

Post-Ramadan Reduction in HbA1c Levels in Young People with Diabetes who Fasted During Ramadan 2022 in Bangladesh

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Received: 19 December 2025

Accepted: 26 December 2025

Published: 12 January 2026

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Abstract

Introduction: Recent studies have demonstrated that individuals with type 1 diabetes (T1D) can fast during Ramadan provided they comply with the Ramadan focused management plan and are under close professional supervision.

Objectives: The study was conducted to assess the safety, changes in hemoglobinA1c, insulin dose, episodes of hypoglycemia in young people with diabetes who did fasting during Ramadan.

Methods: Two hundred forty-three patients with T1D and other types who insisted on fasting were enrolled one month prior to Ramadan 2022. Patients with their caregivers were given a guideline on Ramadan fasting by Diabetes team which included insulin dose, HMBG and dietary adjustments. We compared the basal characteristics and other parameters before and after Ramadan in children and adolescents (< 18 years) with young adults (> 18 years) with diabetes.

Results: Among the study participants 108 (44.4%) were < 18 years with pre Ramadan median HbA1c, 8.7 [7.6-10.2] and 135 (55.6%) were young adults > 18 years with median HbA1c, 8.1[7.3-9.0]] ($p=.001$). A significantly higher number of participants 102(64.2%) were in older age who fasted for more than 15 days ($p=.0001$) and breaking the fast was more in young age group ($p=0.003$). There was reduction of Post Ramadan insulin total daily dose ($p =0.143$) and significant reduction of median HbA1c, 8.6[7.4-9.5] in young and in older group 8.0[7.2-9.0] after Ramadan ($P = 0.016$).

Conclusions: Our data supports Ramadan focused diabetes education with proper care, young people with diabetes can fast safely with improved glycemic control after Ramadan.

Keywords: Fasting, HbA1c, Ramadan, T1 Diabetes, T2 Diabetes.

1. INTRODUCTION

Ramadan fasting is one of the five pillars of Islam and is obligatory for all healthy adult and adolescent Muslims from the time of completing puberty.¹ The duration of fasting during Ramadan varies based on geographical location and season but is mandated to be between dawn and dusk. As Fasting affects the body's homeostasis, metabolic environment, fluid balance, young people with type 1 diabetes mellitus (T1DM) are considered at increased risk for complications during Ramadan. And advise against undertaking the fast in different

guidelines^{2,3} although exempt, children and young adults with diabetes refuse to take this concession as they feel psychologically and spiritually inclined to fast along with other Muslims.⁴ Over the last two decades, there has been a significant increase in number of people with T1DM who are fasting during Ramadan.

Recent studies have demonstrated that individuals with T1DM can fast during Ramadan provided they comply with the Ramadan focused management plan and are under close professional supervision.⁵ In many diabetes centers managing Muslim populations,

healthcare professionals agree that adolescents can fast if they have reasonable glycemic control, good hypoglycemia awareness, and the willingness to frequently monitor their BGLs during fasting.⁶ Safe fasting is possible during Ramadan through Ramadan focused diabetes education and monitoring under supervision of Diabetes Team. Eid et al. showed that an educational program consisting of weekly sessions before and during Ramadan, enabled people with diabetes to fast safely, with a reduced number of hypoglycemic events per month.⁷

Over the past decade, several studies have evaluated fasting among adolescents with T1DM and its associated safety during the month of Ramadan. In our recent studies we found that patients with poor control could fast safely without any severe acute complication if they are provided Fasting-focused education.^{5,8}

This study was conducted to see the safety, number of fasting days, breaking the fasting days, episodes of hypoglycemia, hyperglycaemia, changes in insulin dose and HemoglobinA1c, in patients after Ramadan who fasted during 2022 Ramadan in Bangladesh.

2. METHODS

This prospective study included young people with diabetes aged 10 to 26 years who came for routine follow up 1 to 2 months before Ramadan at BADAS Paediatric Diabetes Care and Research Center in BIRDEM, Dhaka, Bangladesh. The Ramadan in Bangladesh was between April 03 to May 02 in 2022. Pre-fasting assessment was done to ensure the suitability and safety of fasting in young people with diabetes. The criteria of inclusion were diagnosis of all types of diabetes (diagnosed was established by clinical parameters with local criteria as T1DM, T2 DM, FCPD and other types) who were having no other complications.⁹⁻¹¹

