Fasting of Ramadan in peoples with diabetes in Benghazi, Libya: an exploratory study

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Background: The epidemiology of diabetes and Ramadan fasting was reported from many Muslim countries, but not from Libya.
Methodology: We interviewed 493 consecutive diabetic patients at Benghazi Diabetes and Endocrine Center for the potential complications of fasting during Ramadan.
Results: We found 70% of diabetic patients completed the 30 days of Ramadan fasting. Hypo- and hyperglycemia was the most commonly reported complications especially during the first two weeks of Ramadan month.
Conclusion: It seems majority of diabetic patients in Libya manage to fast during Ramadan month. Patient education and early planned adjustment of diabetic medication is needed to decrease the frequency of diabetic complication during Ramadan month.

Keywords: *diabetes*; *hypoglycemia*; *hyperglycemia*; *fasting*; *Ramadan*

Ramadan fasting for diabetics represents a challenge to both patient and physician. The study of epidemiology of diabetes and Ramadan (EPI-DIAR study) reported that about 43% of type-1 and 79% of type-2 patients managed to fast a minimum of 15 days (1). However, although the study included patients from 13 Muslim countries, it did not involve patients from Libya. In Libya it is estimated that there are about 300,000 diabetics, most of whom are adults who try to observe fasting each year (2, 3). Since culture, educational level and the standards of care vary widely between different Muslim countries, we think that fasting and complication patterns among Libyan diabetics might not be similar to those in other Muslim countries. Moreover, only a few small studies have been done in Libya on diabetes and Ramadan fasting (4, 5).

Aims and objectives

The purpose of this study was to define the frequency of fasting and incidence of complications among Libyan diabetic patients during Ramadan.

Subjects and methods

Benghazi is the second largest city in Libya with population of about 670,797 inhabitants and 14.1% prevalence rate of diabetes mellitus (DM) (6), with type-1 constituting about 6% of all cases. We interviewed and reviewed the records of 493 consecutive diabetic patients who attended the Benghazi Diabetes and Endocrine Center (BDEC) during the first week after Eid Elfitr 1429 Hijri (2008), and a standard form was filled by the authors. The following parameters were assessed: age, sex, type of diabetes, duration of diabetes, type and doses of treatment before and during Ramadan, level of HbA1c within three months before Ramadan, number of non-fasted days, causes of breaking the fast, number and time of self-reported hypo- and hyperglycemic episodes, and any history of hospital admission during the preceding Ramadan and the reason for it.

Hypoglycemia was defined as symptoms that were perceived by the patient as hypoglycemia and urged him/her to break fast with or without documented low blood glucose, and it was categorized as severe or mild. A severe hypoglycemic episode was defined as the episode that

Table 1. General characteristics of the study group

	Males	Females	*p*-value	Total
Number of patients	248	245		493
Mean age (years)	60.2±12.7	57.9±10.5	0.029	59±11.7
Mean duration of diabetes (years)	11.4±7.5	11.2±7.8	0.7	11.3±10
No dose change	27.4%	26.1%	0.74	26.8
Mean number of fasted days	29.24±2.6	27.8±5.9	0.001	28.5±4.6
Fasted complete month	73.8%	66.9%	0.09	70.4%
≥15 days fasting	99.6%	95.6%	0.003	97.5%
Mild hypoglycemia	14.1%	15.1%	0.75	14.6%
Severe hypoglycemia	1.6%	4.9%	0.04	3.2%
Hyperglycemia	12.9%	9.4%	0.21	11.2%
Admission	4.8%	5.3%	0.81	5.1%
Type-2	94.4%	95.9%	0.42	95.1%
Mean HbA1c	7.9%±1.7	7.6%±1.4	0.26	7.8%±1.6
HbA1c checked 3 m	37.9%	40%	0.63	38.9%

± Refers to standard deviation. HbA1c checked 3 m: Percent of patients who had their HbA1c checked within three months before Ramadan.

could not be treated by the patient alone, but required assistance from another person. Mild hypoglycemia was defined as a hypoglycemic episode that was treated by the person with diabetes alone without need for assistance. Severe hyperglycemia was defined as a self-reported blood glucose level ≥300 mg/dl.

Statistics

Data were expressed as mean±standard deviation (SD) and differences between groups were tested using the Chi-squared test and independent-samples *t*-test.

Differences were considered significant when the *P*-value was <0.05.

