

Review

Managing People with Diabetes Fasting for Ramadan During the COVID-19 Pandemic: A South Asian Health Foundation Update

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Abstract

The month of Ramadan forms one of the five pillars of the Muslim faith. Adult Muslims are obligated to keep daily fasts from dawn to sunset, with exceptions. This year Ramadan is due to begin on 23 April 2020 and the longest fast in the UK will be approximately 18 hours in length. In addition, due to the often high-calorie meals eaten to break the fast, Ramadan should be seen as a cycle of fasting and feasting. Ramadan fasting can impact those with diabetes, increasing the risk of hypoglycaemia, hyperglycaemia and dehydration. This year, Ramadan will occur during the global COVID-19 pandemic. Reports show that diabetes appears to be a risk factor for more severe disease with COVID-19. In addition, the UK experience has shown diabetes and COVID-19 is associated with dehydration, starvation ketosis, diabetic ketoacidosis and hyperosmolar hyperglycaemic state. This makes fasting in Ramadan particularly challenging for those Muslims with diabetes. Here, we discuss the implications of fasting in Ramadan during the COVID-19 pandemic and make recommendations for those with diabetes who wish to fast.

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Introduction

Muslims around the world fast for the holy month of Ramadan. This involves abstaining from food and drink from dawn (suhour) to dusk (iftar), for the entire month, and is fundamental to the faith as one of the five pillars of Islam. While fasting is considered compulsory for all adult Muslims, there are exemptions for those who are pregnant, lactating, travelling, or have any acute or chronic health conditions (where fasting may place them at risk of ill-health). Although this means fasting is not mandatory for Muslims with diabetes, many will still choose to fast for spiritual as well as social and cultural reasons; the Epidemiology of Diabetes and Ramadan (EPIDIAR) survey of over 12,000 people with diabetes in 13 Islamic countries, indicated that approximately 43% of people with type 1 diabetes mellitus and 79% of people with type 2 diabetes mellitus fast during Ramadan [1]. Similarly, Muslims who develop any acute illness, including COVID-19, are exempt from fasting, but may choose to do so regardless. As COVID-19 can present with a variety of symptoms, which range in

severity from mild to life-threatening, it may be difficult for people with diabetes who are fasting and become symptomatic to assess whether they are well enough to continue their fast or not.

Refraining from eating and drinking from sunrise to sunset has health implications for all observing this spiritual practice, but can significantly impact those with diabetes, placing them at higher risk of complications such as hypoglycaemia, hyperglycaemia and ketoacidosis, and cardiovascular complications [2], which may be exacerbated by COVID-19. The World Health Organisation (WHO) has recently released general guidelines on fasting in Ramadan during the COVID-19 pandemic [3]. However, it is vital, for healthcare professionals to be equipped to specifically counsel people with diabetes on ensuring appropriate food and fluid intake, monitoring of blood glucose and awareness of when to break their fast if necessary. The South Asian Health Foundation has recently published guidelines for healthcare professionals regarding the management of people with diabetes who wish to fast for Ramadan, based on current evidence [4]. However, there is a need to update the advice on how best to support people with diabetes who intend to fast during Ramadan, in the midst of the COVID-19 pandemic.

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Novelty Statement

- Guidelines about managing diabetes during Ramadan have been published by various societies, including the latest one from the South Asian Health Foundation UK.
- The COVID-19 pandemic poses new challenges for managing people with diabetes who choose to fast during Ramadan.
- These guidelines address these challenges and give the most up to date advice based on current evidence, to help those who choose to fast do so safely.

COVID-19 is a severe acute respiratory distress syndrome caused by the SARS-CoV-2 novel coronavirus [5]. The rapid spread of this highly contagious disease has been declared a global public health emergency by the World Health Organisation (WHO) [6] and is straining healthcare systems and economies worldwide. While populations around the world are being affected, recent publications have identified certain risk factors associated with more severe disease; these factors include increasing age, male sex and comorbidities such as cardiovascular disease, hypertension and diabetes [7]. The UK Intensive Care National Audit and Research Centre (ICNARC) suggest that the BAME (Black, Asian and minority ethnic) community, which includes a considerable Muslim population, is at a disproportionate risk of developing severe disease, requiring ventilation [8]. While the reasons for this increased risk are currently unclear, factors ranging from lower socioeconomic background, intergenerational living and congregational prayers may be implicated, along with an increased burden of underlying cardiovascular disease [9] and diabetes [10], as well as possible genetic mechanisms including angiotensin converting enzyme (ACE) polymorphism [11].

