

## ORIGINAL ARTICLE

## GLYCAEMIC CONTROL OF TYPE 2 DIABETIC PATIENTS DURING RAMAZAN FASTING

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**Background:** Among five main pillars of Islam Fasting is one of the key elements, all healthy adult Muslims have to observe fast from dawn till dusk during the holy month of Ramadan. According to a 2009 demographic study, Islam has 1.57 billion believers, making up 23% of the world population of 6.8 billion, and is growing by 3% per year. EPIDIAR (epidemiology of diabetes and Ramadan) study showed that 43% patients with type 1 and 79% patients with type2 diabetes observe fast during the month of Ramadan. Whereas those people who are suffering from diabetes and are fasting may be at risk of adverse outcomes and the risks may rise with longer fasting periods. Ideal management of diabetic patients who wish to fast during Ramadan needs to be done to avoid the complications. The purpose of this study was to observe the effect of fasting on glycaemic control in type 2 diabetic patients during the month of Ramadan. **Methods:** This was an observational cross sectional study; it was conducted at outpatient department Jinnah institute of diabetes and endocrinology Jinnah hospital Lahore during the month of Ramadan. Patients were advised to monitor blood sugar levels for two days before and after three meals (lunch, breakfast and dinner) before Ramadan and then during Ramadan blood sugar levels were monitored for four days in first *Ashra* before and two hours after *Sehari*, for four days at noon during second *Ashra* and then for four days pre and two hours after *Iftar* in last *Ashra* of Ramadan. Patients were educated Pre-Ramadan about glucose monitoring and drug dosage adjustments were done along with dietary counselling. **Results:** Blood glucose levels two days before and during Ramadan fell within range of mean glucose level of 150–187 mg/dl showing no extreme fluctuations in blood glucose levels only one patient reported symptomatic and biochemical hypoglycaemia severe enough to break the fast at noon. **Conclusion:** We concluded that in Ramadan fasting, type 2 diabetic patients with proper education, dietary counselling and drug dosage adjustments glycaemic control can remain in safe acceptable range preventing any life-threatening complication.

**Keywords:** Type 2 Diabetes; Fasting; Ramadan; Glycaemic control

J Ayub Med Coll Abbottabad 2017;29(1):102–6

## INTRODUCTION

It is estimated that there are 1.1–1.5 billion Muslims worldwide, comprising 18–25% of the world population.<sup>1</sup> Fasting during Ramadan, a holy month of Islam, is an obligatory duty for all healthy adult Muslims.<sup>2,3</sup> One of the most important components, among five main pillars of Islam is fasting; all healthy adult Muslims have to observe fast from dawn till dusk during the holy month of Ramadan. According to a 2009 demographic study, Islam has 1.57 billion believers, making up 23% of the world population of 6.8 billion, and is growing by 3% per year. There is 4.6% prevalence of diabetes worldwide.<sup>4</sup> Coupled with the results of the population-based Epidemiology of Diabetes and Ramadan 1422/2001 (EPIDIAR) study, which showed (in 12, 243 people with diabetes from 13 Islamic countries) that 43% of patients with type 1 diabetes and 79% of patients with type 2 diabetes fast

during Ramadan,<sup>5</sup> lead to the estimation that some 40–50 million people with diabetes worldwide fast during Ramadan. EPIDIAR (epidemiology of diabetes and Ramadan) study also showed that 43% patients with type 1 and 79% patients with type2 diabetes observe fast during the month of Ramadan.<sup>5</sup> People with diabetes that fast are at risk of severe outcomes and the risks may enhance with longer fasting periods. Proper care of diabetic patients who fast during Ramadan needs to be done to prevent any complications.<sup>6</sup> A better understanding about fasting Ramadan and its risks is an important step for all healthcare professionals dealing Muslim people with diabetes. This necessitates educating patients besides tailoring the treatment to meet the needs of diabetic patients to reduce the possible risks.<sup>7</sup>

Most significant complication related to fasting in diabetic patients is Hypoglycaemia, Hyperglycaemia, Diabetic ketoacidosis,

Dehydration and thrombosis.<sup>7</sup> Professional opinion recommends that if a patient has made it clear that he or she desire to fast during Ramadan their key physicians and diabetes care experts should evaluate their health risk and livelihood to help them fast as carefully as possibly giving Ramadan focused education which include planning for food and advice for diet, Workout blood glucose observation, and recognizing and managing complications. Dose and timing of medicines should be adjusted on individual basis and strong follow-up is necessary to decrease the risk for increase in complications.<sup>6-8</sup> Recommendations and suggestions concerning safe fasting from expert physicians depend on personal experiences and evidence based guidelines and evidence based guidelines are missing.<sup>8</sup> Further research is needed to help expand knowledge concerning the risks and management issues related to fasting in patients with diabetes.<sup>7</sup> The purpose of this study is to access the glycaemic control and any extreme blood glucose level variations which may have adverse effects during fasting in type 2 diabetic patients. The objective of study was to assess the effect of fasting on glycaemic control in type 2 diabetic patients during month of Ramadan.