They were asked to record about adverse events, including mild to severe hypoglycemia, hyperglycemia, DKA or admission to hospital if required and to maintain SMBG books. A structured Ramadan education session was organized giving emphasis on insulin dose adjustment, dietary education, carb counting and SMBG one month prior to Ramadan and printed materials were distributed among them. Patients were instructed to break the fast if their blood sugar level was <4 mmol/L or if they experience symptoms of hypoglycemia and if their blood glucose level >16.7 mmol/L.¹² A structured

Ramadan focused education session was given with emphasizing on self-monitoring blood glucose (SMBG), insulin dose adjustment and carb counting. They were instructed to do blood glucose test at PreIftar, PreSohur, mid-afternoon, and at any time during the day when they feel symptoms of hypoglycemia and record along with the insulin dose. T1 D patients were on multiple daily insulin injections (MDI) with regular insulin and NPH, the changing dose was recorded. Telemonitoring follow up after first week of Ramadan with review of SMBG logs and insulin doses adjustment was done during Ramadan. HbA1c was done during post Ramadan follow up. Demographic and basic clinical information were retrieved from the patient's previous records. We compared the basal characteristics and other parameters and the follow up HbA1c with insulin doses in children and adolescents (<18 years), with young adults (≥18 years) with diabetes.

2.1. Ethical considerations

The study was approved by the Ethical Review Committee of the Diabetic Association of Bangladesh. Informed consent was taken from patients and parents.

2.2. Statistical analysis

Data analysis was performed by Statistical Package for the Social Sciences program version 26. Descriptive statistics are presented as mean(±SD) scores for normally distributed data and median (interquartile range or range) for skewed data. Continuous data were compared using parametric test Anova and skewed data using the non-parametric test Kruskal-Wallis test. Differences in demographic characteristics and clinical outcomes between participants <18 years and ≥18 years old were tested using chi-squared analysis. All applied statistical tests were two-sided, p-values <0.05 were considered as statistically significant.

3. RESULTS

3.1. Basic Characteristics

Two hundred forty-three patients with T1D and other types who insisted on fasting and met the inclusion criteria were enrolled one or two months prior to Ramadan 2022. The median age was 19[16-23] years, 141 (58.0%) were female; 158(65.0%) were type 1 diabetes, 65(26.7%) Type 2 and 20 (8.2%) were other types. All were on multiple or twice daily injections and/ or oral

drug. Majority of them 206 (84.7%) fasted in previous years.

A large number of patients (60.1%) patients did Self-monitoring blood glucose regularly 3 to 4 times a day during Ramadan. Pre Ramadan median HbA1c was 8.3[7.4-9.5]. Among the

study participants 108 (44.4%) were < 18 years 135 (55.6%) were young adults > 18 years.

Median duration of diabetes was significantly higher in older age group than younger group 11.0[8.0-12.5] vs 6.0[3.0-9.5] (p=0.0001). [Table1]

Table 1. Demographic and clinical characteristics of patients in two groups

| Parameters | Age <18 years (n=108) | Age > 18 years (n=135) | P value |
|--------------------|-----------------------|------------------------|---------|
| Age at diagnosis | 10.6[7.0–12.3] | 13.0[11.0–15.0] | .0001 |
| Current age | 15.0[13.0–17.0] | 23.0[20.0–25.0] | .0001 |
| Gender | | | |
| Male (%) | 48 (44.4) | 54 (40.0) | |
| Female (%) | 60 (55.6) | 81 (60.0) | .485 |
| Diabetes duration | 6.0[3.0–9.5] | 11.0[8.0–12.5] | .0001 |
| Types of diabetes | | | |
| Type 1 (n=158) | 72 | 86 | |
| Type 2 (n=65) | 26 | 39 | |
| Other types (n=20) | 10 | 10 | 0.653 |

Pre Ramadan median HbA1c was higher 8.7 [7.6-10.2] in younger age group compared to older age group, 8.1[7.3-9.0]] (p=.001). [Table 2]

Table 2. Clinical and biochemical characteristics of patients

| Parameters | Age <18 years (n=108) | Age > 18 years (n=135) | P value |
|---------------------|-----------------------|------------------------|---------|
| SMBG done regularly | | | |
| Yes (n=146) | 68 (46.6) | 78 (53.4) | |
| No (n=97) | 40 (41.2) | 57 (58.8) | .246 |
| Basal dose | 28.0[20.0–34.0] | 30.0[24.0–40.0] | .008 |
| Bolus Dose | 30.0[22.0–39.5] | 32.0[24.0–48.0] | .054 |
| Insulin dose (TDD) | 58.0[42.5–73.5] | 62.0[50.0–84.0] | .020 |
| HbA1c (%) | 8.7[7.6–10.2] | 8.1[7.3–9.0] | .001 |