In order to address the concerns of healthcare professionals and people with diabetes fasting for Ramadan, the South Asian Health Foundation here presents updated guidance tailored to the COVID-19 pandemic.

The challenges of fasting for people with diabetes, during the COVID-19 pandemic

There is increased risk of hypoglycaemia, hyperglycaemia, diabetic ketoacidosis (DKA), dehydration and thrombosis in people with diabetes who are fasting during Ramadan [1]. Concurrent COVID-19 may precipitate these complications or exacerbate them. The recent evidence emerging from the United Kingdom in the midst of the COVID-19 pandemic, as well as published data from China and Italy, indicates that people with diabetes have an increased risk of the infection and manifest a severe disease state, with systematic reviews suggesting that diabetes is associated with a two-fold higher risk of severe COVID-19 disease and mortality [16]. It has

been proposed that inadequate glycaemic control may contribute to this increased risk. In people presenting to UK hospitals with COVID-19, there has been a greater incidence of DKA, hyperosmolar hyperglycaemic state (HHS) and euglycaemic ketoacidosis, even in those who have type 2 diabetes, or are insulin naïve. This appears to be a result of severe insulin resistance, starvation ketosis and/or dehydration (or a combination of all three). COVID-19 may, therefore, precipitate the complications seen in people with diabetes who fast. In addition, it has been suggested that dehydration and acute kidney injury (AKI) increase the severity of COVID-19, along with hypercoagulability leading to thrombotic events. Thus, the complications of fasting during Ramadan could be implicated in the worsening of COVID-19. It is important to take these factors into consideration while advising people with diabetes about fasting during Ramadan in the midst of the COVID-19 pandemic.

Risk quantification and stratification

The South Asian Health Foundation has recently published the risk stratification for people with diabetes intending to fast during Ramadan [4]. As a result of the COVID-19 pandemic, additional risk factors should be considered when assessing an individual's risk of complications during fasting. People with diabetes experiencing symptoms of COVID-19 [12], such as high fever, a new, persistent dry cough or anosmia [13] should be considered at high risk for developing complications of fasting during Ramadan, as well as those who have tested positive for COVID-19, or who have been hospitalised with COVID-19. Those living with individuals who have symptoms of COVID-19 as mentioned above, or living with those who have tested positive, should be considered moderate risk for fasting, due to the high likelihood of acquiring the infection. People with diabetes who are living in countries where there is a surge in COVID-19 cases should also be made aware that they are at increased risk of complications should they contract the infection, and that fasting should be undertaken with caution – however, this factor alone is quantified as low risk.

We recommend that people in the high risk category during the current COVID-19 pandemic must not fast. Those in the moderate risk category should not fast. People in the low risk should take adequate precautions if they choose to fast.

This is summarised in Figure 1.

Blood glucose monitoring

For people with diabetes choosing to fast for Ramadan, frequent blood glucose monitoring is imperative to mitigate the risk of complications, particularly with the high incidence of COVID-19 infection. It is well-established that concurrent infection, including COVID-19, may precipitate hyperglycaemia, DKA and dehydration, hypoglycaemia, or alter their