## MATERIAL AND METHODS

A cross sectional study was conducted at Medical and endocrinology OPD departments Jinnah hospital Lahore. A non-probability purposive sample was taken. Sample size of 33 was calculated from EPIDAR study with 95% confidence interval, 10% acceptable error and a standard deviation of .28 for episodes of severe hypoglycaemia among type II diabetic patients during fasting. We included patients of either gender between ages of 30–55 years having type II diabetes mellitus of more than two years taking oral hypoglycaemic agents or Insulin and were regularly fasting during past years and have intentions to fast during the holy month. Patients who at least 20 fasts observed were included in the study. Type 1 diabetic patient and those type 2 Diabetic patients who want to fast but after medical assessment were unfit for fasting, were excluded from study. Patients having HbA1c more than 10.5 before Ramadan, with co morbidities such as advanced micro-vascular complications, chronic liver disease and advanced chronic kidney disease, stroke, Pregnant and lactating women were excluded from study.

Fulfilling the inclusion criteria 33 subjects were selected, after approval of hospital ethical committee and taking informed consent from patients. Demographic details (including name, age, gender, contact) were recorded. Patients were given Ramadan specific education about diet, exercise, blood glucose monitoring and about recognizing and managing

complications, guidance about management of medication during Ramadan was given. Blood sugar levels were checked before and during Ramadan at specific timings. Before Ramadan a two-day profile of blood sugar levels was obtained pre and two hour post breakfast pre and two hour post lunch and pre and two hour post dinner for baseline readings while during Ramadan BSL levels were checked before and 2 hours after *Sehari* for 4 days in 1st 10 days of Ramadan, at noon for 4 days in middle 10 days of Ramadan and before and after *Iftar* in last 10 days of Ramadan. The rationale for this protocol was that Ramadan induces changes in the rhythmic pattern of a number of hormonal variables including cortisol which has an unfavourable influence on the glucose tolerance. It has also been argued that a given nutrient ingested at an unusual time can induce different metabolic effects.<sup>9</sup> Previous research has shown that, unlike in non-fasting periods, cortisol concentrations are biphasic during Ramadan fasting. These researchers reported an increase in serum cortisol starting at 1200 h that reached a plateau between 1600 and 2000.<sup>10</sup> Estimate of blood sugar level at fasting state and 2-hour post prandial coinciding with normal eating pattern of breakfast, noon with mid-day timing and pre and post *iftar* with a fasting period of 15 hours and post prandial blood glucose level at *iftar*. This will give average blood sugar of patients during 24 hours during fasting period. Any events of hypoglycaemia or hyperglycaemia were to be recorded by the patients during fast. All the information was entered in a structured questionnaire. Data was entered and analysed by using SPSS 20.0. Mean and standard deviation was calculated for numerical variables like age, Pre-Ramadan blood sugar levels and during Ramadan blood sugar levels. One way ANOVA with in groups was used to see variation between glucose levels with  $p < .05$  was taken as statistical significant.

## RESULTS

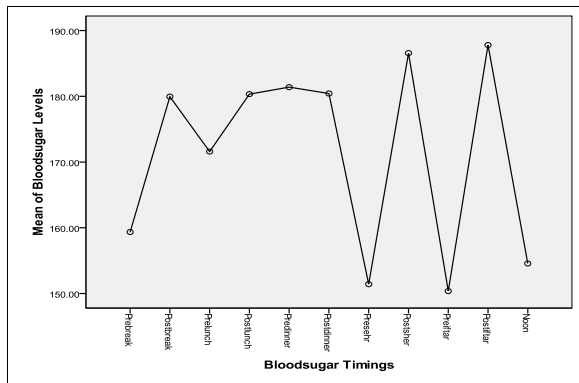
A total of 33 patients with type 2 diabetes who voluntarily fasted during month of Ramadan were recruited for the study. Mean age of patients was  $51.15 \pm 9.36$ . 42.4% were female and 57.6% were male. 72.7% patients were between 46–70 years of age. Table-1 shows mean BSL pre-breakfast was  $159.3485 \pm 50.66$ , mean BSL Post breakfast was  $179.95 \pm 54.02$ , mean BSL Pre-lunch was  $171.59 \pm 50.24$ , mean BSL Post lunch  $180.32 \pm 43.78$ , mean BSL Pre-dinner  $181.3971 \pm 51.80672$ , mean BSL Post dinner  $180.4242 \pm 41.02$ , mean BSL Pre-*sehr* was  $151.41 \pm 47.98110$ , mean BSL Post-*sher*  $186.5758 \pm 49.98$ , mean BSL Pre-*iftar* was  $150.37 \pm 37.74$ , mean BSL post-*iftar* was  $187.79 \pm 57.16$ , mean BSL at noon in Ramadan was  $154.56 \pm 46.21$ . ANOVA test was used to assess any difference of mean between groups was statistically significant.  $p < .001$ .

