



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.



Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Ramadan fasting in people with diabetes and chronic kidney disease (CKD) during the COVID-19 pandemic: The DaR global survey



Mohamed Hassanein ^a, Sanobia Yousuf ^b, Muhammad Yakoob Ahmedani ^{c,*}, Alaa Albashier ^d, Inass Shaltout ^e, Alice Yong ^f, khadija Hafidh ^g, Zanariah Hussein ^h, Majd Aldeen Kallash ⁱ, Naji Aljohani ^j, Hui Chin Wong ^k, Mehmet Akif Buyukbese ^l, Tahseen Chowdhury ^m, M.E.R.Z.O.U.K.I. Fadhila ⁿ, Sri Wahyu Taher ^o, Jamal Belkhadir ^p, Rachid Malek ^q, Noor Rafhati Adyani Abdullah ^r, Shehla Shaikh ^s, Majid Alabbod ^t

^a Dubai Hospital, Mohamed Bin Rashed University, United Arab Emirates

^b Research Department, Baqai Institute of Diabetology and Endocrinology, Baqai Medical University, Karachi, Pakistan

^c Baqai Institute of Diabetology and Endocrinology, Baqai Medical University, Karachi, Pakistan

^d Dubai Hospital, Dubai, University of Sharjah UAE, United Arab Emirates

^e Internal Medicine and Diabetes, Faculty of Medicine, Cairo University, Egypt

^f Endocrine Centre, RPPAS Hospital, Brunei Darussalam

^g Diabetes Unit, Department of Medicine, Rashid Hospital, Dubai Academic Health Corporation, Saudi Arabia

^h Department of Internal Medicine, Hospital Putrajaya, Putrajaya, Malaysia

ⁱ King Fahad Medical City, OEMC Department, Alriyadh, Saudi Arabia

^j Obesity, Endocrine and Metabolic Center, King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia

^k Division of Endocrinology, Department of Internal Medicine, Hospital Tengku Ampuan Rahimah, Klang, Selangor, Malaysia

^l Professor of Internal Medicine, Medistate Kavaick Hospital, ISTANBUL, Turkey

^m Department of Diabetes and Metabolism, The Royal London Hospital, Whitechapel, London, UK

ⁿ University of Tizi Ouzou Algeria, CES Diabetology University of Sétif, Algeria

^o Simpang Kuala Health Clinic, Alor Setar Kedah, Malaysia

^p Endocrinologist – Diabetologist, Rabat, Morocco, President of Moroccan League for the Fight Against Diabetes, Chair of IDF Mena Region

^q Ferhat Abbas Setif University, Algeria

^r Endocrinology Unit, Department of Medicine, Sultanah Bahiyah Hospital, Alor Setar, Malaysia

^s Saif Hospital, Mumbai, Treasurer Maharashtra ESI Executive Committee Member ESI, India

^t Department of Medicine, Alzahra College of Medicine, University of Basrah, Iraq

ARTICLE INFO

Article history:

Received 30 December 2022

Received in revised form

20 May 2023

Accepted 25 May 2023

Keywords:

COVID-19

Ramadan fasting

Diabetes

Chronic kidney disease

ABSTRACT

Background and aims: The DaR Global survey was conducted to observe the impact of the COVID-19 pandemic on the intentions to fast and the outcomes of fasting in people with diabetes and chronic kidney disease (CKD).

Methods: Muslim people with diabetes and CKD were surveyed in 13 countries shortly after the end of Ramadan 2020, using a simple Survey Monkey questionnaire.

Results: This survey recruited 6736 people with diabetes, of which 707 (10.49%) had CKD. There were 118 (16.69%) people with type1 diabetes (T1D), and 589 (83.31%) were with type2 diabetes (T2D). 62 (65.24%) people with T1D and 448 (76.06%) people with T2D had fasted with CKD. Episodes of hypoglycaemia and hyperglycaemia were more frequent among people with T1D compared to T2D, 64.52% and 43.54% vs 25.22% and 22.32% respectively. Visits to the emergency department and hospitalization were more frequent among people with CKD, however no significant difference was found between people with T1D and T2D.

