

## REVIEW ARTICLE

## Management of Diabetes during Fasting and Feasting in India

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**Abstract**

Fasting and feasting are integral part of many religions and cultures. As the amount of food and fluid intake are markedly altered during these phases, patients with diabetes are prone to higher risk of complications. Even though several guidelines for fasting and feasting are available; Indian specific recommendations are the need of the hour, because of the distinct dietary habits and the diet content (high carbohydrate) of Indians. To fill this void, the current guidelines have been developed by experts from India who extensively reviewed the literature, shared their practical knowledge and ultimately arrived at a consensus.

**Introduction**

Fasting and feasting are the common practices observed by people as a regimen for traditional or cultural reasons.<sup>1-3</sup> People observe fasting or feasting depending on the religion and festival in context.<sup>2-7</sup> Literature suggests that medically supervised fasting for 7–21 days is efficacious in treatment of several diseases<sup>1, 8</sup> however, erratic eating pattern and disrupted daily fasting and feasting cycle may have an impact on the progression of metabolic diseases in India.<sup>9</sup>

The International Diabetes Federation (IDF) in their current report states that approximately 73 million people with diabetes are living in India.<sup>10</sup> Data from multi-country studies, including India, report that around 79–94% of Muslims with type 2 diabetes mellitus (T2DM) undergo fasting during Ramadan for at least 15 days. It is evident that many people with diabetes observe fasting or feasting during various festivals in India, hence management of diabetes during these phases becomes extremely important.<sup>11-14</sup> Importantly to the best of our knowledge there is no consensus statement available on the management of diabetes during fasting and feasting in Indian population. This consensus will highlight the evidence-based management strategies for control of diabetes and its associated

complications during fasting and feasting in Indian population.

**Methodology**

An extensive systematic review of literature has been initiated in several search engines including PubMed, Google Scholar, and Cochrane library databases in order to find out the best possible evidence and quality studies for management of diabetes during fasting and feasting. In the process of literature search, various MeSH keywords including fasting, feasting, hypoglycaemia, hyperglycaemia, Ramadan, diabetes, etc. have been used. Existing guidelines, meta-analyses, systematic reviews, randomized controlled trials (RCTs), non-RCTs, and key articles related to diabetes management were reviewed.

**Types of fasting***Hindu fasts and feasts*

There are several types of fasting observed by the Hindu religion; for example women observe day-long

fast during annual Karva Chauth and Guru Purnima to pray for long life for their husbands, monthly fasts during Ekadashi, Purnima, and Pradosha, and longer fasts during the Navratras (9 days) twice a year etc.<sup>2</sup> Moreover, fasting may be “nirahara” – without food; “phalahara” – where fruit and milk are allowed and “alpahara” – when broken rice and the likes are allowed.<sup>3</sup> Alike fasting, feasting is also marked by the Hindu religion where during various festivals including Diwali, Pongal, Dussehra, Holi etc.; people consume high amount of carbohydrates from sweets prepared from sugar, jaggery, rice flour and ghee.<sup>3</sup>

*Islamic fasts and feasts*

Islamic fast, also known as Sawm, is abstaining from eating and drinking during daylight hours. During Ramadan, all Muslims desist from both eating and drinking from dawn to sunset and refrain from smoking, taking oral medications, and sexual activities.<sup>14</sup> Followers consume a high calorie food at iftar (evening meal after breaking the fast), and at suhūr (meal consumed early in the morning). Similarly, during Eid-ul-Fitr, the festival of breaking the fast after Ramadan, Muslims celebrate with eating and drinking.<sup>15</sup>

*Jain fasts and feasts*

Jain people do fast at special times during festivals and on holy days.<sup>4</sup> In Jainism, “Paryushan” is the most observed festival during monsoon, which lasts eight days in Svetambara Jains and ten days in Digambar Jains.