**Table-1: Mean blood sugar levels before and during Ramadan**

Descriptive								
Blood sugar Levels								
	n	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pre-break	33	159.3485	50.66611	8.81984	141.3831	177.3139	95.00	312.00
Post break	33	179.9545	54.02233	9.40408	160.7991	199.1100	116.00	354.00
Pre lunch	33	171.5909	50.24898	8.74723	153.7734	189.4084	92.50	322.50
Post lunch	32	180.3281	43.78864	7.74081	164.5406	196.1156	105.00	305.00
Pre dinner	34	181.3971	51.80672	8.88478	163.3208	199.4733	106.00	361.00
Post dinner	33	180.4242	41.02707	7.14190	165.8767	194.9718	113.50	290.00
Pre seher	33	151.4167	47.98110	8.35244	134.4033	168.4300	105.75	309.50
Post sher	33	186.5758	49.98295	8.70091	168.8526	204.2989	126.25	314.00
Pre iftar	33	150.3712	37.74737	6.57097	136.9866	163.7558	109.50	276.25
Post iftar	33	187.7955	57.16938	9.95191	167.5241	208.0668	103.50	365.25
Noon	33	154.5606	46.21705	8.04536	138.1728	170.9485	91.25	299.50
<b>Total</b>	<b>363</b>	<b>171.2541</b>	<b>49.85600</b>	<b>2.61676</b>	<b>166.1082</b>	<b>176.4001</b>	<b>91.25</b>	<b>365.25</b>

ANOVA					
Blood sugar Levels					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	69436.868	10	6943.687	2.944	.001
Within Groups	830357.751	352	2358.971		
Total	899794.619	362			



**Figure-1: Patterns of blood glucose level in relation to various timings during Ramzan fasting in type II diabetic patients.**

**DISCUSSION**

The holy month of Ramadan is one of five main pillars of being a Muslim. Most Muslims are passionate about fasting during this month. Many patients with diabetes keep fast during the month of Ramadan chronic metabolic disorder of diabetes may pose them at risk of complications if pattern of food and fluid is markedly altered. Quran exempt sick people from fasting if fasting might lead to harmful consequences Holy Quran ALBAKARAH 183—185.<sup>7</sup>

*O you who have believed, decreed upon you is fasting as it was decreed upon those before you that you may become righteous – [2:183]*

*[Fasting for] a limited number of days. So, whoever among you is ill or on a journey [during them] - then an equal number of days [are to be made up]. And upon those*

*who are able [to fast, but with hardship] - a ransom [as substitute] of feeding a poor person [each day]. And whoever volunteers excess - it is better for him. But to fast is best for you, if you only knew. [2:184]*

*The month of Ramadhan [is that] in which was revealed the Qur'an, a guidance for the people and clear proofs of guidance and criterion. So, whoever sights [the new moon of] the month, let him fast it; and whoever is ill or on a journey - then an equal number of other days. Allah intends for you ease and does not intend for you hardship and [wants] for you to complete the period and to glorify Allah for that [to] which He has guided you; and perhaps you will be grateful. [2:185]*

A large epidemiological study of Muslims with diabetes in 13 Muslim countries (n=12 914)—the EPIDIAR study—showed that 43% of patients with type 1 and 79% of those with type 2 diabetes fasted during Ramadan. The EPIDIAR study found that the change in eating patterns during Ramadan increased the risk of severe hypoglycemia 4.7-fold (from 3 to 14 events per 100 people per month) in type I diabetes and 7.5-fold (from 0.4 to 3 events per 100 people per month) in type 2 diabetes. It also found a fivefold increase in the incidence of severe hyperglycemia in patients with type 2 diabetes during Ramadan. In another study, Clinical and Metabolic Effects of Fasting in 41 type 2 Diabetic Patients during Ramadan number of the symptomatic hypoglycemic periods, which were not biochemically verified, increased in eight of the patients (19.5%) during Ramadan. None of the patients, however,

experienced severe hypoglycemia or neuroglycopenic symptoms.<sup>5</sup>

Many diabetic patients still insist on and keep fast during the month of Ramadan posing a management challenge for themselves as well as for healthcare personals. It is important to know the potential risks and complications that patient might come across during fasting. Limited prospective and retrospective studies are available on effect of fasting in type 2 diabetic patients during the month of Ramadan. Our study is one of the connecting links between for awareness about glycaemic trends during fasting.<sup>4</sup>

