Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Higher HbA1c was observed in young people with diabetes who fasted during COVID-19 pandemic lockdown of 2020 Ramadan in Bangladesh – A Post Ramadan survey

Bedowra Zabeen a, b, *, Bulbul Ahmed a, Jebun Nahar a, Samin Tayyeb a, b, Nasreen Islam a, Fauzia Mohsin a, Kishwar Azad a, b

a Department of Paediatrics Bangladesh Institute of Research & Rehabilitation in Diabetes, Endocrine & Metabolic Disorders (BIRDEM), Bangladesh
b Changing Diabetes in Children Programme, Bangladesh Institute of Research & Rehabilitation in Diabetes, Endocrine & Metabolic Disorders (BIRDEM), Bangladesh

ARTICLE INFO
Keywords: COVID-19 Diabetes Fasting Ramadan Pandemic lock down

ABSTRACT
Objective: Muslim people with T1DM should be actively discouraged from fasting during the COVID-19 pandemic, as diabetes has emerged as a significant risk factor for adverse outcomes of COVID-19 infection. We report the experience of young patients with type 1, type 2 and other types diabetes who fasted during Ramadan 2020 at the time of the COVID-19 pandemic time lockdown.

Research Design and Methods. A Post- Ramadan survey was designed for young patients who fasted during Ramadan in 2020 during COVID pandemic time. The study was conducted to compared the basal characteristics and other parameters in children and adolescents (<18 years), with young adults (≥18 years) with diabetes at Paediatric Diabetes Center in BIRDEM in Bangladesh.

Results: Among the study participants, a significantly higher number of participants were in older age group who fasted for more than 15 days (p = 0.045). A considerable proportion (30.7%) of patients developed mild hypoglycaemia, and only eight patients (2.6%) developed moderate to severe hypoglycemia. There was significant reduction of post Ramadan basal insulin dose in both groups (p = 0.001). Although increased bolus insulin dose requirements were observed in older age group, but decreased requirement was observed in younger age group during Ramadan (p = 0.001). Post Ramadan median HbA1C in both groups was increased with marked increase in older age group compared to younger age group though it did not reach the statistical significance. (p = 0.239)

Conclusions: COVID-19 pandemic had minor impact on fasting during Ramadan in our cohort, they could fast safely with less complications during Ramadan. Our data supports Ramadan focused diabetes education with ample self-care, young people with diabetes can fast safely during Ramadan.

1. Introduction

COVID-19 was labeled a global pandemic by the World Health Organization on March 11, 2020 with a call to make crucial and timely changes to control global virus transmission and prevent overburdening of the healthcare system. [1] In Bangladesh, the lockdown started in March 26, 2020, aimed in preventing the spread of the virus through social distancing and isolation and as the number of cases was increasing day by day, a further extension of lockdown was done by the Government of Bangladesh. [2] Although Ramadan fasting is obligatory for all healthy adult and adolescent Muslims from the time of completing puberty [3] but guidance has suggested that Muslim people with T1DM should be actively discouraged from fasting during the COVID-19 pandemic, as diabetes has emerged as a significant risk factor for adverse outcomes of COVID-19 infection. [4–7].

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. [8,9] Fasting affects the body’s homeostasis, metabolic environment, fluid balance, and interaction of foods, drugs, and disease. Although exempt, adults and
children with diabetes refuse to take this concession as they feel psychologically and spiritually inclined to fast along with other Muslims. 

Over the last two decades, there has been a significant increase in number of people with T1DM who are fasting during Ramadan. A population-based study, Epidemiology of Diabetes and Ramadan (EPIDIAR), conducted among 13 countries, showed that 78.7% of patients with type 2 diabetes (T2DM) and 42.8% of T1DM could fast during Ramadan. [11] Although some experts consider fasting during Ramadan a high risk for metabolic deterioration, 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. In one prospective observational study done in 2012 in our center, we evaluated the safety of fasting in 33 children and adolescents with T1DM. [12] Safe fasting is possible during Ramadan through focused diabetes education and monitoring under supervision of Diabetes Team. In our recent experience During the COVID-19 crisis in Bangladesh, patients with type 1 diabetes using insulin pump could fast safely with the support of the telemedicine service by the diabetes team. [13].