* Corresponding author. Co-Chair IDF-Task force, Fasting and Diabetes, Plot No. 111-B, Nazimabad No2, Karachi, 74600, Pakistan.

E-mail addresses: mhassanein148@hotmail.com (M. Hassanein), sanobia93@gmail.com (S. Yousuf), myakoob@bide.edu.pk (M.Y. Ahmedani), alaeldin11@gmail.com (A. Albashier), inassshaltout@hotmail.com (I. Shaltout), alice.yong@moh.gov.bn (A. Yong), khadija.hafidh@gmail.com (Hafidh), zanariah@hotmial.com (Z. Hussein), mkallash@kfmc.med.sa (M.A. Kallash), njaljohani@kfmc.med.sa (N. Aljohani), cerylwhuch@gmail.com (H.C. Wong), akif_buyukbese@yahoo.com (M.A. Buyukbese), tahseen.chowdhury@nhs.net (T. Chowdhury), merzoukififa@gmail.com (M.E.R.Z.O.U.K.I. Fadhila), sriwahyu2006@yahoo.com.my (S.W. Taher), jamilbelkhadir@yahoo.fr, jamilbelkhadir@idf.org (J. Belkhadir), rmalekdz@gmail.com (R. Malek), adyania@yahoo.com (N.R.A. Abdullah), drshehla@gmail.com (S. Shaikh), majid.alabbod@uobasrah.edu.iq (M. Alabbod).

Conclusion: The COVID-19 pandemic had only a minor effect on the intention to fast during Ramadan in people with diabetes and CKD. However, hypoglycaemia and hyperglycaemia were found to be more frequent, as well as emergency visits and hospital admissions among people with diabetic kidney disease. Prospective studies are needed in future to evaluate the risk indicators of hypoglycaemia and hyperglycaemia among fasting people with CKD, especially in the context of different stages of kidney disease.

© 2023 Published by Elsevier Ltd on behalf of Research Trust of DiabetesIndia (DiabetesIndia) and National Diabetes Obesity and Cholesterol Foundation (N-DOC).

1. Introduction

Fasting during Ramadan is mandatory for all healthy adult Muslims. Sick people with chronic conditions like chronic kidney disease (CKD) and cardiovascular disease (CVD) have a clear medical and religious dispensation [1]. Prolonged fasting, lifestyle changes, and dietary patterns during Ramadan can lead to complications such as dehydration, decrease in blood pressure, and thrombosis can cause further kidney damage. Moreover, hypoglycaemia and hyperglycaemia are common and can be serious [2].

Diabetes and Ramadan (DaR) guidelines recognize people with diabetic kidney disease among high and very high-risk categories [1]. Despite this, many people with CKD fast during Ramadan [3].

Ramadan 2020 also coincided with the coronavirus epidemic (COVID-19), making it one of the most challenging fasting times for Muslims around the world. It has been shown that people suffering from COVID-19 underlying chronic conditions like CKD or CVD have poorer outcomes, and the risk is further aggravated in people with poor glycemic control [4–6].

Limited studies have assessed the impact of fasting on people with diabetic kidney disease and found inconsistent results. Some studies reported a temporary improvement in estimated glomerular filtration rate (eGFR) and a reduction in proteinuria in people with CKD or kidney transplants [7,8], while other studies demonstrated a negative effect on kidney outcomes [9–11]. Available studies were conducted in a small number of patients, with a shorter duration of fast, in the winter months of the early 2000s, while few were conducted during the summer. This first global survey was therefore designed to observe fasting patterns, practices, and outcomes in people with diabetic kidney disease during Ramadan of 2020 and the COVID-19 pandemic.