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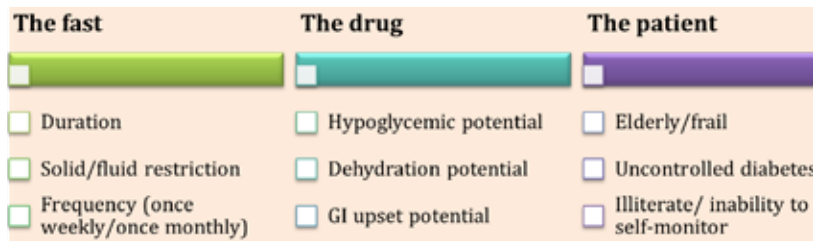
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**Table 1: Risk Stratification of patients with diabetes during fasting**

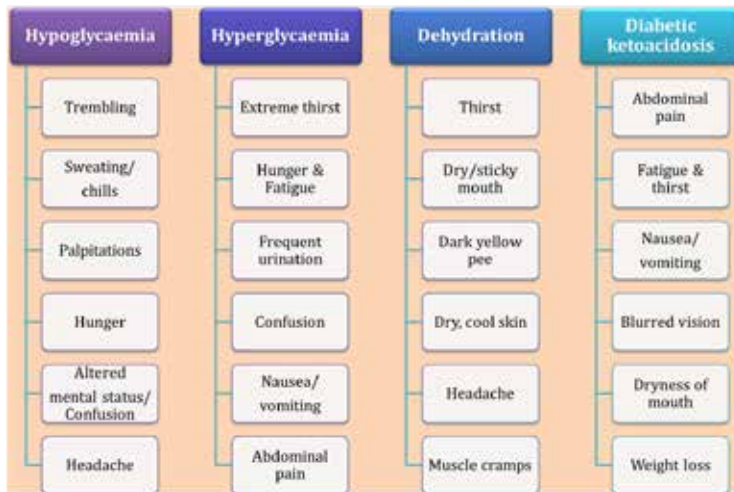
Very high risk	High risk	Moderate risk	Low risk
<ul style="list-style-type: none"> <li>o Severe hypoglycemia / ketoacidosis / hyperosmolar hyperglycaemic coma within last 3 months prior to Ramadan</li> <li>o History of recurrent hypoglycemia</li> <li>o Hypoglycemia unawareness</li> <li>o Sustained poor glycaemic control</li> <li>o Patients on dialysis</li> <li>o Patients who perform intense physical labor</li> <li>o Acute illness</li> <li>o Gestational diabetes mellitus treated with insulin</li> <li>o Pregnancy</li> <li>o Type 1 diabetes</li> </ul>	<ul style="list-style-type: none"> <li>o Moderate hypoglycemia (Average blood glucose 150-300mg/dL)</li> <li>o Renal insufficiency</li> <li>o People living alone that are treated with multiple insulin injections</li> <li>o Old age with ill health</li> <li>o Patients with macro and microvascular complications that present additional risk factors</li> </ul>	<ul style="list-style-type: none"> <li>o Well controlled patients (HbA1c &lt;7.5%) treated with short-acting insulin secretagogues and modern sulphonylureas</li> </ul>	<ul style="list-style-type: none"> <li>o Well controlled patients (HbA1c &lt;7%) treated with diet alone, metformin, or a thiazolidinedione who are otherwise healthy</li> </ul>

Patients with the following conditions should refrain from fasting: ✓ Pregnant and lactating women; ✓ Type 1 diabetes; ✓ Acute peptic ulcer; ✓ Cancer; ✓ Severe bronchial asthma, pulmonary tuberculosis; ✓ Overt cardiovascular diseases- recent MI, sustained angina; ✓ Hepatic dysfunction

Adapted from: South Asian Consensus Guideline, ADA 2005, IDF 2016, and IGDR 2015



**Fig. 1: Factors responsible for the development of diabetes associated complications during fasting**



Adapted from: IDF 2016

**Fig. 2: List of complications associated with diabetes along with their symptoms**

Furthermore, Digambar Jains do not take food and/or water (boiled) more than once in a day, and Shwetambar Jains take only boiled water during their fast days.<sup>4</sup> In addition, most Jains observe “Ratri Bhojan Tyag,” where they abstain from food and water after sunset.<sup>4</sup> During Diwali, New Year day, Mahavir Jayanti, and other festivals they offer Prasad made from ghee, sugar, jaggery, and mark their feasting.

**Buddhist fasts and feasts**

Many people follow Buddhism in

China and India.<sup>5,10</sup> Vassa or Buddhist Lent is the fast and feast observed by Buddhists for three lunar months every year in the rainy season. During this time they follow fast for 12 hour period (from noon to midnight) and a feast for 12 hours period (from midnight to noon).

