

# Assessment of Ramadan Education and Knowledge Among Diabetic Patients

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## ABSTRACT

**BACKGROUND:** During Ramadan, Muslims fast from dawn until dusk for one lunar month every year. Most of the Muslim patients with diabetes are unaware of the potential complications that can occur while fasting, such as hypoglycemia. The aim of this study is to assess the patient education level and patients' overall awareness of any possible complications that could occur while fasting during Ramadan and to determine how these patients deal with these complications.

**METHODS:** We conducted a cross-sectional study and surveyed diabetic patients about their diabetes-related knowledge over a period of 4 months from the outpatient clinic at the Obesity, Endocrine, and Metabolism Center at King Fahad Medical City. Patients were included if they were  $\geq 16$  years and if they had been receiving treatment for at least 1 year before the study, irrespective of the medications used; patients were also asked about the presence or absence of complications.

**RESULTS:** This study included 477 patients (325 women and 152 men). Most patients (297; 62.3%) had type 2 diabetes. The patients' mean age was  $39.72 \pm 15.29$  years, and the mean duration of diabetes was  $10.80 \pm 5.88$  years. During the preceding Ramadan, 76% of patients reported fasting, whereas 58% said that they monitored their blood glucose levels once per day. Hypoglycemic episodes were reported in 60.3% of cases with type 2 diabetes and in 8.3% of cases with type 1 diabetes. Among those who had hypoglycemia, 2.8% of patients with type 1 diabetes and 17.8% with type 2 diabetes broke their fast. Finally, 54% of patients reported that their health care providers offered them instructions on diabetes management during Ramadan.

**CONCLUSIONS:** Ramadan health education in diabetes can encourage, improve, and guide patients to change their lifestyles during Ramadan while minimizing the risk of acute complications.

**KEYWORDS:** Diabetes, Ramadan, fasting, hypoglycemia, Islam, education

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## Introduction

Diabetes is one of the most common chronic metabolic diseases around the world. It is highly prevalent in the Kingdom of Saudi Arabia, which was found to have the seventh highest prevalence rate for diabetes globally.<sup>1</sup> Fasting during Ramadan represents the fourth of the 5 pillars of Islam. Most of the Muslims with either type 1 or type 2 diabetes fast every year during the lunar month of the Islamic calendar. All healthy adult Muslims are obligated to fast during this time<sup>2</sup>; however, Islam exempts the acutely ill, those who are old and frail, travelers, menstruating women, pregnant and nursing mothers, as well as those with chronic diseases (such as diabetes mellitus) from fasting. Importantly, some diabetic patients insist on fasting, and they choose to do so against the advice of their doctors.<sup>3,4</sup> Patients with poorly controlled diabetes and who fast during Ramadan may be at risk for certain adverse events, which may increase with longer fasting periods.<sup>5</sup> During Ramadan, Muslims must abstain from consuming food or water, smoking,

and taking oral medications from sunrise to sunset, which marks the variable duration of daylight hours between summer and winter months. Fasting during Ramadan may potentially affect one's dietary habits, daily physical activity, sleep patterns, glycemic control, weight, lipid profile, and food intake.<sup>6</sup>

The Epidemiology of Diabetes and Ramadan (EPIDIAR) study investigated 12,243 diabetic patients and their associated characteristics during Ramadan. The results showed that 43% of patients with type 1 diabetes and 79% of those with type 2 diabetes were able to fast during the month of Ramadan.<sup>7</sup> Diabetic ketoacidosis was more frequent in patients with type 1 diabetes due to an excessive reduction in insulin dosage secondary to decreased food intake.<sup>8</sup> The overall frequency of severe hyperglycemia (requiring hospitalization) was observed to be up to 5-fold greater for cases with type 2 diabetes and up to 3-fold greater for cases with type 1 diabetes.<sup>9</sup> Diabetic patients who fast during Ramadan pose a challenge for health care providers,