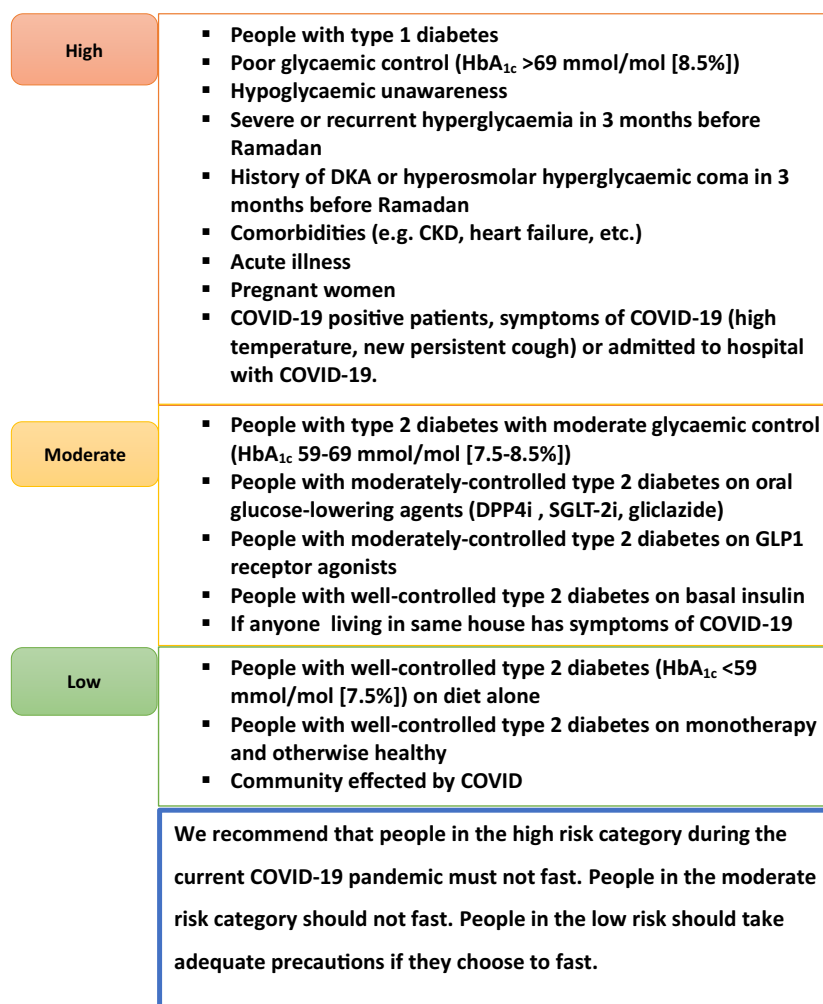


FIGURE 1 Risk Stratification for people with diabetes intending to fast during Ramadan during the COVID-19 pandemic.

presentation [14]. We recommend, therefore, that people with diabetes; check their capillary blood glucose at least four times a day during fasting – at suhoor time, two hours into the fast, just before breaking the fast at iftar and two hours after breaking the fast. People with diabetes who demonstrate COVID-19 symptoms; check their blood glucose every 4-6 hours, along with ketone levels. Additionally, if they experience any symptoms of hypo- or hyperglycaemia or become unwell, they check their blood glucose.

When to break the fast

People with diabetes are advised to break their fast if they develop any symptoms of hypoglycaemia, hyperglycaemia, dehydration, or other acute illness. While, people with diabetes need to break the fast for any acute illness, it needs to be emphasised that development of symptoms of COVID-19 during fasting requires prompt breaking of the fast. If blood glucose during fasting is <3.9 mmol/L or >16.6 mmol/L, people with diabetes need to break their fast, whether or not they have any symptoms [13]. For those using insulin or

sulfonylureas, the fast should be broken if blood glucose is <3.9 mmol/L at the beginning of the fast [15].

Managing people with type 1 diabetes who are fasting during the COVID-19 pandemic

We recommend that any people with type 1 diabetes experiencing symptoms of COVID-19 [13] do not fast. It is also highly advisable for people with type 1 diabetes not to fast if there are high rates of transmission of COVID-19 in their country. If people with type 1 diabetes choose to fast during this pandemic, they need to check their capillary blood glucose at least four times a day. If people with type 1 diabetes who are fasting develop COVID-19 symptoms, they should break their fast and check their blood glucose and ketones every 4-6 hours. Alongside these measures, people with type 1 diabetes should ensure adequate fluid intake of 2-3L of water or unsweetened beverages during non-fasting hours, and close adherence to infection control measures including frequent hand-washing and social distancing.

Managing people with type 2 diabetes who are fasting during the COVID-19 pandemic

People with type 2 diabetes are at risk of complications from both fasting and COVID-19, and therefore we recommend they need to follow guidelines closely if they choose to fast. For these people, the focus is on avoiding hypoglycaemia during the fast and post-prandial hyperglycaemia, as well as avoiding weight gain and dehydration, and, as for all people, reducing the risk of acquiring COVID-19 infection. It is important for people with diabetes to adhere to social distancing guidance to reduce their risk of infection, including avoiding congregational prayers at the mosque.