Numbers of fasting days and breaking the fast

Among the study participants, 48 (19.7%) patients fasted all days. A large number of patients, 159(65.4%) fasted more than 15 days. Participants who were in older age group (>18

years) fasted for more than 15 days which was significantly higher in number than younger age group (p=.0001). [Fig. 1]

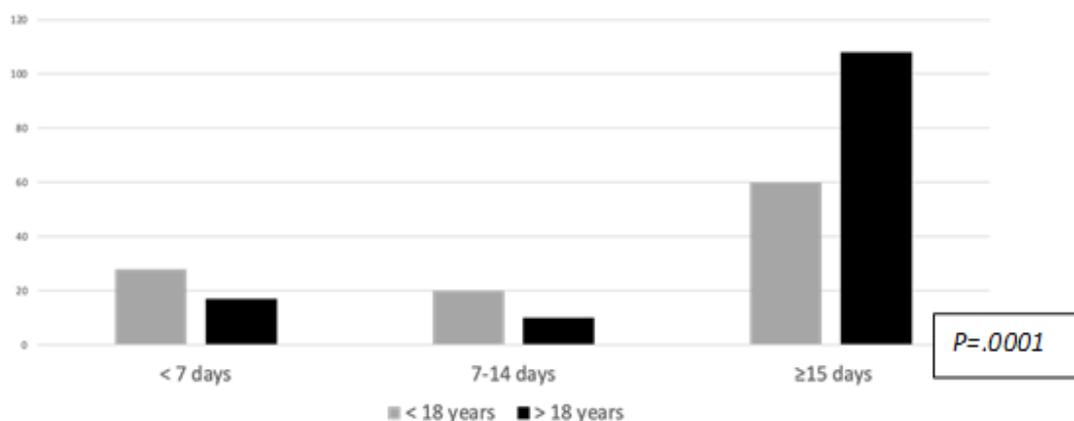


Fig 1. Comparison of fasting days during Ramadan in two groups

While considering the types of diabetes, 69.2% of type 2 and 62% of type 1 diabetes participants fasted more than 15 days among the different types of diabetes, (p= .212).

3.2. Incidence of hypoglycemia

Hypoglycemia was a common acute complication during fasting, 26.7% developed

mild hypoglycaemia and only four patients (1.6%) developed severe hypoglycemia. There was no significant difference of hypoglycaemia between (28.7 % vs 25.2%) young and older age group ($p=.538$). [Fig.2] Most of them had

hypoglycemia in pre iftar time (9.9%) mid-afternoon (8.2%) mid-morning after sehri (3.3%). Twenty-one (8.6%) patients broke the fast due to hypoglycaemia. Those who developed hypos just before iftar, did not break the fast.

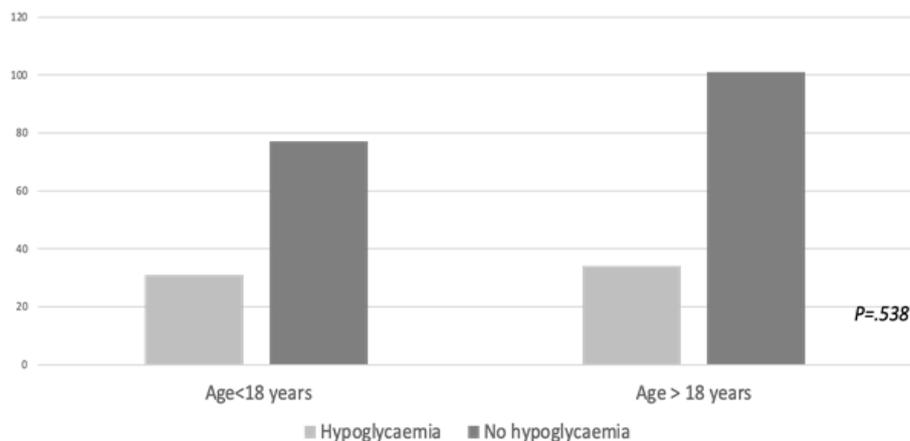


Fig 2. Incidence of Hypoglycaemia in two groups during Ramadan

3.3. Incidence of Hyperglycaemia

Hyperglycaemia was not very common in fasting hours during the day time. Only 31 (12.8%) patients, all of them were T1D who developed hyperglycaemia, mostly post iftar and sehri, few had also during pre sehri or mid-afternoon time. While comparing there was no significant difference between two groups (12.0% vs 13.3%) ($p=.784$). [Fig.3] Only seven (2.8%) patients developed severe hyperglycaemia (> 20 mmol/L) and 10 (4.1%) patients did break the fast due to hyperglycaemia. None of the fasting patients developed DKA during Ramadan.