We report the experience of young patients with type 1, type 2 and other types diabetes who fasted during Ramadan 2020 at the time of the COVID-19 pandemic time lockdown. This study was conducted to see the safety, number of fasting days, breaking the fasting days, episodes of hypoglycemia and hyperglycemia during Ramadan fasting, insulin dose survey. The criteria of inclusion were diagnosis of all types of diabetes and invitation to participate in the Children Program (CDiC) and Life for a Child (LFAC) Paediatric Diabetes Center in BIRDEM, Dhaka, Bangladesh were invited to participate in the survey. None of them said that COVID-19 pandemic had influenced their choice on whether or not to fast while asked the question. The median age was 20[17–23] years, 134 (44.7%) were male; all were on multiple or twice daily injections or oral drug. While dividing into two groups, 198 (66.0%) were in older age group (≥18 years) and 102 (34.0%) were in younger age group(<18 years). Among 300 patients, 211 (70.3%) were T1D, 63 (21.0%) were T2 D and 26 (8.7%) were other types. Among other types, 14 were FCPD, 6 MODY type, 3 Secondary type (Thalassaemia), 1 steroid induced, 1 Wolfram syndrome and 1 was severe resistance syndrome (who were clinically diagnosed). Majority patients 268 (89.3%) fasted in previous years. The median age was 22.0[20.0–24.0] years in ≥18 years group and 16.0[14.0–17.5] in <18 years group (p = 0.0001). [Table1] Duration of diabetes was significantly higher in older age group (p = 0.0001). [Table1]

During the study period, 832 patients came for follow up and 300 (36%) patients with different types of diabetes fasted and agreed to participate the survey. None of them said that COVID-19 pandemic had influenced their choice on whether or not to fast while asked the question. The median age was 20[17–23] years, 134 (44.7%) were male; all were on multiple or twice daily injections or oral drug. While dividing into two groups, 198 (66.0%) were in older age group (≥18 years) and 102 (34.0%) were in younger age group(<18 years). Among 300 patients, 211 (70.3%) were T1D, 63 (21.0%) were T2 D and 26 (8.7%) were other types. Among other types, 14 were FCPD, 6 MODY type, 3 Secondary type (Thalassaemia), 1 steroid induced, 1 Wolfram syndrome and 1 was severe resistance syndrome (who were clinically diagnosed). Majority patients 268 (89.3%) fasted in previous years. The median age was 22.0[20.0–24.0] years in ≥18 years group and 16.0[14.0–17.5] in <18 years group (p = 0.0001). [Table1] Duration of diabetes was significantly higher in older age group (p = 0.0001). [Table1]

A large number of patients (62.3%) patients did Self-monitoring blood glucose regularly during Ramadan, among them more were in older age group. [Table1] Pre Ramadan median HbA1c was higher in

2.2. Insulin dose adjustment

Majority of T1 D patients were on multiple daily insulin injections (MDI) with regular insulin and NPH. The changing dose was recorded. Those who were Type 2D were on oral drugs only or with NPH. Other types were having insulin only.

2.3. 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.

2.4. 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

During the study period, 832 patients came for follow up and 300 (36%) patients with different types of diabetes fasted and agreed to participate the survey. None of them said that COVID-19 pandemic had influenced their choice on whether or not to fast while asked the question. The median age was 20[17–23] years, 134 (44.7%) were male; all were on multiple or twice daily injections or oral drug. While dividing into two groups, 198 (66.0%) were in older age group (≥18 years) and 102 (34.0%) were in younger age group(<18 years). Among 300 patients, 211 (70.3%) were T1D, 63 (21.0%) were T2 D and 26 (8.7%) were other types. Among other types, 14 were FCPD, 6 MODY type, 3 Secondary type (Thalassaemia), 1 steroid induced, 1 Wolfram syndrome and 1 was severe resistance syndrome (who were clinically diagnosed). Majority patients 268 (89.3%) fasted in previous years. The median age was 22.0[20.0–24.0] years in ≥18 years group and 16.0[14.0–17.5] in <18 years group (p = 0.0001). [Table1] Duration of diabetes was significantly higher in older age group (p = 0.0001). [Table1]