Nutrition plan

People with type 2 diabetes should follow an individualised nutrition plan, taking into account their age, cultural norms and comorbidities. At mealtimes, people with diabetes should incorporate foods with a low glycaemic index, and ensure a balanced macronutrient profile, avoiding the large meals containing highly processed carbohydrates and sugars that are often seen at iftar. People with diabetes need to eat their suhoor meal as late as possible, to avoid hypoglycaemia towards the end of the fast. This is especially important during prolonged fasts. To avoid dehydration, people with type 2 diabetes need to drink 2-3 litres of water or unsweetened beverages over the course of the non-fasting hours, particularly as any concurrent COVID-19 infection can be worsened by dehydration and hypovolaemic acute AKI. For many Muslims, physical activity is reduced during Ramadan [16], particularly voluntary exercise (compared to physical labour for work, for example), as a result of altered sleeping patterns, lethargy associated with fasting and increased priority of socio-religious practices. However, performing light exercise may be beneficial in avoiding weight gain, maintaining fitness and improving mood and sleep [17]; this psychological benefit is especially important in light of social isolation measures and financial uncertainty leading to low mood and increased anxiety as a result of the COVID-19 pandemic [18]. The government-imposed social distancing measures may make exercising more challenging, but people with diabetes can take their permitted daily exercise, while maintaining social distancing and infection control measures. Exercise may be performed in the home or in the garden to reduce exposure to other members of the public. It is important, however, to avoid strenuous exercise while fasting, particularly in hot weather, due to the risk of dehydration, and preferential to avoid exercise in the last few hours before iftar, owing to the increased risk of hypoglycaemia at this time. If people with type 2 diabetes feel unwell during or after exercise, they should check their blood glucose and consider breaking the fast if any of the above circumstances apply.

Management of medications in light of COVID-19

We recommend the following advice with regards to medication during fasting, in the COVID-19 pandemic.

Metformin

Currently, there is little information specifically pertaining to the incidence of hypoglycaemia during fasting in people with diabetes using metformin alone. However, the risk of hypoglycaemia is considered low, as metformin augments insulin sensitivity rather than increasing insulin secretion [19]. People with type 2 diabetes taking metformin therefore do not require any dose modification, and can take their lunchtime dose at iftar time. People with stable diabetes on metformin should be able to fast safely, but need to ensure adequate fluid intake. If people with type 2 diabetes experience any symptoms of dehydration, or of infection with COVID-19, or are admitted to hospital while fasting, they should break the fast. Healthcare professionals should also stop metformin if people with diabetes develop dehydration or COVID-19 symptoms, or if the eGFR is rapidly dropping, due to the risk of AKI [20].

Sulphonylureas

Sulphonylureas increase the risk of hypoglycaemia in people with diabetes, as they stimulate the secretion of insulin. It is recommended that long-acting sulphonylureas like glibenclamide should be avoided while fasting during Ramadan, as they have a greater risk of hypoglycaemia. Second generation sulphonylureas (gliclazide and glimepiride) however, can still be used. The once-daily dose needs to be taken at iftar. For people with stable diabetes, who are taking sulphonylureas twice daily, the suhoor dose needs to be reduced while the iftar dose remains the same. People with diabetes taking sulphonylureas who develop COVID-19 symptoms need to continue their medications, check their blood glucose levels more frequently and maintain adequate hydration [20].

DPP-4 inhibitors

Studies have demonstrated the safety of DPP-4 inhibitors in people with diabetes who are fasting during Ramadan. These agents carry a minimal risk of hypoglycaemia, and require no dose adjustment for fasting. In people with diabetes who take DPP-4 inhibitors and develop symptoms of COVID-19, it is recommended to continue with their medication, check blood glucose levels regularly and maintain adequate hydration.

SGLT-2 inhibitors (SGLT-2i)

SGLT-2i have emerged as an important therapeutic option in reducing the risk of cardiovascular and renal disease in people with type 2 diabetes. They also have a lower risk of hypoglycaemia and require no dose adjustment for fasting in Ramadan. They are effective in reducing weight and blood pressure [21]. One of the risks associated with SGLT-2i is dehydration, particularly in hot climates. Furthermore, the Food and Drug Administration Drug Safety Communication warns of the risk of euglycaemic ketoacidosis [22]. Current reports regarding COVID-19 suggest that people with dehydration and AKI are at increased risk of developing severe disease. There have been many reports of people with type 2 diabetes and COVID-19 presenting with ketoacidosis, regardless of the use of SGLT-2i. Hence, extra care should be taken when using this class of drugs in people with diabetes fasting for Ramadan. Table 1 summarises the concerns and practical tips on the use of SGLT2 inhibitors during Ramadan fasting in people with type 2 diabetes, in the COVID-19 pandemic.

We recommend that SGLT-2i should be continued in select people with diabetes, with all necessary precautions taken. If people with diabetes develop symptoms of COVID-19, they stop their SGLT-2 inhibitors, ensure adequate hydration, check their blood glucose levels frequently and follow “sick day rules”.