2. Methodology

The survey was conducted in countries with significant Muslim populations including Algeria, Bangladesh, Brunei, Egypt, India, Kingdom of Saudi Arabia (KSA), Malaysia, Morocco, Pakistan, Tunisia, Turkey, United Arab Emirates (UAE), and the United Kingdom (UK). Approval was taken from local research and ethics authorities. Adult people with type1 diabetes (T1D) and type2 diabetes (T2D) who fasted during the month of Ramadan were recruited. All subjects who gave consent and had their routine consultation visit post-Ramadan were recruited between June–August 2020. Patients with CKD, confirmed by their physician, were analyzed separately. CKD in this survey was defined as either reduced eGFR, microalbuminuria, or both. Data was gathered using a SurveyMonkey questionnaire including demographic characteristics, fasting intention, number of days fasted during the months of Ramadan and Shawwal (the month after Ramadan), symptoms of hypoglycaemia and hyperglycaemia developed during fasting, attendance at an emergency department or admission to hospital. Differences in demographic characteristics and clinical

outcomes between people with T1D and T2D were tested using chi-squared analysis. All applied statistical tests were two-sided, *p*-values <0.05 were considered as statistically significant. No adjustment or weight for comparisons was made. Statistical analyses were performed in SPSS version 26.

Hyperglycaemia was defined as blood glucose more than 300 mg/dl, diabetic ketoacidosis (DKA), or hyperosmolar state, while hypoglycaemia was defined as blood glucose level of ≤ 70 mg/dl. Severe hypoglycaemia is considered when the subject requires a third party help or admission to the emergency department.

3. Results

The total number of people with diabetes recruited in the study was 6736, of which 707 (10.49%) had CKD. This included 118 (16.69%) people with T1D and 589 (83.3%) people with T2D (*p*-value 0.000). Demographic characteristics are shown in Table 1.

3.1. Intentions and abilities to fast during COVID-19 pandemic (T1D versus T2D)

The COVID-19 pandemic influences decisions to fast or not to fast in 23 (19.49%) people with T1D and 80 (13.58%) people with T2D (*p*-value 0.016). 46 (74.19%) people with T1D and 362 (80.80%) people with T2D have fasted for an average of 23 and 25 days, respectively (*p*-value = 0.005) (see Table 2).

3.2. Hypoglycaemia and breaking of fast during Ramadan (CKD versus without CKD)

A total of 5440 (90.23%) people without CKD have fasted out of 6029. Among those 1255 (23.07%) experienced day-time hypoglycaemia and 1087 (20.04%) broke their fast due to diabetes related illness (*p*-value = 0.000). Among CKD population 510 (72%) have fasted out of 707, among those 153 (30%) experienced day time hypoglycaemia and 149 (29.16%) broke their fast due to diabetes related illness (*p*-value = 0.000) (see Table 3).

Table 1
Baseline characteristics of the study population (n = 707).

Variables	Type 1 diabetes	Type 2 diabetes	<i>p</i> -value
n	118 (16.69%)	589 (83.3%)	0.000
Age (years)	31.93 $\pm$ 13.49	60.32 $\pm$ 11.88	0.000
Female	50 (42.37%)	264 (44.97%)	0.604
Male	68 (57.63%)	323 (55.03%)	
HbA1c (%)	8.95 $\pm$ 2.29	8.69 $\pm$ 2.024	0.230
Duration of diabetes (years)	16.66 $\pm$ 8.80	15.21 $\pm$ 8.31	0.088
Treatment regimens			0.000
SU	0 (0.00%)	190 (30.89%)	
Insulin	118 (100.00%)	425 (69.11%)	

Data presented as Mean $\pm$ SD or n (%).

P-value <0.05 is considered to be statistically significant.

Table 2
Impact of COVID-19 on the intentions and abilities to fast (n = 707).

Questions	Responses	Type1 diabetes (n = 118)	Type2 diabetes (n = 589)	p-value
Did the COVID-19 epidemic affect your decision to fast during Ramadan?	Yes	23 (19.49%)	80 (13.58%)	0.016
How many days did you manage to fast this year?	1–10	8 (12.90%)	42 (9.38%)	0.001
	11–20	8 (12.90%)	44 (9.82%)	
	21–30	46 (74.19%)	362 (80.80%)	
Average days of fasting		23.2 ± 9.33	25.39 ± 8.19	0.059
Did you fast any days after Ramadan (Shawal)?	Yes	13 (21%)	147 (33.18%)	0.053

Data presented as Mean ± SD or n (%).

