>	
Male	30.8 (8)
Female	69.2 (18)
<b>Educational level</b>	
Illiterate	15.4 (4)
Only reading and writing	11.5 (3)
Primary school (5-8 yrs education)	46.2 (12)
High school (11-12 yrs education)	15.4 (4)
University (13-15 yrs education)	11.5 (3)
<b>Level of daily physical activity</b>	
Sedentary or light activity	23.1 (6)
Moderate activity	69.2 (18)
Heavy activity	7.7 (2)
<b>Medical treatment</b>	
Only medical nutrition treatment	3.8 (1)
Only OA	65.4 (17)
Insulin	11.5 (3)
OA+insulin	19.3 (5)
<b>Presence of long-term diabetes complications</b>	
Neuropathy	11.5 (3)
Coronary artery disease	7.7 (2)
Hypertension	69.2 (18)

OA: Oral antidiabetic.

were no patients with nephropathy, retinopathy or diabetic foot ulcer (Table 1).

Sixty-five percent of the patients (n=17) had previously been consulted by a religious authority or were informed by a health professional on fasting; 42.3% of them (n=7) were informed by a health professional and 19.2% (n=3) by a religious authority, and told that patients with diabetes were exempted from fasting after Holy Quran rules due to health-related reasons. However, 96.2% of them (n=16) intended to continue fasting although they were informed about negative health consequences related with long-term fasting. None of them perceived pressure from their social environment to fast.

The mean duration of fasted days was 26.8 (SD= 4.6, range= 8-29 days). Twenty of 26 patients

(76.9%) changed their medication schedule. About 88.5% of them (n=23)

rearranged the morning and evening medications according to fasted hours, and skipped the doses to the period between dawn and sunset. Forty two percent of patients (n=11) changed their sleeping hours, 84.6% (n=22) diet routine, and 61.5% (n=16) eating habits and food preference. Approximately, 15% of them (n=4) decreased their daily physical activity level because of lack of energy caused by fasting.

More than half of the patients (57.7%, n=15) experienced at least one episode of hypoglycemia during fasting period; all hypoglycemia experiences were mild episodes. No patient needed to stop fasting. There was no case who experienced hyperglycemia. There were no emergency admissions due to fasting-related health problems.

Table 2 shows the Effects of Ramadan on some metabolic variables. As shown in the Table, we did not observe any significant changes in the patients' metabolic parameters as measured by means of weight, HbA1c, fructosamine, C-peptide, insulin, and lipid profile, before and after Ramadan. With regard to the diabetes treatment, we divided the study group into two sub-groups including patients who received insulin or an insulin secretagogue (sulfonylurea) and patients who received other treatment modalities (diet, acarbose, metformine). There were no differences between two groups re-

garding hypoglycemia experiences and other metabolic parameters.

## DISCUSSION

There are more than one billion Muslims in the world, and majority of them fast between dawn and sunset during holy lunar month of Ramadan each year. The month of Ramadan consists of either 28 or 30 days. Although Islamic rules allow sick people not to fast; a significant number of patients insist on fasting despite the advice of their health professionals and the permission of religious authorities.<sup>1</sup>

Although 65% of the patients were informed by a religious authority or a health professional about not to fast because of its negative effects on the metabolic condition, 96.2% of them insisted to continue fasting. None of them perceived pressure from their social environment.

Our results are comparable with the findings of previous studies. In the EPIDIAR study which included patients from Algeria, Bangladesh, Egypt, India, Indonesia, Jordan, Lebanon, Malaysia, Morocco, Pakistan, Saudi Arabia, Tunisia and Turkey, it was found that 86% of the patients with type 2 diabetes fasted during Ramadan. Average number of fasting days was 27. Similar to our results, 62% of patients were provided recommendations from health professionals on Ramadan fasting and diabetes.<sup>3</sup> A study by Peeters et al. performed among Turkish migrants in Belgium (n=52) indicated that

**TABLE 2:** Effects of Ramadan on some metabolic variables.

	Before Ramadan (mean±SD)	After Ramadan (mean±SD)	p
Weight (kg)	78.3±7.4	78.1±8.2	0.678
HbA1c (%)	6.8±0.7	6.8±0.9	0.627
Fructosamine (µmol/L)	2.8±0.5	2.8±0.5	0.897
C- peptide (ng/mL)	2.6±0.7	2.5±1.0	0.422
Insulin (µU/ml)	16.9±18.3	13.8±9.6	0.319
Total Cholesterol (mg/dL)	186.7±35.9	190.7±30.3	0.641
Triglycerides (mg/dL)	151.6±77.7	155.1±47.9	0.808
HDL-Cholesterol (mg/dL)	46.7±11.1	46.6±9.4	0.939
LDL-Cholesterol (mg/dL)	116.5±27.4	119.3±31.5	0.618