Thiazolidinediones

Thiazolidinediones are considered safe for use by people with type 2 diabetes fasting for Ramadan, as they are not directly associated with hypoglycaemia [19]. Recently, a hypothesis has emerged, suggesting that thiazolidinediones, along with other medication classes such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin II Type-I receptor blockers (ARBs), and ibuprofen, may lead to the increased expression of angiotensin-converting enzyme-2 (ACE-2) receptors [23]. As the novel SARS-CoV-2 coronavirus interacts with the ACE2 receptor to facilitate transmission [24], this group proposed that the increased expression of ACE-2 receptors may augment infection with COVID-19, increasing the risk of people treated with the aforementioned drugs developing severe COVID-19. It should be reinforced that this is a hypothesis based on retrospective data showing increased incidence of severe COVID-19 in people with hypertension and diabetes, groups of people prescribed ACE-inhibitors, ARBs and thiazolidinediones. There is currently a lack of direct evidence to support the discontinuation of thiazolidinediones in people with diabetes and COVID-19. People with type 2 diabetes can continue using thiazolidinedione medications while fasting, but should break their fast if they develop symptoms of COVID-19, and ensure adequate hydration and check blood glucose regularly.

Table 1 Concerns and practical tips on the use of SGLT2 inhibitors during Ramadan fasting in people with Type 2 diabetes, in the COVID-19 pandemic

Concerns	Practical tips
• Volume depletion (due to osmotic diuresis) • Dehydration (due to abstinence from fluid intake) • Hypotension • Euglycaemic diabetic ketoacidosis • Mycotic fungal genital infections	• Appropriate patient selection • Review the need and decide on continuation/resumption/discontinuation • Ensure absence of contraindications like severe renal impairment, end-stage renal disease, or dialysis • Consider temporary discontinuation in settings of reduced oral intake or fluid losses in people with & at risk of acute kidney injury and impairment in renal function • Monitor for hydration status (volume and colour of urine) and maintain adequate fluid intake • Monitor for hypotension, particularly in people on loop diuretics, older people, or those with impaired renal function (eGFR <60 mL/min/1.73m²) • Assess people who present with signs and symptoms of metabolic acidosis for ketoacidosis • Evaluate people for signs and symptoms of urinary tract infections and treat promptly, if indicated • Consider lowering the dose of insulin secretagogue or insulin to reduce the risk of hypoglycaemia • Avoid commencement of SGLT-2i less than one month before the start of Ramadan

GLP-1 receptor agonists (GLP-1RA)

GLP-1RA are considered safe drugs for people with diabetes to continue using during Ramadan, due to their low risk of hypoglycaemia [19]. Nausea and vomiting are well-established side-effects of GLP-1RA [25], meaning dehydration is a hypothetical risk with use of these medications. However, studies of GLP-1RA in Ramadan have shown low risk of dehydration or infection [26]. Other benefits of GLP-1RA include increased satiety; this reduces the likelihood of overeating once the fast is broken, which may avoid postprandial hyperglycaemia and weight gain. Data from the ICNARC indicates that many people admitted to ITU with severe COVID-19 are overweight or obese; hence GLP-1RA

may be a beneficial therapeutic option [8]. GLP-1RA are safe to use for people with type 2 diabetes fasting for Ramadan, including if they develop mild symptoms of COVID-19, but adequate hydration and regular checking of blood glucose is required. If people with diabetes develop severe COVID-19 symptoms, requiring hospital admission, or develop AKI, reduced appetite or gastrointestinal symptoms, the GLP-1RA should be stopped.

Insulin

Insulin increases the risk of hypoglycaemia significantly during Ramadan fasting, so doses must be adjusted and individualised on the basis of baseline glycaemic control, diet, exercise, occupation and blood glucose monitoring, especially in older people. People with diabetes need to monitor their blood glucose levels regularly, at least four times a day; we recommend at suhoor time, two hours into the fast, just before breaking the fast at iftar and two hours after breaking the fast, as well as if they experience any symptoms of hypo- or hyperglycaemia. If blood glucose are <3.9 mmol/L or >16.6 mmol/L at any time during the fast, people with diabetes should break the fast. If blood glucose levels are <3.9 mmol/L at the time of suhoor, they should not undertake the fast. A recent study evaluating the effect of optimum diabetes care on the safety of fasting in Ramadan in adults with type 2 diabetes found no increased safety risks in those treated with insulin, when Ramadan-focused education and medical advice for treatment adjustment was provided before Ramadan, alongside flash glucose monitoring for the duration of the fasting period [27]. If people with diabetes develop COVID-19 symptoms during fasting, they need to break the fast and check their blood glucose levels, and ketones. They should follow the “sick day rules” that advise continuing the dose of insulin, monitoring blood glucose levels regularly and maintaining adequate fluid intake and diet. If people with diabetes are suffering from diarrhoea and vomiting, they need to take oral fluids; if blood glucose levels are low, these fluids should contain sugar, and if high, should be unsweetened.