In this study, we found that the blood sugar levels in fasting type 2 diabetic patients were on higher sides between Ramadan timings. In pre *sehr* was 105.75–309.50 mg/dl, in post *sehr* 126.25 to 314.00 mg/dl, in pre *iftar* it was 109.50–276.25 mg/dl, post *iftar* BSL was 103.50–365.25 mg/dl and at noon was 91.25–299.50 mg/dl. In another prospective study in Ramadan this range was 99–199 mg/dl.<sup>6</sup> Only one patient during our study had hypoglycaemia enough at midday to break the fast. Complications regarding the extreme fluctuations of glycaemic control needing hospitalizations were not reported. One study showed less than 1% hypoglycaemic episodes.<sup>11</sup>

In another retrospective study of glycaemic trends during Ramadan in fasting diabetic subject's frequency of hypo and hyperglycaemia were 21.7% and 18.8% respectively whereas 4% patients had major hypoglycaemic episodes and 8% had major hyperglycaemic episodes.<sup>9</sup>

The safe range of glucose levels (less hypoglycaemia) in our study might be attributable to patient education about fasting and precautions advised to be taken about diet drug dosage adjustment and regular follow-up of Patients during Ramadan.

Study done by Sadiya *et al* on effect of Ramadan on metabolic markers showed no patients experience complications or increased symptoms of hypoglycaemia during Ramadan. Total energy consumption remained similar to pre-Ramadan despite meal frequency decreased (3.2±0.5 vs 2.1±0.4 meals/day). Fasting P-glucose (6.3±1.7 vs 6.8±2.0 mmol/L,  $p=0.024$ ).<sup>11</sup> Sari *et al* in his study showed body weight, fasting plasma glucose, fructosamine, HbA1c, total cholesterol was not changed in groups during the study. ( $p=0.024$ ). Only one hypoglycaemic event occurred at day 6 of Ramadan in patients in and that was in patient with high dose of oral hypoglycaemic agent.<sup>12</sup>

The mean glucose ranges before and during Ramadan were in match able ranges showing the patients were able to keep blood

glucose control in comparable ranges to Pre-Ramadan levels. In a multicentre prospective study done in Pakistan of patients with type 1 and type 2 diabetes, 33.33% and 48% discontinued their fast when they felt hypoglycaemic symptoms, respectively. None of the patient with type 1, while 18.87% patients with type 2 diabetes discontinued fast on the development of hyperglycaemic symptoms. Drug dosage and timing were altered in 80% patients with type 1 and 90.5% patients with type 2 diabetes during Ramadan. Majority of the patients with type 2 diabetes changed from moderate/severe levels of physical activity before Ramadan to light physical activity during Ramadan ( $p<0.000$ ).<sup>13</sup>

Our study showed that safe fasting without extreme fluctuations of blood sugar levels is possible in type 2 diabetic patients if they keep in touch with their physicians in pre-Ramadan period for dietary and life style education and their medication adjustments and also during Ramadan active glucose monitoring and close follow up with the concerned physician will help to keep safe fast in type 2 diabetic patients. Further prospective studies are needed to support our results as well as to explore new problems faced by type 2 diabetic patients.

Strengths of our study were actively involving volunteer fasting patients in Pre-Ramadan counselling and medication modifications and providing help services if they needed during the month of Ramadan which made them fast safely. Limitation of our study was small sample size and resource limitations.

## ACKNOWLEDGEMENTS

We acknowledge the support of our supervisor Dr. Khurshid Ahmad Khan and staff of Jinnah institute of diabetes and endocrinology especially Miss. Maria Sarfaraz, Kamran Albert and Abdul Ghaffar and Dr. Mamoon Akbar Qureshi from community medicine department for invaluable support and help.

## AUTHORS' CONTRIBUTION

UM: Main author, Manuscript writing, data collection, follow up of patients. NM: Data collection, patient follow up, help in stats. KAK: Supervisor. MH: Discussion writing. FAR: Discussion writing & manuscript review. SS, AR: Data collection. KW: Peer review

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Received: 1 September, 2016

Revised: --

Accepted: 18 December, 2016

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