Data presented as Mean ± SD or n (%).

P-value <0.05 is considered to be statistically significant.

3.3. Hypoglycaemia and hyperglycaemia during Ramadan (T1D versus T2D)

Out of 62 (52.54%) people with T1D and 448 (76.06%) people with T2D who fasted, 40 (64.52%) people with T1D and 113 (25.22%) people with T2D have reported daytime hypoglycaemia (p-value 0.000). Most hypoglycemic episodes occurred between 3 p.m. and iftar (see Table 4).

A total of 27 (43.54%) people with T1D and 100 (22.32%) people with T2D have reported hyperglycaemia (p-value 0.028). Most hyperglycemic episodes were observed during non-fasting hours (see Table 4).

3.4. Responses of people who had hypoglycaemia and hyperglycaemia during Ramadan fasting (T1D versus T2D)

A total of 33 (82.50%) people with T1D and 80 (70.80%) people with T2D had to break their fast due to hypoglycaemia (p-value 0.148). 5 (19.23%) people with T1D and 34 (33.33%) people with T2D had to break their fast due to hyperglycaemia (p-value 0.163) (see Table 4).

3.5. Severe hypoglycaemia and hyperglycaemia events requiring emergency visits (ER) and hospital admission (CKD versus without CKD)

When compared to subjects without CKD, more patients with CKD attended the emergency department with hypoglycaemia 9.8% (n = 15 out of 153 subjects with CKD) vs 4.3% (n = 54 out of 1255 subjects without CKD). Moreover, 1.9% (n = 3) subjects with CKD have been admitted to hospital compared to 0.96% (n = 12) subjects without CKD.

ER and hospital admissions with hyperglycaemia were seen more frequently among subjects with CKD compared to subjects without CKD. Out of 130 subjects with CKD reporting hyperglycaemia, 11.5% (n = 15) had visited to ER or had hospital admission compared to 6.4% (n = 73) out of 114 subjects without CKD (see Table 5).

3.6. Ramadan specific diabetes education and self-monitoring of blood glucose (SMBG) (T1D versus T2D)

A total of 85 (72.03%) people with T1D and 293 (49.74%) people with T2D monitored their blood glucose in the same way as before

Ramadan. 5 (4.23%) people with T1D and 64 (10.86%) people with T2D checked less frequently than before Ramadan, and 23 (19.49%) people with T1D and 63 (10.69%) people with T2D checked their blood glucose more frequent before Ramadan (p-value 0.000) (see Table 6).

A total of 63 (53.38%) people with T1D and 331 (56.19%) people with T2D received Ramadan specific diabetes education (p-value 0.560). 55 (59.14%) people with T1D and 273 (71.28%) people with T2D received an education by their doctors (p-value 0.000) during their routine consultation (see Table 6).

4. Discussion

People with diabetes and chronic kidney disease (CKD) are generally considered as high or very high risk to fast during the month of Ramadan. This sub-study from DAR global survey is the first report to show fasting trends, complications, and practices of people with diabetes and CKD during Ramadan 2020 amidst the COVID-19 pandemic.

This DaR-Global survey has found that the COVID-19 pandemic did not affect the decision of fasting among CKD patients, as a total of 72.5% of the people with T1D and T2D with CKD have fasted during the month of Ramadan, and some also did after Ramadan. The higher rate of fasting among high-risk individuals with CKD is similar to what has been reported in previously published epidemiological surveys on people with diabetes [12–16]. People with CKD had more frequent hypoglycaemia compared to people without CKD. Most of the episodes of hypoglycaemia were observed between 12noon and iftar and most were during the first week of Ramadan, similar to earlier reports [15,16]. This higher rate of hypoglycaemia during the first week of Ramadan may be due to the transition of medication timing, and doses as well as dietary changes that may take place during Ramadan.