For people with diabetes fasting in Ramadan, basal insulin is the preferred initial formulation. For long acting insulins, the dose should be reduced by 20% and taken at iftar. In people using a basal-bolus regime, the lunch dose of rapid-acting insulin need to be omitted and the remaining two doses need to be taken with meals at suhoor and iftar. In people on mixed insulin, taking a higher dose of insulin in the morning and lower dose in the evening, the dosing should be switched during fasting so that the lower dose is taken at suhoor and the higher dose at iftar. In some cases, the higher dose may be reduced.

The recommendations for all glucose-lowering therapies during Ramadan in the COVID-19 pandemic is summarised in Table 2.

The management of medications in people with diabetes fasting during Ramadan

When people with type 1 or type 2 diabetes are admitted to the hospital acutely unwell, with evidence of dehydration or AKI, the following classes of medications need to be stopped:

- **Diuretics:** frusemide, bendroflumethiazide, indapamide, bumetanide
- **ACE inhibitors:** ramipril, lisinopril, perindopril
- **ARBs:** candesartan, losartan, irbesartan
- **NSAIDs:** ibuprofen, naproxen, diclofenac
- **Metformin**
 - If declining eGFR or lactic acidosis
- **SGLT-2i:** canagliflozin, dapagliflozin, empagliflozin,
- Consider stopping if indicated:
 - **Sulphonylureas:** gliclazide, glimepiride, glibenclamide
 - **GLP-1RA:** dulaglutide, exenatide, exenatide LAR, liraglutide, lixesanatide, semaglutide

Management of intercurrent illness for people with diabetes

Any acute illness can precipitate metabolic decompensation in people with diabetes, leading to complications such as hypoglycaemia, hyperglycaemia and DKA. In people with diabetes who are fasting, hyperglycaemia can occur in acute illness despite there being no food consumption, due to the increased endogenous steroids and catecholamines induced by the stress response to illness. Frequent blood glucose monitoring is therefore recommended for people with diabetes who experience symptoms of other illness, including the symptoms of COVID-19. Other recommendations for the outpatient management of diabetes in people who are fasting and develop symptoms of COVID-19 are as follows:

- Ketones need to be checked, every 2-4 hours.
- Break the fast.
- Ensure adequate hydration.
- Follow government advice for mild symptoms of COVID-19:
 - Rest
 - Use paracetamol for fever
- Continue diabetes medications, both oral hypoglycaemic agents (OHA), GLP-1RA and insulin.
- If symptoms of diarrhoea and vomiting, continue fluids containing sugar, if blood glucose measurements are low.

Table 2 Summary of recommendations for glucose-lowering therapies during Ramadan in the COVID-19 pandemic

Glucose-lowering therapy	Recommendation during Ramadan	Additional recommendations during COVID-19 pandemic
Metformin	- First-line glucose-lowering therapy - Low risk of hypoglycaemia - No dose modification required	- Ensure adequate fluid intake - Regular monitoring of blood glucose
Sulphonylureas	- Avoid glibenclamide due to high risk of hypoglycaemia - Second-generation sulphonylureas (glimepiride, glicazide) can be used - Once-daily dosing: Take at iftar - Twice-daily dosing: iftar dose remains the same, in those with adequate glucose levels, the suhoor dose should be reduced	- If severe COVID-19 symptoms, stop metformin - Ensure adequate fluid intake - Regular monitoring of blood glucose
DPP-4 inhibitors	- Low risk of hypoglycaemia - No dose modification required	- Ensure adequate fluid intake - Regular monitoring of blood glucose
SGLT-2 inhibitors	- Emerged as a vital therapeutic option to delay or prevent cardiovascular and renal complications in people with Type 2 diabetes - Low risk of hypoglycaemia - No dose modification required - People with diabetes should either be switched to or established on a stable dose well in advance of Ramadan (4 weeks)	- Ensure adequate fluid intake - Regular monitoring of blood glucose - If unwell (even if blood glucose normal) or blood glucose >16.6mmol/L, check ketones; if elevated, stop medication seek medical advice
Thiazolidinediones	- Low risk of hypoglycaemia - No dose modification required	- Ensure adequate fluid intake - Regular monitoring of blood glucose
GLP-1 receptor agonists	- Emerged as a vital injectable therapy to delay or prevent cardiovascular and renal complications in people with Type 2 diabetes - Low risk of hypoglycaemia - No dose modification required	- Ensure adequate fluid intake - Regular monitoring of blood glucose - If severe COVID-19 symptoms with AKI or GI symptoms, stop GLP-1RA
Insulin	- High risk of hypoglycaemia Basal (long-acting) insulin: - Preferred initial formulation - Dose reduction by 20% and take at iftar Rapid-acting insulin: Omit lunch dose, take twice daily with meals at suhoor and iftar Mixed insulin: In those taking a higher dose of insulin in the morning and lower dose in the evening, dosing should be switched during fasting so that the lower dose is taken at suhoor and the higher dose at iftar (may be reduced in some cases)	- Ensure adequate fluid intake - Check blood glucose and ketones regularly - Follow “sick day rules”