A large number of patients (62.3%) patients did Self-monitoring blood glucose regularly during Ramadan, among them more were in older age group. [Table1] Pre Ramadan median HbA1c was higher in

Table 1

| Characteristics | Age group < 18 years (n = 102) | Age group ≥ 18 years (n = 198) | P value |
|----------------|--------------------------------|--------------------------------|---------|
| Area           |                                |                                |         |
| Age at Diagnosis | 12.0[9.7–14.0] | 13.0[12.0–15.0] | 0.0001 |
| Current age (years) | 16.0[14.0–17.5] | 22.0[20.0–24.0] | 0.0001 |
| Gender         |                                |                                |         |
| Male (%)       | 44 (43.1%) | 90 (45.5%) |         |
| Female (%)     | 58 (56.9%) | 108 (54.5%) | 0.702  |
| Duration of diabetes | 4.0[2.0–6.0] | 9.0[7.0–11.0] | 0.0001 |
| Types of diabetes |                                |                                |         |
| Type 1 (n = 211) | 75         | 136         |         |
| Type 2 (n = 63)  | 23         | 40          |         |
| Other types (n = 26) | 4          | 22          | 0.110  |
| SMBG done      |                                |                                |         |
| Yes (n = 102) | 54 (28.9%) | 48 (42.5%) |         |
| No (n = 198) | 133 (71.1%) | 65 (57.5%) | 0.016  |
| Basal dose     |                                |                                |         |
| 24.0[19.5–32.0] | 30.0[21.5–38.0] | 0.001 |
| Bolus dose     |                                |                                |         |
| 28.0[15.5–36.0] | 34.0[21.5–46.0] | 0.004 |
| TIDD           |                                |                                |         |
| 53.0[34.0–68.0] | 64.0[44.0–84.0] | 0.002 |
| Median HbA1c   |                                |                                |         |
| 8.4[7.2–9.8]  | 7.9[7.1–9.0] | 0.135  |         |
younger age group compared to older age group. Basal clinical characteristics of the two groups were described in Table 1.

3.2. Numbers of fasting days and breaking the fast

Among the study participants, 56 (18.7%) fasted all days, 139 (46.3%) fasted between 15 and 29 days and 105 (35.0%) fasted 1 to 15 days. There was a significantly higher number of participants in older age group who fasted for more than 15 days (p = 0.045). While 69.6% in ≥ 18 years managed to the full month whereas 30.4% in < 18 years; and 43.8%, 28.8%, and 56.2%, 71.2%, could fast 1–14 days, 15–29 days respectively in < 18 years and ≥ 18 years of age groups (p = 0.039).

Among the different types of diabetes, there was no significant difference on fasting days, median fasting days was higher in type 2 diabetes 25.0 [17.0–29.0] whereas in type 1 was 21.0 [10.0–28.0] and other types was 22.5 [14.0–25.5] days. (p = 0.228). While comparing the breaking the fasting days, majority in older age group broke the fast within 7 days only (p = 0.031). [Fig. 1].

3.3. Incidence of hypoglycemia

Hypoglycemia was a common acute complication during fasting. A considerable proportion (30.7%) of patients developed mild hypoglycaemia, and only eight patients (2.6%) developed moderate to severe hypoglycaemia. None of them required hospital admission. Most of them had hypoglycaemia in morning after sehri, mid-afternoon and pre iftar time, few of hypos are also during pre sehri or early morning. Forty-four (14.6%) patients broke the fast due to hypoglycaemia. Among them 33 (75%) were T1 D, 5 (11.4%) were T2D and 6 (13.6%) were other types. Those who developed hypos just before iftar, did nt break the fast. While comparing between the two groups, there was no significant difference (P = 0.162). [Fig. 2].