The most important piece of information provided in this study is of severe hypoglycaemia and hyperglycaemia requiring ER visits or hospital admissions among CKD population. We found significant visits to ER and hospital admissions due to hypoglycemia among people with CKD compared to people without CKD. Due to hyperglycemia visits to ER and hospital admissions were not significant among people with and without CKD. There are no previous studies that have shown similar results. One study showed an increase risk of hypoglycaemia in patients with stage 3 CKD, the authors reported a doubling in the number and duration of hypoglycemic episodes monitored using a freestyle libre sensor. The

Table 3
Frequency of daytime hypoglycaemia and discontinuation of fast in the whole study population (with CKD versus without CKD).

Questions	Without CKD (n = 5440)	CKD (n = 510)	p-value
Did you have any day-time hypoglycaemia during this Ramadan?	1255 (23.07%)	153 (30%)	0.000
Did you break your fast because of diabetes related illness?	1087 (20.04%)	149 (29.16%)	0.000

Data presented as Mean ± SD or n (%).

p-value <0.05 is statistically significant.

Table 4

Hypoglycaemia and hyperglycaemia among fasting people with diabetic kidney disease (T1D vs T2D).

Questions	Responses	Type1 diabetes (n = 62)	Type2 diabetes (n = 448)	p-value
Did you have any day-time hypoglycaemia during this Ramadan?	Yes	40 (64.52%)	113 (25.22%)	0.000
Did you break your fast during this Ramadan because of hypoglycaemia?	Yes	33 (82.50%)	80 (70.80%)	0.148
Did you need to attend emergency department or got admitted to hospital because of daytime hypoglycaemia?	Yes, I attended the emergency department only, Yes, I got admitted to hospital,	2 (5.00%) 1 (2.50%)	13 (11.40%) 2 (1.75%)	0.399
Did you have any hyperglycaemia during this Ramadan?	Yes	27 (43.54%)	100 (22.32%)	0.028
Did you break your fast during this Ramadan because of hyperglycaemia (BG > 300 mg/dl)?	Yes	5 (19.23%)	34 (33.33%)	0.163
Did you need to attend emergency department or got admitted to hospital because of daytime hyperglycaemia?	Yes, I attended the emergency department only, Yes, I got admitted to hospital,	1 (3.70%) 2 (7.41%)	9 (8.74%) 3 (2.91%)	0.299

Data presented as Mean $\pm$ SD or n (%).

P-value <0.05 is statistically significant.

Table 5

Hypoglycaemic and hyperglycaemic events requiring emergency visits (ER) and hospital admission in the whole study population (with CKD versus without CKD).

Variables	Without CKD (n = 5440)	CKD (n = 510)	p-value
Hypoglycaemia	1255 (23.07%)	153 (30%)	0.000
ER visits	54 (4.30%)	15 (9.8%)	0.003
Hospital admission	12 (0.96%)	3 (1.9%)	
Hyperglycaemia	1141 (20.97%)	130 (25.49%)	0.040
ER visits	48 (4.21%)	10 (7.69%)	0.091
Hospital admission	25 (2.19%)	5 (3.85%)	

Data presented as Mean $\pm$ SD or n (%).

P-value <0.05 is statistically significant.

hypoglycemic episodes were mild and there was no report of severe hypoglycemic episodes [17].

Blood glucose monitoring during Ramadan is essential for people with diabetes who hold fast during Ramadan particularly, in people with T1D and in T2D who require insulin. Most of the individuals in our study did not increase the frequency of monitoring during Ramadan. However, many continued to monitor as before Ramadan. Frequent monitoring in these high-risk individuals with CKD is even more important especially in regions with longer fasting hours or warmer climates [18].

Around half of CKD people in this survey did not receive their Ramadan specific diabetes education. The role of structured education for patients is well established in the management of diabetes and guidelines state that this should be extended to Ramadan-focused diabetes education so that people can make informed decisions [1]. It has been shown that patients who received Ramadan-specific diabetes education followed Ramadan-specific diabetes management recommendations better compared with patients who did not receive education [19,20]. Moreover, we

Table 6

Responses regarding Ramadan specific diabetes education and SMBG during Ramadan.