Results

Of the 493 patients, 95% were type-2 diabetics, 50.3% were males and 39% had their HbA1c checked within three months before Ramadan. Mean age was 59±11.7 years, mean duration of diabetes was 11.3±10 years, and mean HbA1c (for those who had HbA1c results) was 7.8±1.6. About 27% of the patients had no treatment changes during Ramadan fasting. The mean number of fasted days was 28.5±4.6 days. About 70.4% of patients completed 30 days of fasting and 97.5% fasted at least 15 days (Table 1). The main reason of breaking the fast was hypoglycemia (43.4% of causes) followed by severe hyperglycemia (27%), while other causes constituted about 30% (Fig. 1). About 14.6% experienced mild hypoglycemia, 3.2% had severe hypoglycemia and 11.2% had severe hyperglycemia. Only 5.1% were admitted to hospital during the study period (Table 1). There was no significant difference between type-1 and type-2 diabetics regarding number of days fasted, frequency of

hypoglycemia or severe hyperglycemia, or admission rate during Ramadan (Table 2). Among type-2 diabetic patients during Ramadan fasting, 77.3% were on insulin therapy, 20.5% were on oral anti-diabetics, and 2.2% were on diet control alone. There was no significant difference between those who were treated with insulin or with oral anti-diabetic agents in the mean HbA1c, mean number of fasted days, admission rate or incidence of hypoglycemia, or severe hyperglycemia (Table 3).

The incidence of hypoglycemia during Ramadan was 31 episodes/100 patients, while the incidence of severe hyperglycemia was 17 episodes/100 patients (Table 4). About 74% of hypoglycemic episodes and 79% of hyperglycemic episodes occurred during the first two weeks of Ramadan (Fig. 2), and about 90% of all hypo- and hyperglycemic episodes occurred during the day-time. Females had a significantly higher frequency of severe hypoglycemic episodes (4.9% vs. 1.6%, *p*=0.04) and a lower mean number of fasting days than males (27.8±5.9 vs. 29.24±2.6, *p*=0.001). Patients

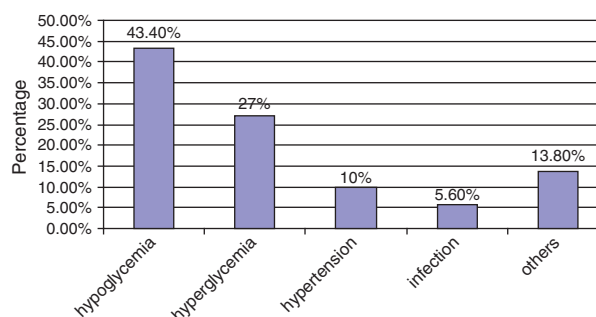*Fig. 1.* Percentage of causes of breakfasting during Ramadan.

Table 2. Comparison between type-1 and type-2 diabetics

	Type-1	Type-2	*p*-value	All
Number of patients	24	469		493
Mean age (years)±SD	38.3±15	60.1±10.5	0.000	59±11.7
Mean duration (years)±SD	14.2±11.3	11.2±7.4	0.06	11.3±10
No dose change	25%	26.9%	0.84	26.8
Mean fasting (days)±SD	27.5±6.6	28.5±4.5	0.29	28.5±4.6
Full fasting	70.8%	70.4%	0.96	70.4%
≥15 days fasting	95.8%	97.7%	0.57	97.5%
Mild hypoglycemia	20.8%	14.3%	0.3	14.6%
Severe hypoglycemia	4.2%	3.2%	0.79	3.2%
Hyperglycemia	20.8%	10.7%	0.12	11.2%
Admission	8.3%	4.9%	0.45	5.1%
Males	58.9%	49.9%	0.42	50.3%
Mean HbA1c±SD	8.2%±1.7	7.7%±1.6	0.32	7.8%±1.6
HbA1c checked	45.8%	38.59%	0.47	38.9%

Table 3. Comparison between type-2 patients according to the type of treatment

	Insulin	Oral anti-diabetics	*p*-value	Diet alone
Number of patients	357	101		11
Mean age (years)±SD	60.5±10.1	59.6±11.3	0.43	50±9.7
Mean duration (years)±SD	12.6±7.3	6.8±5.8	0.000	6.1±3.9
Mean HbA1c (%)±SD	7.8%±1.4	7.7%±1.8	0.78	7%±2.1
HbA1c checked	34.1%	47.5%	0.014	90%
Mean fasted days±SD	28.5±4.7	28.6±4.1	0.76	29.9±0.3
Mild hypoglycemia	14.2%	15.8%	0.69	0
Severe hypoglycemia	3.9%	0.99%	0.14	0
Severe hyperglycemia	10.9%	9.9%	0.76	9%
Admission rate	4.7%	5.9%	0.63	0