3.4. Incidence of hyperglycaemia

Hyperglycaemia was not very common in fasting hours during the day time. Only 9 (3%) patients, all of them were T1 D developed hyperglycaemia, mostly Post iftar and sehri, few had also during pre sehri or mid-afternoon time. Only 2 patients did break the fast due to hyperglycaemia. Normoglycaemia and hyperglycaemia were more in older age group (p = 0.084). [Fig. 3] None of the fasting patients developed DKA during Ramadan.

3.5. Changes in hemoglobin A1c, and insulin dose

Changes in hemoglobin A1c, and insulin dose, before and at the end of Ramadan between and two groups are shown in Table 2. There was significant reduction of basal insulin dose in both groups (p = 0.001). Although increased bolus insulin dose requirements were observed in older age group, but decreased requirement was observed in younger age group during Ramadan (p = 0.001). [Table 2] Post Ramadan median HbA1c 8.9 [7.6–10.3] was increased in T2 D patients compared to T1 D 8.5 [7.7–9.4]. There was increased Post Ramadan median HbA1C in both groups with marked increase in older group compared to younger age group though it did not reach the statistical significance. [Fig. 4]

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. Over the last two decades there has been a significant increase in number of people with T1DM who are fasting. Even during COVID time, Muslims around the world intended to fast. Amidst the COVID-19 pandemic, large DaR Global survey, a population-based survey was conducted among 13 countries, most of them with a Muslim majority population, showed that 71.1% of participants with T1DM fasted during Ramadan. [18].

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. [11] In our study population, among 300 patients 70.3% were T1D, and 21.0% were T2D. In a recent survey, 26.8% managed to fast the full month, 6.1%, and 5.9% could fast, 8–14 days, and 1–7 days respectively. And 59.9% and 59.1% of < 18 years and ≥ 18 years of age broke their fast. [18] In our study population, majority 69.2% people in older age group fasted for atleast15 days. 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. [19–29] A large number of our patients had fasted before and had the Ramadan based education in previous years which may made them confident enough to fast in this pandemic time where they cannot do their routine visit in the hospital.

The potential risks associated with fasting in patients with T1DM are a disruption in glycemic control revealing as hypoglycemia, hyperglycemia, and metabolic emergencies. [30] Hypoglycemia is a common acute complication during fasting. Monitoring blood glucose during fasting is essential to predict, prevent, and treat hypoglycemia. It is usually advised that the fasting should be interrupted if significant hypoglycemia arises. [29] However, young people do not necessarily agree to break their fasting, particularly if hypoglycemia occurs close to sunset, which marks the end of fasting for the day. In our previous study, there was mostly incidence of mild hypoglycemia and only one patient had severe hypoglycaemia and none of them required admission. [20] In this study, majority developed mild hypoglycaemia only eight patients developed moderate to severe hypoglycaemia, 28.3 %of < 18 years and 71.7% of ≥ 18 years had experienced at least an episode of hypoglycemia. In a recent survey, the frequency, timing, and severity of hypoglycemia were elucidated where 55.6% of < 18 years and 62.6% of ≥ 18 years had experienced at least an episode of hypoglycemia. [18] Most of hypoglycemic episodes were encountered between 3 pm and Maghreb time before iftar (42.3%), followed by between 12 pm and 3 pm at noon (39.1%), then between Suhr and 11 am (17.3%) and only 1% developed after iftar at night. Whereas in a recent survey most of hypoglycemic episodes were encountered between 3 pm and Maghreb time (40%). [18] In our previous study we found that most of them had hypoglycemia in mid-afternoon and pre iftar time, few of hypos are also during pre sehri or early morning. [20] This implicates that
hypoglycemia during Ramadan, occurs at all times of the day with the highest time during the period extending from mid-day to sunset time. Those who developed hypoglycaemia before iftar did not break the fast, though they had the intense education but may be they were unwilling to break the fast thinking spiritual aspect. Whereas a study done in young people with T1 D showed that the majority of fasting children and adolescents were willing to terminate their fast on the occurrence of hypoglycaemia regardless of the timing of the day. [31]