Questions	Type1 diabetes	Type2 diabetes	p-value
Did you do SMBG during Ramadan?			
No	5 (4.23%)	169 (28.70%)	0.000
Yes, same as before	85 (72.03%)	293 (49.74%)	
Yes, at less frequency than before Ramadan	5 (4.23%)	64 (10.86%)	
Yes, more frequency than before Ramadan	23 (19.49%)	63 (10.69%)	
Did you receive any education specific for Ramadan fasting?	63 (53.38%)	331 (56.19%)	0.560
How long did education session last?	27.08 $\pm$ 14.03	17.83 $\pm$ 12.93	0.000

Data presented as Mean $\pm$ SD or n (%).

P-value <0.05 is considered to be statistically significant.

have observed previously that active glucose monitoring, adjustment of medications; dietary counseling, and patient education significantly reduced the risk of acute complications in fasting people with diabetes [21–24].

5. Limitations

Though the DaR-global survey is the first population-based study on people with diabetes and CKD, it has certain limitations. Since this is a retrospective study, observations are subject to recall bias. Episodes of hypoglycaemia and hyperglycaemia were not confirmed through laboratory investigations. Participants with CKD were not classified according to the stage of their kidney involvement; hence, the results are not generalizable.

6. Conclusion

In conclusion, the COVID-19 pandemic had only a minor effect on the intention to fast during Ramadan in people with diabetes and CKD. However, hypoglycaemia and hyperglycaemia were found to be more frequent, as well as emergency visits and hospital admissions among people with diabetic kidney disease. The results of this survey also highlight the fact that CKD should be taken as an important risk element for Pre-Ramadan risk stratification as recently advocated by DAR-IDF 2021 guidelines. Prospective studies are needed in future to evaluate the risk indicators of hypoglycaemia and hyperglycaemia among fasting people with CKD, especially in the context of different stages of kidney disease.

Declaration of competing interest

There is no declaration of interest or conflict of interest.

References

- [1] Hassanein M, Al-Arouj M, Hamdy O, Bebakar WMW, Jabbar A, Al-Madani A, et al. International diabetes federation (IDF), in collaboration with the diabetes and Ramadan (DAR) international alliance. Diabetes and Ramadan: practical guidelines. *Diabetes Res Clin Pract* 2017 Apr;126:303–16.
- [2] Anjum S, Yousuf S, Ahmedani MY. Effect of Ramadan fasting on renal function of people with diabetes; a prospective longitudinal study. *Diabetes Res Clin Pract* 2021 Nov;181:109090.
- [3] Emami-Naini A, Roomizadeh P, Baradaran A, Abedini A, Abtahi M. Ramadan fasting and patients with renal diseases: a mini review of the literature. *J Res Med Sci* 2013 Aug;18(8):711–6.
- [4] Pei G, Zhang Z, Peng J, Liu L, Zhang C, Yu C, et al. Renal involvement and early prognosis in patients with COVID-19 pneumonia. *J Am Soc Nephrol* 2020 Jun;31(6):1157–65.
- [5] Muniyappa R, Gubbi S. COVID-19 pandemic, coronaviruses, and diabetes mellitus. *Am J Physiol Endocrinol Metab* 2020 May;318(5):E736–41.
- [6] Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *Int J Infect Dis* 2020 May;94:91–5.