**Fasts and feasts in other religions**

Apart from discussed religions, India is the home for several other religious people’ including Christians, Sikhs, Parsis etc.<sup>16</sup> They also celebrate

various festivals and observe fasting and feasting. Literature advocates that Greek Orthodox Christians undergo fast for a total of 180 to 200 days in each year. Nativity Fast (40 days before Christmas), Lent (48 days before Easter), and the Assumption (15 days in August) are the main fasting periods.<sup>6</sup> However, Parsis don’t have fasts on their calendar but, have feasts and most of their diet is rich in non-vegetarian food.<sup>17</sup>

**Diabetes, fasting and feasting Risk population**

It is important to stratify patients into different risk categories according to their comorbid status, continued medication, health status etc. (Table 1, Figure 1).<sup>2,13-14,18-24</sup>

**Challenges**

- Hyperglycaemia, hypoglycaemia, dehydration, diabetic ketoacidosis (DKA), microvascular and macrovascular problems may create challenges,
- Taking insulin and other OADs without any dose adjustment during fasting period increases the risk of complications,
- In spite of ill health, some people do fast
- During fasting, alteration of physical and mental health, especially in elder and comorbid patients with diabetes, places them at great risk of complications,
- Due to irregular food habit some patients may miss their usual medication dose
- Poor monitoring of diabetes complications, and blood sugar, specifically in rural areas pose a significant risk.<sup>2-5,20,25-26</sup>

**Table 2: Management of diabetes complications (hypoglycaemia, hyperglycaemia, diabetic ketoacidosis, and dehydration) during fasting and feasting period (Akbari F, 2005; Kalra S, 2015)**

Lifestyle modification	<ul style="list-style-type: none"> <li>○ Attend pre-fast counselling and learn the warning symptoms of hyperglycaemia and hypoglycaemia</li> <li>○ Strict adherence to the diabetic diet</li> <li>○ Take medication regularly as per instruction</li> <li>○ Do not overeat after the fast is broken and minimize eating sweet or fatty foods</li> <li>○ Record weight daily and inform doctor of gains or loss of more than 2kg</li> <li>○ If a complication occurs, break the fast immediately and seek medical help</li> <li>○ Patients/family should be aware of potential problems and alert their doctor immediately</li> <li>○ Serving of meal supplements may be added to pre-fast meals or intra fast liquids, to prevent hypoglycaemia</li> </ul>
Frequent blood glucose monitoring	<ul style="list-style-type: none"> <li>○ Test blood glucose regularly especially patients on insulin therapy during prolonged fasting like Ramadan, Navratri, and Vaasa etc.</li> <li>○ Test blood glucose before and 2 hours after Iftar, before Suhur and at mid-day</li> <li>○ Frequent SMBGs testing should be introduced</li> </ul>
Exercise	<ul style="list-style-type: none"> <li>○ Normal levels of physical activity may be maintained. However, excessive physical activity may lead to higher risk of hypoglycaemia and should be avoided</li> </ul>
Breaking the fast	<ul style="list-style-type: none"> <li>○ If the blood glucose level is &lt;70 mg/dL (3.9 mmol/L) or &gt;300 mg/dL (16.7 mmol/L) and/or development of diabetes complication, the fast should be broken</li> <li>○ After breaking the fast due to hypoglycaemia, patients should consume a little amount of a fast-acting carbohydrate diet</li> </ul>
Medication	<ul style="list-style-type: none"> <li>○ Patients taking insulin and sulfonylureas should be closely monitored for hypoglycaemia</li> <li>○ SGLT-2 inhibitors should not be used in elderly and frail patients and those residing at hot &amp; humid conditions</li> <li>○ Dose modification should be done as per individual patients risk and the preference</li> </ul>

**Breaking of fast**

Literature and guidelines advocate that patients with diabetes should break their fast if:

- Blood glucose level is <70 mg/dL (3.9 mmol/L) or >300 mg/dL (16.7 mmol/L)<sup>21</sup>
- Symptoms of hypoglycaemia, hyperglycaemia, dehydration or acute illness develop (Figure 2)<sup>20</sup>
- Patients taking insulin, or on any other OHA, if the blood glucose levels fall <70 mg/dL in the first few hours after the start of fast<sup>22</sup>
- Patients suddenly feeling unwell<sup>21</sup>
- Dramatic changes in their blood glucose profile during fasting period<sup>20</sup>