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as clinicians need to provide additional education and while emphasizing the need for closer blood glucose monitoring during the fasting period. Several studies have shown that if fasting diabetic patients are properly educated and trained well, then they can safely and effectively engage in this practice.<sup>6,8-11</sup> A recent study showed that structured educational programs on how to fast during Ramadan reduced the risk of hypoglycemic events and they also prevent weight gain.<sup>11</sup>

Ramadan-focused diabetes education can serve as a useful tool to achieve better health care for people with diabetes during Ramadan, as it will allow patients to fast safely.<sup>12</sup> Thus, the aim of this study is to assess the level of patient education provided related to fasting during Ramadan. We also examined patients' awareness of any possible complications that could occur while fasting throughout this period, and we further explored their knowledge of the strategies that these patients employed to deal with such complications. The recommendations for managing patients with diabetes during Ramadan are based on consensus rather than clinical trials. Provision of a Ramadan-specific education program appears to be critical for ensuring safe fasting among individuals with diabetes.<sup>13</sup>

## Methods

A cross-sectional study design was used to assess the level of patient education provided during the fasting period of Ramadan. Also explored were patients' awareness of the possible complications that could occur while fasting during this period and their knowledge of how to deal with diabetes-related complications over a period of 4 months. This study was conducted on the Obesity, Endocrine, and Metabolism Center at King Fahad Medical City, Riyadh, Saudi Arabia.

### *Participants and inclusion criteria*

The participants in this study were Muslim patients with type 1 or type 2 diabetes who attended the outpatient clinic at our institution. Patients were included if they were  $\geq 16$  years of age and if they had been receiving diabetes related treatment for at least 1 year prior to the study, irrespective of the medications used. Patients with serious complications, (such as those with unstable angina or uncontrolled hypertension), pregnant women, and patients with brittle diabetes were excluded from the study. A consecutive sample of 477 patients participated in the study.

### *Study instrument*

A structured self-administered questionnaire was developed in accordance with the main objectives of the study. All participants provided their written informed consent to participate in this study.

### *Data collection*

Data were recorded by abstracting information from the patients' files, as well as by conducting individual interviews.

The following variables were obtained: demographic characteristics, dietary habits, and physical activity during Ramadan, as well as the type and duration of diabetes, and any medications that the patients were taking at that time. Other information that was obtained included associated comorbidities (dyslipidemia, hypertension, and the presence of heart disease), as well as changes in the time and dose of medication administration. Evidence of hypoglycemia and hyperglycemia, and how to manage these conditions during fasting, were also recorded. The specific type of diabetes was determined as per the originally reported diagnosis.

### *Statistical analysis*

Descriptive statistics were used to describe the patients' demographic and disease related characteristics. The data are represented as the mean  $\pm$  SD and percentages. The data were analyzed using the SPSS (IBM Corporation, Armonk, NY, USA). The institutional review board of King Fahad Medical City, Riyadh, Saudi Arabia, approved this study.

## Results

A total of 477 diabetic patients (325 women and 152 men) participated in this study. Of these, there were 180 (37.7%) and 297 (62%) patients with type 1 and type 2 diabetes, respectively. The patients' mean age was  $39.72 \pm 15.29$  years. All patients were Saudi. The mean duration of diabetes was  $10.80 \pm 5.88$  years. Table 1 shows the baseline demographic and clinical characteristics of the survey population. In general, we observed that most of the patients (76%) were able to fast during Ramadan. The overall frequency of diabetes-associated comorbidities was relatively high; the frequencies of hypertension, dyslipidemia, and cardiac disease were 36.3%, 36.1%, and 18.0%, respectively. Regarding diabetes treatment, 46% of patients were on insulin therapy, 25% were on oral glucose-lowering agents (OHAs), and 21% were on combined oral medication (OHA) and insulin therapy; 8.2% were on a specialized diet alone.