Table 4. Incidence of acute glycemic derangement

|	Total number of episodes	Incidence rate
Mild hypoglycemia	132 episodes	26/100 patient/month
Sever hypoglycemia	24 episodes	4.8/100 patient/month
Hypoglycemia requiring admission	1 episode	0.2/100 patient/month
Any hypoglycemia	156 episodes	31/100 patient/month
Severe hyperglycemia	84 episodes	17/100 patient/month
Hyperglycemia requiring admission	5 episodes	1/100 patient/month
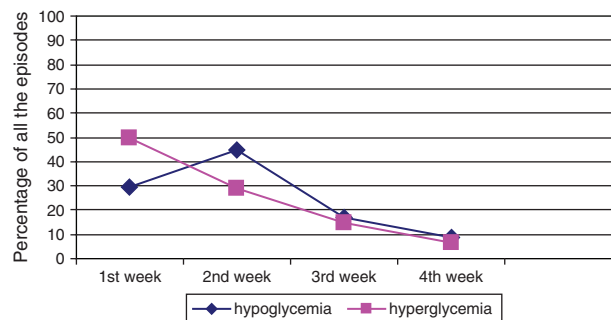
Fig. 2. Time trend of hypoglycemia and hyperglycemia during Ramadan.

Table 5. Comparison between BDEC study and EPIDIAR study

	BDEC study (Benghazi, Libya)	EPIDIAR (13 Muslim country)
Lunar year (Gregorian)	1429 Hijri (2008)	1422 Hijri (2001)
Total number of patients	493	12,243
Number of patients/country	493	757–1,357
Percentage of Type-2 DM	95.1%	91.3%
Mean age for type-1 $\pm$ SD	38.3 $\pm$ 15 years	31 $\pm$ 12.7 years
Mean age for type-2 $\pm$ SD	60.1 $\pm$ 10.5 years	54 $\pm$ 11.0 years
Mean duration of type-1 DM $\pm$ SD	14.2 $\pm$ 11.3 years	10 $\pm$ 7.6 years
Mean duration of type-2 DM $\pm$ SD	11.2 $\pm$ 7.4 years	7.6 $\pm$ 5.8 years
Dose changes during Ramadan	73.2%	27.9%
Type-1 fasting $\geq$ 15 days	95.8%	9.4–71.6%
Type-2 fasting $\geq$ 15 days	97.7%	57.8–89.8%
Mean fasting for type-1	27.5 days	18.1–25.6 days
Mean fasting for type-2	28.5 days	23.9–28.5 days
Hypoglycemia requiring admission	0.2%	2.6%
Hyperglycemia requiring admission	1%	4.7%

who experienced severe hyperglycemia had a significantly higher baseline HbA1c than other patients ($8.4 \pm 1.1\%$ vs. $7.6 \pm 1.6\%$, $p = 0.02$). They also had a significantly lower mean number of fasting days ($26.9 \pm 5.7\%$ vs. 29 ± 4, $p = 0.001$).

Discussion

Both type-1 and type-2 diabetic patients in Benghazi managed to fast more frequently than diabetics in other Muslim countries, with a remarkably lesser frequency of hypo- and hyperglycemia (Table 5). It is possible that Libyan diabetics are more motivated to fast than those in other Muslim countries. More likely, however, is that about three-quarters of the Libyan patients had some treatment adjustment during Ramadan as compared to less than one-third of those in the EPIDIAR study (1), which probably contributed to the lower rate of hypo- and hyperglycemia, and hence to a lower frequency of breaking the fasting.

The most common complications that occurred during Ramadan were hypoglycemia followed by hyperglycemia, and these were the main two reasons for breaking the fast, as reported elsewhere (1). However, both types of episodes were remarkably less frequent during the last two weeks as compared to the first two weeks, perhaps because patients adjust their dietary habits and schedules to suit their condition as the days go by.

The definition of hypoglycemia used in this study depended mainly on patients' perception of symptoms, which means that in principle episodes of hypoglycemia might go unnoticed. However, patients are probably unlikely to miss feeling a hypoglycemic episode because it would become exacerbated as the fasting continued during the day. On the other hand, we might have included some non-hypoglycemic episodes that were

interpreted as hypoglycemia by the patients. Therefore, we believe that the reported figure of the frequency of hypoglycemic episodes might be a slight overestimate rather than an underestimate of the frequency of these episodes.

There was no significant difference between type-1 and type-2 diabetics regarding fasting rate, admission rate and frequency of hypo- and hyperglycemic episodes during Ramadan. These results are contrary to the reported higher risk of complications in type-1 patients during Ramadan fasting (7). The mean HbA1c in type-1 patients was $8.2 \pm 1.7\%$, which is above the currently recommended goal of $<7\%$. If type-1 patients had a strict glycemic control with mean HbA1c level lower than 7%, it would be more likely that they will get a more frequent hypoglycemic episodes. Nevertheless the number of type-1 diabetics in this study was too few to draw conclusions.

Conclusion

Most type-2 diabetic patients in Libya managed to fast during Ramadan. Patient education and adjustment of doses throughout Ramadan is needed to decrease the risk of both hypo- and hyperglycemia. Further large studies are needed to study the effects of Ramadan fasting on type-1 diabetic patients in Libya.

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