**Patient monitoring**

Patients who are at higher risk of diabetes associated complications, should be monitored regularly.<sup>20,22,25,27</sup>

- Those on insulin therapy
- ill and comorbid patients
- patients treated with OADs especially metformin, or glibenclamide
- patients with T1DM

**Diabetes complications**

The population-based epidemiology of Diabetes and Ramadan (EPIDAR) study reports that fasting increases the risk of severe hypoglycaemia

(defined as hospitalization due to hypoglycaemia) by 4.7-fold in patients with T1DM (from 3 to 14 events/100 people/month) and 7.5-fold in patients with T2DM (from 0.4 to 3 events/100 people/month).<sup>12,28,29</sup>

There was a 5-fold increase in incidence of severe hyperglycaemia (requiring hospitalization) in T2DM (from 1 to 5 events/100 people/month) and an approximately 3-fold increase in patients T1DM (from 5 to 17 events/100 people/month) during Ramadan, as reported by the extensive EPIDAR study.<sup>12,28</sup> Less fluid intake for a prolonged time may attribute to dehydration, and this may become severe in hot and humid climates and among individuals who perform hard physical labour<sup>28</sup> (Table 2).

**Management of diabetes during fasting and feasting***Pre-fast medical assessment/counselling*

Pre-medical assessment decides the patient eligibility for fasting and aids in eliminating further unavoidable risks and complications. After assessing all the details, the physician should advise the patient on whether to fast or to seek exemption; the decision should take into consideration person-centeredness and emotion and belief of the patient<sup>2,21-22</sup> (Figure 3).

*Structured diabetes education*

The health care professionals should

be sufficiently trained to deliver a structured patient education to patients and family members inclusive of blood glucose monitoring, nutritional advice, exercise advice, dosage, timing of medications, their adjustments, symptoms of complications and their management, and knowing when to break the fast in order to reduce the complications.<sup>14, 21-22</sup>

*Management of T1DM*

Patients with T1DM have been considered as a very high-risk group for fasting in various guidelines and literature.<sup>14,20-22</sup> This risk increases in patients with uncontrolled/poorly-controlled diabetes and having no access to medical care, unable/unwilling to monitor blood glucose level, uneducated and unaware of hypoglycaemic events that require recurrent hospitalizations etc.<sup>14</sup> The evidence suggests that fasting for 25 hours is safe and can be observed by patients with T1DM.<sup>31</sup> This group of patients should be made aware of the associated potential risks and be monitored closely.<sup>21,32</sup>

The South Asian Consensus Guideline on insulin use during Ramadan<sup>23</sup> advocates that once-or-twice daily injections of intermediate or long-acting insulin along with pre-meal rapid-acting insulin can be safely used in patients during fasting.<sup>23,33</sup>

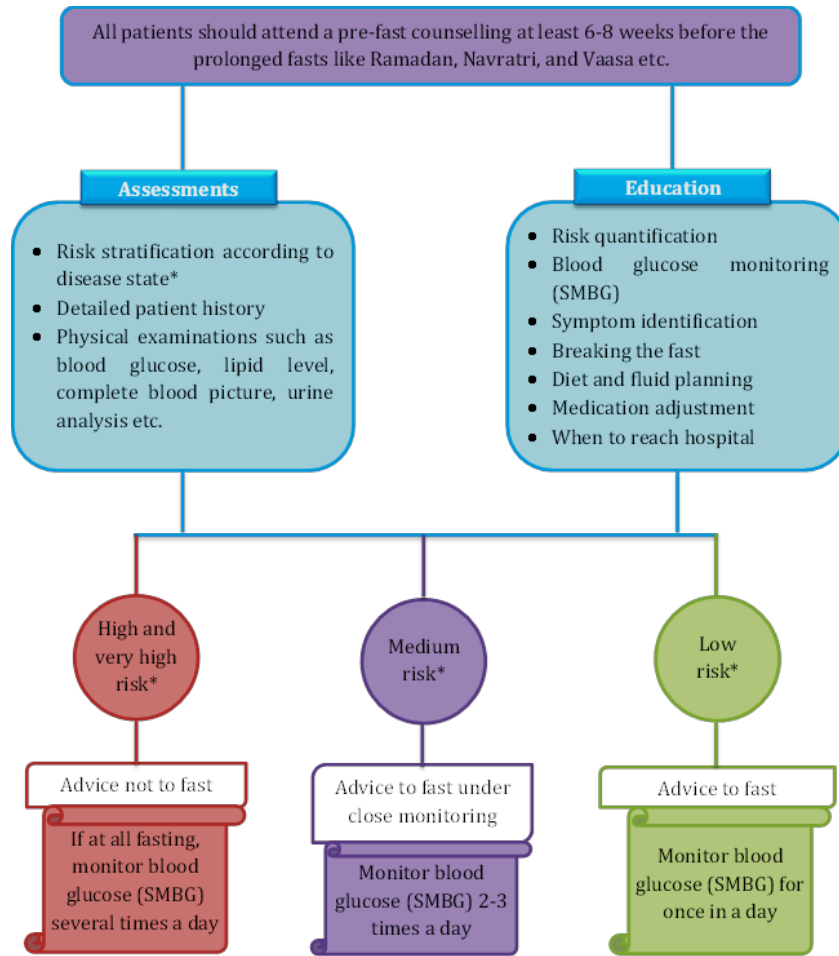
**Management of T2DM***Non-pharmacological management*