Approximately 76% of participants reported fasting during Ramadan; moreover, the medication dosage and timing had changed for 71% of diabetic patients during this same period. With respect to blood glucose monitoring, a considerable proportion of the patients (58%) did so once a day during Ramadan. Most responders consumed enough fluid (90%), and they ate the predawn meal (Suhoor) at a late time (80%); a low proportion of patients ate sweet foods (36%). In terms of physical activity, most patients did not exercise during Ramadan (82%). Hypoglycemia management was achieved by most of the patients (88.5%), who took in a lot of juice and fluids; however, only 27.3% used a glucagon injection during the fasting period. The changes related to exercise, fluid intake, food intake, and treatment during fasting are shown in Table 2.

A total of 84% and 85% of patients appeared to be knowledgeable about the symptoms of hyperglycemia and hypoglycemia, respectively. Furthermore, 54% of patients reported receiving instructions from their health care providers about

**Table 1.** Patients' demographic and clinical characteristics.

PARAMETER	NO. (%)
Total no.	477
Sex	
Female	325 (68.1)
Male	152 (31.9)
Age, y	
12-20	77 (16.1)
21-30	70 (14.7)
31-40	54 (11.3)
41-50	85 (17.8)
>50	191 (40.0)
Comorbidities	
Dyslipidemia	172 (36.1)
Hypertension	173 (36.3)
Heart disease	86 (18.0)
Diabetes type	
Type 1	180 (37.7)
Type 2	297 (62.3)
Duration of diabetes, y	
≤1	16 (3.4)
1-5	98 (20.5)
6-10	129 (27.0)
11-15	84 (17.6)
>15	150 (31.4)
Type of treatment	
Diet (only)	39 (8.2)
OHA	119 (24.9)
OHA + insulin	100 (21.0)
Insulin	219 (45.9)

Abbreviation: OHA, oral glucose-lowering agent.

diabetes management during Ramadan; however, a substantial proportion of responders (79%) still believed that they needed additional Ramadan health education. Most of the participants (61%) knew that they should achieve good glycemic control during the fasting period, and 79% believed that fasting would help to control their diabetes. Table 3 shows the patients' knowledge of diabetes while fasting during Ramadan.

Symptomatic hypoglycemia was seen in 8.3% of patients with type 1 diabetes and in 60.3% of patients with type 2 diabetes. Blood glucose levels were checked for 88.9% of patients with type 1 diabetes and for 72.1% of patients with type 2 diabetes

**Table 2.** Changes in patients' medication, food intake, blood glucose monitoring, and lifestyle during Ramadan.

QUESTION	NO. (%)
Do you fast during Ramadan?	
Yes	339 (76)
No	108 (24)
How many times do you monitor your blood glucose during Ramadan?	
Never	25 (5.2)
Once a day	279 (58.5)
More than one time per day	42 (8.8)
Once a week	80 (16.8)
Monitor at clinic	51 (10.7)
Do you eat sweets during Ramadan?	
Yes	173 (36.3)
No	304 (63.7)
Do you consume enough fluids during Ramadan?	
Yes	430 (90.1)
No	47 (9.9)
Do you exercise during Ramadan?	
Yes	87 (18.2)
No	390 (81.8)
Do you take your Suhoor late?	
Yes	380 (79.7)
No	97 (20.3)
Do you change the time and dose of your medicine during Ramadan?	
Yes	339 (71.1)
No	138 (28.9)
How do you manage your hypoglycemia during fasting?	
I do not do anything	22 (4.6)
I consume a lot of juice and fluids	422 (88.5)
I eat small snacks	32 (6.7)
I stop taking my medication	1 (0.2)
Do you use an injection of glucagon while fasting?	
Yes	130 (27.3)
No	347 (72.7)

when they developed hypoglycemia symptoms during fasting. If patients developed symptoms of hypoglycemia, approximately 2.8% of those with type 1 diabetes and 17.8% of those with type 2 diabetes reported that they broke their fast to address this issue.