72.5% of patients fasted during Ramadan, and 56% of them received advice on fasting and diabetes management during Ramadan.<sup>5</sup> The most common advice provided was not to fast.<sup>5</sup> A study from Pakistan by Ahmadani et al. reported the prevalence of fasting in type 2 diabetes patients as 96.3% and the mean duration of fasting was 25 days.<sup>4</sup> In contrary to previous studies, none of these patients were informed about Ramadan fasting and diabetes.<sup>4</sup>

During Ramadan, people have only two meals at dawn and sunset, usually one large meal after sunset and one lighter meal before dawn.<sup>2,9,14</sup> In addition, patients have to wake up before dawn to prepare and have a meal. They also modify the timing of their medications to the fasting hours, and sometimes skip or change medication dosage used. These modifications all cause changes of daily routine including sleeping hours and physical activity.<sup>9</sup>

EPIDIAR study showed that 27.7% of insulin users and 21% of OA users decreased or stopped taking their medications. The rate of patients who changed their food intake, physical activity, and sleep duration were 58.7%, 46.2% and 54.4%, respectively.<sup>3</sup> Patel et al. from Oman reported that 49.5% of patients changed their insulin/OA doses, and 49.4% of them decreased their physical activity.<sup>15</sup> In Peeters et al.'s study, 13% of OA users and 20% of the insulin users changed their medication doses because of Ramadan in Belgium.<sup>5</sup> Pinelli and Jaber studied Arab-American patients and showed that patients exercised less frequently during Ramadan.<sup>16</sup> Finally, in Sadiya et al. showed that total sleeping time were similar before and during Ramadan.<sup>17</sup> However, there were delayed and shortened night sleep periods, which were compensated by daytime sleeping.<sup>17</sup> Despite some discrepancies in the results of the studies, these results indicated that Ramadan caused some changes in patients' daily routines. We found that most of the patients skipped the doses between dawn and sunset, changed their morning and evening medications and took them according to their meal hours in Ramadan. Most of the patients changed their diet routine as well as their eating habits and food pref-

erences. About half of the patients decreased their daily physical activity level, and 42% shifted their sleeping hours from night to day time.

During Ramadan, a considerable amount of foods rich of refined carbohydrate such as rice and pasta, dried fruits such as apricot, date and fig, and desserts such as baklava are traditionally prepared and consumed in the non-fasting period.<sup>2,9,14</sup> Consuming carbohydrate-rich foods during Ramadan may present a risk for hyperglycemia and weight gain, although some studies found that food intake was not changed and was lower during Ramadan.<sup>9,15,18</sup> The risk of hypoglycemia may also increase during Ramadan because of daytime fasting, limited fluid intake, and skipping both meals and snacks despite taking medications or decreasing the drug doses.<sup>9</sup> In the current study, there was no severe hypoglycemia or hyperglycemia events requiring hospitalization, although more than half of the patients experienced at least one mild episode of hypoglycemia during fasting period. This result may be attributable to the effects of shifting the medication doses between dawn and sunset, and reasonable rates of well-educated diabetic patients.

Previous studies which investigated the effects of Ramadan fasting on severe hypoglycemia or hyperglycemia events among type 2 diabetes patients revealed controversial results. In EPIDIAR study, rates for severe hyperglycemia with/without ketoacidosis and hypoglycemia requiring hospitalization were 4% and 2%.<sup>3</sup> In the same study, it was concluded that there was three to five fold increase in the incidence of severe hypoglycemia during fasting period. In Ahmedani et al.'s study, seven out of 110 subjects experienced symptomatic hypoglycemia whereas 20 patients had biochemical hypoglycemia.<sup>19</sup> Sari et al. reported that only one of 52 patients who used repaglinidone had hypoglycemia.<sup>12</sup> Fatima et al. indicated that there was a significant increase in the number of mild symptomatic hypoglycemia events during Ramadan when compared to the period before and after Ramadan, although no patients needed hospitalization.<sup>20</sup> In Sadiya et al.'s study, no patients experienced severe hypo- or hyperglycemia, how-

ever only two patients had slight symptoms of hypoglycemia during Ramadan; the severity and frequency of hypoglycemia events were similar to the non-fasting month.<sup>17</sup> Contrary to these studies, Patel et al. and Bravis et al. showed that the mean number of hypoglycemia episodes decreased during Ramadan.<sup>15,21</sup>