Although mild hypoglycaemia is common but several studies showed that the incidence of severe hypoglycaemia was negligible in people with T1DM during Ramadan fasting. [26,32–36] In our study population only 2.7% developed moderate to severe hypoglycaemia. The structured Ramadan focused diabetes education program can enable people with diabetes to reduce their risk of severity of hypoglycaemia during fasts. Our patients though could not come for follow up immediately before Ramadan but their previous knowledge could impact on management during fasting this year. The most concern part is even few participants fasted despite not doing any blood glucose monitoring but they did their insulin dose adjustment.

Although much of the focus during Ramadan is related to hypoglycaemia, however, the studies have reported severe hyperglycemia with ketoacidosis. [37–39] None of our patients developed DKA during fasting and none of them required admission in the month of Ramadan. 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 whereas in our population, only 9(3%) patients developed hyperglycaemia and there was no significant difference between two groups. The reason may be the patients did little change in basal dose during sehri time according to their blood glucose level. The role of structured education in reducing the 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. Majority of our patients fasted in previous years and had structured Ramadan focused education before Ramadan each year.

The South Asian Guidelines for Management of Diabetes in Ramadan recommends reducing basal insulin by 10% to 20% during the fasting days. [40] Current recommendations for patients treated with multiple daily injection (MDI) include a reduction of the total daily dose (TDD) of insulin to 70% to 85% of the pre-fasting TDD or to 60% to 70% of the basal insulin. [9,36,41] In our study population there was significant reduction of basal insulin dose in both groups during Ramadan although there was episodes of mild hypoglycaemia. Though based on the pharmacodynamic profile of NPH, there is a considerable risk of mid-day hypoglycaemia and end of the day hyperglycemia, most of our patients were on NPH insulin and developed very few episodes of hyperglycaemia at the end of the day.

Pre Ramadan optimum glycaemic control is prerequisite for safe fasting in Ramadan. In our recent study we found that patients with poor control could fast safely without any severe acute complication with Post Ramadan reduction of HbA1c. [20] In our study, there was fair control in both groups and there was marked increase of Post Ramadan HbA1c in both groups with more in older age group. Gad et al assessment included a total of nine observational studies and showed that there was no difference in the change of HbA1c. [42] In pandemic time, fear of hypoglycaemia with reduction of insulin dose might cause post Ramadan hyperglycaemia in our patients. More over people here take lots of carbohydrates during iftar including simple carbohydrates and not adjusting the dose accordingly may cause worse glycemic control after Ramadan with higher HbA1c in both groups.

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 hypoglycaemia awareness and are willing to frequently monitor their blood glucose levels during the fasting. [40] Over the past decade, several studies have evaluated fasting among adolescents with T1DM and its associated safety during the month of Ramadan. Kaplan et al used CGM to assess the impact of fasting on interstitial glucose concentrations in 14 adolescents with T1DM. There was no difference in the mean glucose readings or the duration of hypoglycaemia, hyperglycemia, and severe hyperglycemia between the Ramadan and non-Ramadan period, respectively [21] Adolescents with T1DM continue to have wide glucose fluctuations during Ramadan and, when fasting, close glucose monitoring should be recommended.

The management of children with diabetes who choose to fast during Ramadan is a challenge for a pediatrician as the majority of guidelines and data on the safety and metabolic impact of fasting are based on practice and studies on the adult population. In pandemic time Ramadan, the lock down was going on and our patients could fast without any severe complications like severe hypoglycaemia or DKA. 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 though post Ramadan HbA1c was raised as the insulin adjustment was done by themselves. Moreover, we also assumed that parental supervision,
insulin adjustment by themselves, and receiving education in previous years are the main reasons for lower hypoglycemia episodes in our patients. It is also possible that high food intake and higher HbA1c in our patients provided them with protection against hypoglycemia and later developed high HbA1c after Ramadan.