**Table 3.** Patients' knowledge of diabetes while fasting during Ramadan.

QUESTION	YES	NO
Are you aware of the symptoms of hyperglycemia?	401 (84.1)	76 (15.9)
Are you aware of the symptoms of hypoglycemia?	406 (85.1)	71 (14.9)
Do you want to know more about fasting during Ramadan?	376 (78.8)	101 (21.2)
Did you receive instructions and knowledge about diabetes mellitus during Ramadan?	259 (54.3)	218 (45.7)
Are you aware of your glucose levels during Ramadan?	416 (87.2)	61 (12.8)
Do you maintain control of your glucose levels during Ramadan?	291 (61.0)	186 (39.0)
Dose fasting help to control blood glucose levels?	376 (78.8)	101 (21.2)

**Table 4.** Frequency of symptomatic hypoglycemia and hyperglycemia during Ramadan.

	TYPE 1 DIABETES	TYPE 2 DIABETES
Did you experience the symptoms of hypoglycemia?		
Yes	15 (8.3%)	179 (60.3%)
No	165 (91.7%)	118 (39.7%)
Did you check your blood glucose levels if symptoms of hypoglycemia developed?		
Yes	160 (88.9%)	214 (72.1%)
No	20 (11.1%)	83 (27.9%)
What did you do if symptoms of hypoglycemia developed during this time?		
Continued to fast	175 (97.2%)	244 (82.2%)
Stopped fasting	5 (2.8%)	53 (17.8%)
Visited a doctor	0 (0.00%)	0 (0.00%)
Required hospitalization	0 (0.00%)	0 (0.00%)
Did you experience the symptoms of hyperglycemia?		
Yes	78 (43.3%)	208 (70%)
No	102 (56.6%)	89 (30%)
Did you check your blood glucose levels if symptoms of hyperglycemia developed?		
Yes	163 (90.6%)	238 (80.1%)
No	17 (9.4%)	59 (19.9%)
What did you do if symptoms of hyperglycemia developed during this time?		
Continued to fast	158 (87.8%)	256 (86.2%)
Stopped fasting	22 (12.2%)	41 (13.8%)
Visited a doctor	0 (0.00%)	0 (0.00%)
Required hospitalization	0 (0.00%)	0 (0.00%)

Conversely, hyperglycemic symptoms were recognized in 43.3% of patients with type 1 diabetes and in 70% of patients with type 2 diabetes. Blood glucose levels were checked by 90.6% of patients with type 1 diabetes and by 80.1% of patients with type 2 diabetes on the development of hyperglycemic symptoms. Approximately 12.2% of patients with type 1 diabetes and 13.8% of patients with type 2 diabetes interrupted

their fast when they experienced symptoms of hyperglycemia. None of the patients with either type 1 or type 2 diabetes developed diabetic ketoacidosis nor did they experience a hyperglycemic hyperosmolar state during fasting; none of the patients required hospitalization. Table 4 shows the frequency with which hypoglycemia and hyperglycemia were experienced by the patients during Ramadan.

## Discussion

In this study population, we observed that 37.7% of patients had type 1 diabetes. This proportion was similar to those in other studies conducted in Saudi Arabia (27.7%). On the other hand, the proportion of type 1 diabetic patients was rather low in other countries (1.1%–8.7%).<sup>7</sup>

Moreover, we observed that most patients (76%) were able to fast during Ramadan. Similar results were observed in another study that demonstrated how 43% of patients with type 1 diabetes and 79% of patients with type 2 diabetes fasted during Ramadan.<sup>7</sup> None of our patients required hospitalization for any acute diabetes-related complications throughout the fasting period. Similarly, hospitalization during Ramadan was rare in The Multi-Country Retrospective Observational Study of the Management and Outcomes of Patients with Diabetes during Ramadan (the CREED study), as approximately 0.5% of patients required hospitalization throughout the course of that study.<sup>14</sup>