The study results mentioned above should be interpreted with caution because the samples were quite different from each other by means of metabolic control, modification on medication timing or doses, mean duration of fasting days, definition of hypo or hyperglycemia, and education and counseling given to patients before the Ramadan. For instance, in Patel et al.'s study, almost all patients fasted 30 days during Ramadan and 83% of them were poorly controlled before Ramadan.<sup>15</sup> Bravis et al. proved the effectiveness of structured patient education in reducing frequency of hypoglycemia episodes.<sup>21</sup> Additionally, Ahmetcani et al. showed that majority of hypoglycemia episodes occurred just before the start of the actual fast, followed by midday episodes, possibly because of shifting of full morning insulin dose or OA before sunset meals.<sup>19</sup>

Based on these findings, we concluded that overall incidences of hypoglycemia and hyperglycemia episodes were low among patients with type two diabetes, and glycemic excursions in Ramadan would remain low when patients were assessed before Ramadan and adjustments for fasting, modification for medication and physical activity were done. As mentioned in Hui and Oliver's study, despite dietary changes and previous reports of hypoglycemic and hyperglycemic excursions in Ramadan, the differences are not significant compared with the fasting hours.<sup>14</sup>

We found neither negative nor positive effects of Ramadan on metabolic control variables including weight, HbA1c, fructosamine, C-peptide, insulin, and lipid profile (Table 2). Studies evaluating the effects of Ramadan on health are controversial. Ramadan had no effect on body weight in our study group, although weight gain and weight loss during Ramadan were previously reported. Some studies have shown that Ramadan fasting

had no effect on HbA1c and fructosamine.<sup>11,12,15,17,20,22-24</sup> Bouguera et al. reported no change between HbA1c and fructosamine levels obtained 3 weeks before Ramadan, at 4<sup>th</sup> week of Ramadan and 3 weeks after Ramadan in 25 good metabolic controlled patients.<sup>25</sup> In the same study, it was also indicated that Ramadan fasting led to further deteriorations in patients with poor glycemic control.<sup>25</sup> In contrary to this study, other studies showed that HbA1c and fructosamine levels improved during Ramadan.<sup>2,26</sup>

Previous results regarding the effect of Ramadan fasting on lipid profile are again controversial. Although fasting did not alter lipid profile in some studies, it caused reduction of triglycerides and LDL-cholesterol; an increase in HDL cholesterol, LDL-cholesterol and total cholesterol in some others.<sup>11,12,23,24,27</sup> A study on healthy subjects found decrease in triglycerides, increase in HDL cholesterol, LDL-cholesterol and total cholesterol.<sup>28</sup> The favourable changes in lipid profile may be related to weight loss. Similar to other studies, in our study, there was no change in the body weight. This partly explains why different studies have produced different results. These different results regarding effects of Ramadan on metabolic variables may be affected by duration of fasting period i.e. the number of hours per day which affected by the seasonal and the geographic distribution of the country, the number of days fasting, the baseline insulin resistance and demographics of the population studies, the amount of weight loss (if any), the use and type of medication, and the diet consumed.<sup>29</sup>

We have concluded that Ramadan fasting has no negative health effects in patients with type 2 diabetes. However, our sample size was quite small and non-randomized; therefore our findings cannot be generalized. We need further experimental studies to clarify causal relationships between fasting and metabolic disturbances in a large representative sample. Although recent studies show that most of the patients with type 2 diabetes can fast safely during Ramadan, health professionals tend to advise not to fast for both

well and poor controlled diabetic patients. The patients who wish to observe this religious ritual should be evaluated, educated and motivated just before Ramadan to determine the risk stratification and stabilize their metabolic condition as well. If their metabolic control is poor, fast should not be advised to and patients must be warned for the negative effects of long term hunger.<sup>9</sup> All research results on fasting including the current study may be a guide to health professionals to de-

cide whether Ramadan fasting is safe for diabetic patients or not.

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