Changes in hemoglobin A1C and insulin dose

The median HbA1c was reduced after Ramadan 8.2[7.3-9.2] in our study participants. While comparing in both groups there was significant reduction of median HbA1c ($p=.016$) in younger than older group after Ramadan [Table2]

During Ramadan insulin total daily dose was reduced in both groups ($p=.143$) [Table 3]. Although basal and bolus both doses were reduced but bolus insulin dose requirements were more reduced in both groups. [Table 3]

4. DISCUSSION

Fasting during Ramadan is not only abstinence from eating or drinking but also involves a radical change in lifestyle and usual habits which is more challenging for people with T1DM.

In a recent study, 66% (14/21) of the subjects who intended to fast completed fasting, with a mean of 26.07 ± 2.8 successful fasting days, of

them 70.1 % were Type 1 diabetes.⁷ The Epidemiology of Diabetes and Ramadan (EPIDIAR) study, which was conducted in 2001, found that as many as 42.8% people with T1DM reported fasting for at least 15 days and 78.7% of patients with T2DM fasted during Ramadan.¹³ In our study population, among 243 patients, 65.0% were type 1 diabetes and 26.7% were Type 2 and 8.2% were other types who fasted during Ramadan. Among older participants, 64.2% could fast more than 15 days which was consistent with our previous and other studies.^{5, 14} A large number of our patients had fasted in previous years and had the Ramadan based education in previous years including this year which may have made them confident enough to fast more days in this Ramadan. Several studies including our previous study have shown that people with T1DM, including many adolescents, with the Ramadan based appropriate education, and supervision by Diabetes Team can fast safely during Ramadan.¹⁵⁻¹⁹

Hypoglycemia is a common acute complication during fasting. Previous studies have shown that counseling stringently applied in the pediatric diabetes clinic by health care providers before Ramadan about the importance of diet, exercise, dose adjustment and that regular glucose monitoring is vital to avoid complications reassuring them that this does not invalidate the fast reduces the incidence of hypoglycaemia.^{3,20} The role of structured education in reducing the acute complications of diabetes is well established, and guidelines state that this

structured education should be extended to Ramadan-focused education programs so that people with diabetes can make informed decisions.^{2,3} in a recent study that compared the patients with diabetes who participated in structured education program with patients with diabetes who did not participate they found a significant decrease in the total number of hypoglycaemic events in the educational program group.²¹

In this study few patients (26.7%) developed mild hypoglycaemia, only 1.6% developed severe hypoglycaemia which was lesser than our previous study, 30.7% of patients developed mild hypoglycaemia, and 2.6% developed moderate to severe hypoglycemia.⁵

The reduction of event of hypoglycemia may be the result of the providing structured education, weekly telemonitoring follow-up with SMBG logs, and insulin dose adjustment accordingly. The structured Ramadan focused diabetes education program can enable people with diabetes to reduce their risk of severity of hypoglycaemia during fasts. Several studies have found that the incidence of severe hypoglycemia was negligible in people with T1DM during Ramadan fasting²²⁻²⁶

Studies have shown that hypoglycemia has been typically encountered during the hours preceding *Iftar*.²⁷ In our study participants, around 10% had hypoglycemia in pre iftar time and 8.2% at mid-morning after sehri. Monitoring blood glucose during fasting is essential to predict, prevent, and treat hypoglycemia. Those who developed hypos just before iftar, did not break the fast in our population which was found in previous studies though people are usually advised that the fasting should be interrupted if significant hypoglycemia arises.²⁸ Most of our patients were on NPH insulin and developed very few episodes of hyperglycaemia at the end of the day though based on the pharmacodynamic profile of NPH, there is a considerable risk of mid-day hypoglycemia and end of the day hyperglycemia.²⁹

Although much of the focus during Ramadan is related to hypoglycemia, however, the studies have reported severe hyperglycemia with ketoacidosis.³⁰⁻³² in our study participants, 12.8 % patients developed hyperglycaemia, 4.1% of them broke the fast and none of them developed DKA. In DaR Global survey, 44.8% participants reported hyperglycemia and this occurred with no significant difference in the participants aged

<18 years and ≥18 years.¹⁴ Majority of our patients fasted in previous years and had structured Ramadan focused education before Ramadan each year which may have an impact of reducing hyperglycaemia.