Patients' awareness and recognition of the symptoms of hypoglycemia and hyperglycemia, as well as the associated complications during fasting were well recognized by most of our patients (84% and 85%, respectively). Only 54.3% of our study population received instructions and knowledge about diabetes during Ramadan. This finding is in alignment with the results of a study by Al-Amoudi et al,<sup>15</sup> which showed that only 30% of patients received education and advice about fasting during Ramadan. Blood glucose monitoring during Ramadan is required for high-risk patients who choose to fast, as this will help them to break the fast if their blood glucose levels are  $<70$  mg/dL ( $<3.9$  mmol/L) or  $>300$  mg/dL ( $16.7$  mmol/L).<sup>16</sup> Most of the patients in this study monitored their blood glucose levels once per day or they did so if they experienced symptoms of hypoglycemia or hyperglycemia while fasting. However, for low-risk diabetic patients, it is advisable that they perform blood glucose monitoring at the following times: pre-Suhoor, midday, pre-Iftar, and whenever the symptoms of hypoglycemia or acute illness occur.<sup>15</sup>

Fasting during Ramadan is associated with unavoidable changes in meal frequency and eating patterns, as people consume less food and higher calories. Therefore, both the dosage and timing of antidiabetic medication administration are adjusted accordingly. In this study, two-thirds of patients changed the timing of their medication administration, as well as their medication dosage, during Ramadan; the decision to do so was either based on the advice of their healthcare providers, or they did so when they developed symptoms consistent with hypoglycemia.

Studies examining physical activity especially exercise among diabetic patients during Ramadan have not shown any negative effects. In fact, engaging in light to moderate levels of physical activity on a regular basis is encouraged, as is performing normal levels of physical activity.<sup>10</sup> However, it is better to avoid vigorous exercise during daytime fasting, especially for the few hours dedicated to the sunset meal, as it may increase patients' risk of hypoglycemia.<sup>10</sup> In this study, most of the

diabetic patients did not exercise during Ramadan. This may be explained by the lack of sufficient education on the type and time of the physical activity that is appropriate during this period. Moreover, the study by Ahmedani et al<sup>13</sup> showed that most of the patients with type 2 diabetes followed the medical advice that was provided to them; those patients who initially engaged in moderate/high-intensity physical activity before Ramadan eventually switched to light exercise during Ramadan. Other studies reported that most of the diabetic patients avoided engaging in physical activity during Ramadan due to the fear of hypoglycemia<sup>17,18</sup>; however, most patients admit that they continued their usual daily physical activity.

In this study, the prevalence of symptomatic hypoglycemia while fasting was 8.3% and 60.3% in patients with type 1 and type 2 diabetes, respectively; of note, most of these episodes were mild. This finding is in keeping with those of other studies, which showed a 4-fold to 7.5-fold increase in hypoglycemic events among these patients during fasting.<sup>7,11</sup> When describing how patients handled the onset of symptoms of hypoglycemia, most patients reported drinking lots of juice and fluids, and around one-third stated that they used a glucagon injection. Most participants (80%) were also aware that they needed to eat the predawn meal late at night before going to sleep. Furthermore, none of the patients in the study developed diabetic ketoacidosis nor did they experience a hyperglycemic hyperosmolar state. Also, no patients required hospitalization for symptomatic hypoglycemia; this finding could be attributed to the fact that many patients in this study consumed a lot of fluid at night; it may also be the result of the delayed suhoor/dawn. Conversely, considerable proportions of patients with type 1 and type 2 diabetes (43% and 70%, respectively) reported that they experienced symptomatic hyperglycemia; these rates were higher than those of other studies, which provided estimates of around 16%.<sup>13</sup> Our results may have resulted from the excessive consumption of sweets and simple carbohydrates, especially during the sunset meal. Furthermore, 36% of patients ate sweets during Iftar. This finding is similar to those of another study, which showed that there was a higher tendency to overeat during the nonfasting time. A study in Malaysia reported that more than half of the patients consumed highly refined sugars on breaking the fast during Ramadan.<sup>17,19,20</sup>