- If blood glucose levels are elevated, continue drinking clear fluids without sugar
- If symptoms of dehydration, stop SGLT-2i.
- If unwell requiring hospital admission, consider stopping metformin (if evidence of AKI), SGLT-2 inhibitors, GLP-1 receptor agonists. Continue other OHA medications and insulin.
- If evidence of AKI, or dehydration, consider stopping ACE-inhibitors and ARBs.
- Avoid using Non-Steroid Anti-Inflammatory Drugs (NSAIDs).
- Be aware that people with diabetes (both type 1 and type 2 diabetes) requiring hospital admission may present with DKA, HHS, or euglycaemic ketoacidosis.
- All people with type 1 and type 2 diabetes admitted to hospital will require ketones to be checked regularly, along with blood glucose monitoring.
- It appears in those with COVID-19 and diabetes, the development of DKA and HHS is associated with significant insulin resistance and therefore, these people may require up to 20 units of insulin per hour [20]. In addition, fluid replacement with DKA/ HHS protocols should be individualised and may require more cautious replacement

Table 3 Future research priorities regarding people with diabetes fasting for Ramadan during the COVID-19 pandemic

- Impact of COVID-19 on people's quality of life during fasting for Ramadan
- Effects of ethnicity and socioeconomic factors on COVID-19, in people with diabetes
- Complications of COVID-19 in people with diabetes who fast during Ramadan
- Epidemiological studies investigating the change in proportion of people and number of days fasted by people with diabetes during the COVID-19 pandemic.
- Studies demonstrating the safety of diabetes medications in people with COVID-19 fasting during Ramadan

in those at risk of acute respiratory distress syndrome or COVID myocarditis.

Future research priorities

These guidelines from the South Asian Health Foundation (UK) are based on current consensus and initial evidence of people with COVID-19 and diabetes. However, gaps still exist in the management of diabetes during this pandemic, which could be the focus for future research (Table 3).

Conflicts of interest

SH has no conflicts of interest.

SA has no conflicts of interest.

MH has no conflicts of interest.

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References

- 1 Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C *et al.* 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.
- 2 Rashid F, Abdelgadir E. A systematic review on efficacy and safety of the current hypoglycemic agents in patients with diabetes during Ramadan fasting. *Diabetes Metab Syndr Clin Res Rev* 2019 Mar; **13**(2): 1413–29.
- 3 WHO. Safe Ramadan practices in the context of the COVID-19. 2020. [Accessed 2020 Apr 15]. Available from <https://apps.who.int/iris/handle/10665/331767>
- 4 Hanif W, Patel V, Ali SN, Karamat A, Saeed M, Hassanein M *et al.* The South Asian Health Foundation (UK) Guidelines for Managing Diabetes during Ramadan: 2020 Update. South Asian Health Foundation (UK) [Internet]. [Accessed 2020 Apr 15] Available from: www.SAHF.org.uk/resources
- 5 Wang L, Wang Y, Ye D, Liu Q. A review of the 2019 Novel Coronavirus (COVID-19) based on current evidence. *Int J Antimicrob Agents* 2020 Mar 19; 105948.
- 6 The World Health Organisation [Internet]. [Accessed 2020 Apr 15]. Available from: [https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov))
- 7 Li B, 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* 2020 Mar 11;
- 8 ICNARC Case Mix Programme Database. ICNARC report on COVID-19 in critical care 2020;(April):1–16. [Accessed 2020 Apr 15]. Available from <https://www.icnarc.org/DataServices/Attachments/Download/76a7364b-4b76-ea11-9124-00505601089b>
- 9 Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979–2003: slow declines notable for some groups. *Heart* 2007 Oct 4; **94**(4): 463–70.
- 10 GOV.UK PDP model. Chapter 3: trends in morbidity and risk factors - [Internet]. 2016 [Accessed 2020 Apr 15]. Available from: <https://www.gov.uk/government/publications/health-profile-for-england-2018/chapter-3-trends-in-morbidity-and-risk-factors#diabetes>
- 11 Zhou P, Yang X-L, Wang X-G, Hu B, Zhang L, Zhang W *et al.* A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020 Mar 3; **579**(7798): 270–3.
- 12 NHS UK [Website]. Symptoms and what to do - Coronavirus (COVID-19) - NHS [Internet]. [Accessed 2020 Apr 16]. Available from: <https://www.nhs.uk/conditions/coronavirus-covid-19/symptoms-and-what-to-do/>
- 13 Melina Michelen NJ and CS. In patients of COVID-19, what are the symptoms and clinical features of mild and moderate cases? [Internet]. Oxford COVID-19 Evidence Service Team Centre for Evidence-Based Medicine, 2020. [Accessed 2020 Apr 15]. Available from: <https://www.cebm.net/covid-19/in-patients-of-covid-19-what-are-the-symptoms-and-clinical-features-of-mild-and-moderate-case/>
- 14 Casqueiro J, Casqueiro J, Alves C. Infections in patients with diabetes mellitus: A review of pathogenesis. *Indian J Endocrinol Metab* 2012 Mar; **16**(Suppl1): S27–36.