It is recommended that during Ramadan, the pre-Ramadan basal insulin dose should be reduced by 20%, when given in the evening.^{2,4,22,26,33-36} When taken at *Iftar*, a further reduction may be needed—up to 40% of the pre-Ramadan basal dose.^{3,37} The South Asian Guidelines for Management of Diabetes in Ramadan recommends reducing basal insulin by 10% to 20% during the fasting days.²⁰ In our study population there was significant reduction of basal insulin dose in both groups and more reduction in younger age group.

Pre Ramadan optimum glycaemic control is prerequisite for safe fasting in Ramadan but our previous study we found that patients with poor control could fast safely without any severe acute complication.⁸ in our study population, there was fair glycaemic control in both groups and marked reduction of Post Ramadan HbA1c. In our recent study, though there was fair control before Ramadan but there was marked increase of Post Ramadan HbA1c. In a review, Gad et al assessment included a total of nine observational studies and showed that there was no difference in the change of HbA1c.³⁸ the emphasis on dietary education with carb counting, insulin dose adjustment during fasting and telemonitoring may play role for reduction of HbA1c after Ramadan.

Over the past decade, several studies have evaluated fasting among adolescents with T1DM and its associated safety during the month of Ramadan. The recommendation to fast varies among different countries, depending on different cultural perspectives and religious views. In many diabetes centers with a Muslim population, health-care professionals agree that adolescents can fast if they have reasonable glycemic control, good hypoglycemia awareness and are willing to frequently monitor their blood glucose levels during the fasting.²⁰

Our patients were more in older age, compared to our previous study probably have developed self-care, more attentive to the treatment regimen may have played a role in less complications with post Ramadan HbA1c reduction as the insulin adjustment was done by themselves with the help of Diabetes team. Moreover, we also assumed that parental and Health care professionals

'supervision, insulin adjustment by themselves, and receiving Ramadan focused structured education in previous years are the main reasons for lower hypoglycemia episodes and improvement of HbA1c in our patients.

This Study has some limitations as information were collected from the patients and based on documentation of self-reporting of some information - the incidence of hypoglycemia, hyperglycaemia, insulin dose and the management of diabetes. Although self-reporting may be affected the data, but hypoglycemia, hyperglycemia are recognized features, and especially fasting days and breaking of the fast cannot be hidden as fasting has a religious impact and a person has to compromise on fasting days. Moreover, fasting is a spiritual and religious ritual and, in our society, parents as well supervise their children vigilantly during fasting.

5. CONCLUSION

There is limited high-quality data on the management of young people with diabetes who fast during Ramadan. A well designed randomized controlled trials with insulin analogues, or insulin pumps with continuous glucose monitoring to assess glucose fluctuations throughout the fasting and eating hours is required to ensure the safety and feasibility of fasting during Ramadan. Though these new technologies are not accessible in our context, but with Ramadan focused diabetes educational program, young people with type 1 diabetes on regular and NPH insulin could fast safely with less complications and improved glycaemic control after Ramadan.

6. ETHICAL APPROVAL AND PATIENT CONSENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

7. DISCLOSURE OF ETHICAL STATEMENTS

- Approval of the research protocol: The study was approved by the local ethical committee (ERB) of Diabetic Association of Bangladesh.
- Informed Consent: Informed consent was taken from either parents or caregivers of all children.

- Approval date of Registry and the Registration No. of the study/trial: No. BADAS-ERC/EC/20/00291. September 3, 2020.
- Animal Studies: N/A

8. CONFLICT OF INTEREST

No potential conflicts of interest relevant to this article exist.

9. AUTHOR CONTRIBUTIONS

BZ and BA conceptualized the paper, ABS, ST helped in data collection, KH helped in analysis, BZ wrote the paper; BA, JN, ST and KH revised the text and BZ and KA finally edited and approved the final manuscript.

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Citation: Bedowra Zabeen et al. Post-Ramadan Reduction in HbA1c Levels in Young People with Diabetes who Fasted During Ramadan 2022 in Bangladesh. *ARC Journal of Diabetes and Endocrinology*. 2025; 11(1):1-8. DOI: <https://doi.org/10.20431/2455-5983.1101001>.

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