Our patients reported that fasting helps them maintain good diabetic control during Ramadan; similar findings were also reported in previous studies.<sup>17,19</sup> Ensuring that patients possess adequate knowledge related to how to manage their diabetes is essential for ensuring that they are engaging in appropriate practices when fasting during Ramadan. In one study that was conducted in Malaysia, low levels of knowledge and inappropriate diabetes-related practices were reported.<sup>20</sup> Similarly, another study found that more than half of their patients continued to fast against medical advice.<sup>18</sup> In keeping with this finding, another study conducted in Singapore reported deficiencies in their patients' general knowledge of diabetes management, and the participants

identified the need for more health education prior to fasting.<sup>21</sup> In this study, half of our patients received instructions on how to fast safely, and they were also provided with information on how to appropriately manage diabetes during Ramadan. However, two-thirds of diabetic patients wanted additional information related to best practices when fasting for Ramadan.

It is well recognized that structured education programs can help empower diabetic patients to improve their general knowledge of diabetes, as well as their knowledge of diabetes management while fasting. The results of this study suggest that there are knowledge deficits and inappropriate practices among Muslim patients with diabetes, and the findings further emphasize the need to implement health care provider-led, Ramadan-specific diabetes education programs to educate diabetic patients on how to manage their condition while fasting to ensure patient safety and to prevent the onset of acute complications.

Various studies have demonstrated that interventional education programs, such as the ones used in the Ramadan Education and Awareness in Diabetes study and the Ramadan Prospective Diabetes study, were effective at minimizing the occurrence of acute complications.<sup>11</sup>

Furthermore, the Ramadan Specific Diabetes Education (RSDE) study found that patients who received this type of education tended to engage in safer fasting practices when compared to those who did not receive this type of education.<sup>22</sup>

These programs were also able to reduce the development of diabetes-related complications that was observed while patients fasted during the EPIDIAR study [7]. Also evident was the fact that structured educational and interventional programs are important for diabetic patients. These programs are also particularly beneficial if healthcare professionals wish to bridge the current knowledge gap to foster safe fasting practices during Ramadan. Such educational programs can empower patients to engage in lifestyle modifications during Ramadan, while simultaneously minimizing the risk of developing any potential adverse effects associated with fasting. These programs should ideally take place 6–8 weeks before the start of Ramadan [23–26]. This was emphasized in the most recently published guidelines on Diabetes and Ramadan.<sup>27</sup>

There are limitations to this study that the design does not allow us to characterize the status of the 2 groups (type 1 vs type 2) and those on oral agents and on insulin separately. This will allow treating physician to closely monitor patients who may be more likely to have more complications during Ramadan. Future studies are needed to more thoroughly describe those with poor knowledge of diabetes mellitus and correlate with the outcomes (eg, hypoglycemia) and to identify the overall characteristics of subjects with poor outcomes, particularly hypoglycemia. Moreover, it would be instructive to know whether satisfactory knowledge translated into positive outcomes.

## Conclusions

Our study revealed that diabetic patients who attended a specialized clinic at a tertiary health care center lacked information on diabetes, in general, as well as on the practices associated with safe fasting during Ramadan. The findings of this study could have major implications for the incidence of diabetes-related complications. The development and implementation of public health programs that address diabetes management prior to the holy month of Ramadan are very important. These programs will promote safe fasting practices and prevent diabetes-related complications. We believe that health care providers should be educated and trained to deliver appropriate advice to ensure safe fasting practices during Ramadan.

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## Author Contributions

Study design: MA; Data collection: SA; Data analysis MA and SA; Wrote first draft of manuscript: MA and IH; Contributed to writing of manuscript: MA and FA; Agree with Manuscript result and conclusion: MA and FA; Made critical revision and approved final version: MA, AA and FA. All authors reviewed and approved of the final manuscript.

## Ethical Approval

This study was approved by the institutional review board of King Fahad Medical City, Riyadh, Saudi Arabia.

## Informed Consent

Written informed consent was obtained from each patient, enabling us to reproduce the information appearing in this work.

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