- 15 Al-Arouj M, Ben-Nakhi A, Hasasanein M. Risk stratification of individuals with diabetes before ramadan. *Diabetes and Ramadan : Practical Guidelines*. 2016. 41–51 p.
- 16 Hassanein M, Al Awadi FF, El Hadidy KES, Ali SS, Ehtay 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; **151**.
- 17 Tuka V, Daňková M, Riegel K, Matoulek M. Physical activity - the Holy Grail of modern medicine? *Vnitr Lek* 2017; **63**(10): 729–36.
- 18 Torales J, O'Higgins M, Castaldelli-Maia JM, Ventriglio A. The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int J Soc Psychiatry* 2020 Mar 31; 20764020915212.
- 19 Ali S, Davies MJ, Brady EM, Gray LJ, Khunti K, Beshyah SA *et al*. Guidelines for managing diabetes in Ramadan. *Diabet Med* 2016; **33**(10): 1315–29.
- 20 ABCD Association of British Clinical Diabetologists. Concise advice on Inpatient Diabetes (COVID:Diabetes): Front Door Guidance. [Accessed 2020 Apr 15] Available from <https://abcd.ca/re/resource/concise-advice-inpatient-diabetes-during-covid19-front-door-guidance>
- 21 Majewski C, Bakris GL. Blood pressure reduction: an added benefit of sodium-glucose cotransporter 2 inhibitors in patients with Type 2 diabetes. *Diabetes Care* 2015 Mar 1; **38**(3): 429–30.
- 22 United States Food and Drug Administration [Website]. FDA revises labels of SGLT2 inhibitors for diabetes to include warnings about too much acid in the blood and serious urinary tract infections | FDA. [Accessed 2020 Apr 15] Available from <https://www.fda.gov/drugs/drug-safety-and-availability/fda-revises-labels-sgl2-inhibitors-diabetes-include-warnings-about-too-much-acid-blood-and-serious>
- 23 Fang L, Karakiulakis G, Roth M. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? *Lancet Respir Med* 2020 Apr 1; **8**(4): e21.
- 24 Wan Y, Shang J, Graham R, Baric RS, Li F. Receptor Recognition by the Novel Coronavirus from Wuhan: an Analysis Based on Decade-Long Structural Studies of SARS Coronavirus. *J Virol* 2020 Mar 17; **94**(7).
- 25 Filippatos TD, Panagiotopoulou TV, Elisaf MS. Adverse Effects of GLP-1 Receptor Agonists. *Rev Diabet Stud*. 2014; **11**(3–4): 202–30.
- 26 Pathan F, Latif ZA, Sahay RK, Zargar AH, Raza SA, Khan A *et al*. South Asian consensus guideline: Use of GLP-1 receptor agonists during Ramadan: Update 2016 Revised Guidelines on the use of GLP-1A in Ramadan. *J Pak Med Assoc* 2016 Jun; **66**(6): 774–6.
- 27 Bashier AMK, Bin Hussain AK, Alawadi F, Alsayyah F, Alsaed M, Rashid F *et al*. Impact of optimum diabetes care on the safety of fasting in Ramadan in adult patients with Type 2 diabetes mellitus on insulin therapy. *Diabetes Res Clin Pract* 2019 Apr; **150**: 301–7.