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

In conclusion, COVID-19 pandemic had minor impact on fasting during Ramadan in our cohort, who could fast safely without any severe complications like severe hypoglycemia or DKA. Post Ramadan higher HbA1c was observed more in young adults compared to children and adolescents. Our patients were more in older age with longer diabetes duration who fasted in previous years which supports Ramadan emphasizes diabetes education with ample self-care, young people with diabetes can fast safely during Ramadan.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

No funding was received in association with this manuscript

References

[1] World Health Organization. WHO Director-General’s opening remarks at the media briefing on COVID-19: 11 March. Accessed October 20. 2020 World Health Organization. WHO Director-General’s opening remarks at the media briefing on COVID-19: 11 March. Accessed October 20. 2020
[2] Zabeen B, Bhowmik B, Huda K, Naz F, Tayyeb S, Azad K. Use of telemedicine for the management of type 1 diabetes in children and adolescents in Bangladesh during the COVID-19 pandemic. J Diabetol. 2021;12(1):18–21.
[3] The Holy Quran, Sura 2: verses 183-185.
[4] Yang J, Zheng Y, Gou X, Ku K, Chen Z, Guo Q, et al. Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. Int J Infect Dis 2020;93:241-252.
[5] Zheng Z, Peng F, Xu B, Zhao J, Liu H, Peng J, et al. Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. Int J Infect Dis 2020; 81:161–25.
[6] Li Bo, Yang J, Zhao F, Zhi L, Wang X, Liu L, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. Clin Res Cardiol. Off J German Cardiac Soc 2020;109(5):531–8.
[7] Yang JK, Feng Y, Yuan MY, Yuan SY, Fu HJ, Wu BY, et al. Plasma glucose levels and diabetes are independent predictors for mortality and morbidity in patients with SARS. Diabet Med J Br Diabet Assoc 2006;23(6):623–8.
[8] Al-Arouj M, Assaad-Khalil S, Buse J, Fahdil I, Fahmy M, Hafez S, et al. Comparison of insulin pump therapy and multiple daily injections insulin regimen in patients with type 1 diabetes during Ramadan fasting. Diabetes Technol Ther 2017;19(6):362-370.
[9] Hanif S, Ali SN, Hassanein M, Khunti K, Hanif W. Managing people with diabetes fasting during the COVID-19 pandemic: A South Asian diabetes foundation update. Diabet Med: J Br Diabet Assoc 2020;37(7):1094–1092.
[10] Al-Madani A, Zabeen B, Nahar K, Nabi N, Mohsin F, Alrajhi A, et al. Fasting during Ramadan in an adolescent with diabetes. Indian J Endocrinol Metab 2014;18(1):44–7.
[11] Zabeen B, Ahmed B, Nahar J. Young people with type 1 diabetes on insulin pump therapy could fast safely during COVID-19 pandemic Ramadan: A telemonitoring experience in Bangladesh. J Diabetes Invest 2021;12(6):1060–3.
[40] Azad K, Mohsin F, Zargar AH, et al. Fasting guidelines for diabetic children and adolescent. Indian J Endocrinol Metab 2012;6(4):516-8.

[41] Azar ST, Khairallah WG, Merheb MT, Zantout MS, Filti F. Insulin therapy during Ramadan fast for patients with type 1 diabetes mellitus. J Med Liban 2008;56(1): 46.

[42] Gad H, Al-Muhammadi H, Musleman P, Malik RA. Continuous subcutaneous insulin infusion versus multiple daily insulin injections in patients with Type 1 diabetes mellitus who fast during Ramadan: A systematic review and meta-analysis. Diabetes Res Clin Pract 2019;151:265–74.