- [7] Bragazzi NL. Ramadan fasting and chronic kidney disease: does estimated glomerular filtration rate change after and before Ramadan? Insights from a mini meta-analysis. *Int J Nephrol Renovascular Dis* 2015 Jun;8:53–7.
- [8] Bernieh B, Al Hakim MR, Boobes Y, Abu Zidan FM. Fasting Ramadan in chronic kidney disease patients: clinical and biochemical effects. *Saudi J Kidney Dis Transpl* 2010 Sep;21(5):898–902.
- [9] El-Wakil HS, Desoky I, Lotfy N, Adam AG. Fasting the month of Ramadan by Muslims: could it be injurious to their kidneys? *Saudi J Kidney Dis Transpl* 2007 Sep;18(3):349–54.
- [10] NasrAllah MM, Osman NA. Fasting during the month of Ramadan among patients with chronic kidney disease: renal and cardiovascular outcomes. *Clin Kidney J* 2014 Aug;7(4):348–53.
- [11] Hendawy A. Effect of Ramadan fasting on renal physiology. *Urol Nephrol Open Access J* 2014;1. 10.15406.
- [12] Babineaux SM, Toaima D, Boye KS, Zagar A, Tahbaz A, Jabbar A, et al. Multi-country retrospective observational study of the management and outcomes of patients with Type 2 diabetes during Ramadan in 2010 (CREED). *Diabet Med* 2015 Jun;32(6):819–28.
- [13] Hassanein M, Al Awadi FF, El Hadidy KES, Ali SS, Echay A, Djaballah K, et al. The characteristics and pattern of care for the type 2 diabetes mellitus population in the MENA region during Ramadan: an international prospective study (DAR-MENA T2DM). *Diabetes Res Clin Pract* 2019 May;151:275–84.
- [14] Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C, et al. EPIDIAR study group. A population-based study of diabetes and its characteristics during the fasting month of Ramadan in 13 countries: results of the epidemiology of diabetes and Ramadan 1422/2001 (EPIDIAR) study. *Diabetes Care* 2004 Oct;27(10):2306–11.
- [15] Ahmadani MY, Riaz M, Fawwad A, Hydrie MZ, Hakeem R, Basit A. Glycaemic trend during Ramadan in fasting diabetic subjects: a study from Pakistan. *Pakistan J Biol Sci* 2008 Aug;11(16):2044–7.
- [16] Elmehdawi RR, Mukhtad NA, Allaghi NI, Elmajberi SJ. Fasting of Ramadan in peoples with diabetes in Benghazi, Libya: an exploratory study. *Libyan J Med* 2010 Mar;5.
- [17] Alawadi F, Rashid F, Bashier A, Abdelgadir E, Al Saeed M, Abuelkheir S, et al. The use of Free Style Libre Continues Glucose Monitoring (FSL-CGM) to monitor the impact of Ramadan fasting on glycemic changes and kidney function in high-risk patients with diabetes and chronic kidney disease stage 3 under optimal diabetes care. *Diabetes Res Clin Pract* 2019 May;151:305–12.
- [18] Ibrahim M, Davies MJ, Ahmad E, Annabi FA, Eckel RH, Ba-Essa EM, et al. Recommendations for management of diabetes during Ramadan: update 2020, applying the principles of the ADA/EASD consensus. *BMJ. Open Diabet. Res Care* 2020 May;8(1):e001248.
- [19] Ahmedani MY, Alvi SF, Haque MS, Fawwad A, Basit A. Implementation of Ramadan-specific diabetes management recommendations: a multi-centered prospective study from Pakistan. *J Diabetes Metab Disord* 2014 Feb;13(1):37.
- [20] Chowdhury A, Khan H, Lasker SS, Chowdhury TA. Fasting outcomes in people with diabetes and chronic kidney disease in East London during Ramadan 2018: the East London diabetes in Ramadan survey. *Diabetes Res Clin Pract* 2019 Jun;152:166–70.
- [21] Ahmedani MY, Haque MS, Basit A, Fawwad A, Alvi SF. Ramadan Prospective Diabetes Study: the role of drug dosage and timing alteration, active glucose monitoring and patient education. *Diabet Med* 2012 Jun;29(6):709–15.
- [22] Hassanein M, Abdelgadir E, Bashier A, Rashid F, Saeed MA, Khalifa A, et al. The role of optimum diabetes care in form of Ramadan focused diabetes education, flash glucose monitoring system and pre-Ramadan dose adjustments in the safety of Ramadan fasting in high risk patients with diabetes. *Diabetes Res Clin Pract* 2019 Apr;150:288–95.
- [23] Ahmedani MY, Ahsan S, Haque MSU. Role of Ramadan specific diabetes education (RSDE). A prospective study. *Pakistan J Med Sci* 2017 May-Jun;33(3): 586–93.
- [24] Gad H, Al-Muhannadi H, Purra H, Mussleman P, Malik RA. The effect of Ramadan focused education on patients with type 2 diabetes: a systematic review and meta-analysis. *Diabetes Res Clin Pract* 2020 Apr;162:108122.