Fasting is considered as an element of lifestyle modification (LSM), and LSM itself is a management strategy for T2DM patients.<sup>2</sup> Physical activity and Yoga can be performed to lose body weight and to control the emotions; however, excessive and aggressive physical activity should be avoided during prolonged fasting periods.<sup>14,30,34</sup>

*Nutrition plan*

A food-plate comprising all foods for diabetes individuals during fasting is depicted in Figure 4.<sup>14,35-36</sup>

The pre-fast meal should be composed of complex carbohydrates with low glycaemic index and proteins such that it can provide enough "slow-release" calories to take care of the fasting period; unprocessed cereals, fruits, nuts, and lentils can be used in the pre-fast meals.<sup>2</sup> In contrast, post-fast meal should be composed of simple carbohydrates like bread, cereals, rice,



\*For stratification of the risk of diabetes patients, please follow table 1 in this document

Adapted from: Hassenein M, 2017

**Fig. 3: Patient flow chart for assessment, risk stratification, education and physician decision before prolonged fasting**



Adapted from: Sadikot S, 2017

**Fig. 4: The nutrition plan (food plate) for patients with diabetes during the fasting period. The plate demonstrates the individual daily caloric intake, percentage of carbohydrate, fat and proteins that can meet the cultural setting and food preference of each individual**

mango, pasta, and artificial syrups.<sup>14</sup> Adequate water and fluids must be taken prior to the fast especially in cases where fluid intake will be restricted throughout the day.

**Pharmacological management**

The details of dose adjustment of medications are provided in Table 3.<sup>2-5,14,20</sup>

**Metformin**

Metformin can be safely used during fasting periods due to minimal chances of hypoglycaemia.<sup>14</sup> However, patients who are taking metformin during lunch time should omit the dose during day fasting;<sup>37</sup> morning dose can be taken as usual but, a larger dose should be taken after breaking the fast to avoid hyperglycaemia.<sup>2,14,37</sup>

**Sulfonylureas**

Sulfonylureas (SUs), are widely used after metformin in patients with T2DM in India.<sup>14</sup> The main concern with their use is hypoglycaemia and this might be due to their glucose-independent insulin secretory action. However, this is not the class effect and differs with agents due to variations in their individual pharmacokinetic and pharmacodynamic properties.<sup>38</sup> Glibenclamide, gliclazide, glipizide, and glimepiride are the various SUs used in India for the management of T2DM. Evidence advocates that gliclazide, among all the SUs, is associated with good glycaemic control with lesser hypoglycaemia.<sup>39</sup> This might be due to its lesser pancreatic overstimulation action and restoration of the early insulin peak in response to glucose stimulation and higher reversibility of binding with receptors present in beta- cell.<sup>38</sup> Moreover, a meta-analysis of RCTs did not find any significant difference in the incidence of symptomatic hypoglycaemic events between DPP-4 inhibitor and gliclazide (5.6% versus 7.2%, risk ratio 1.12, 95% CI 0.73-1.73, p=0.61) in patients during fasting.<sup>40</sup> A systematic review and network meta-analysis of RCTs reports that gliclazide compared to other SUs is associated with lower risk of all-cause and cardiovascular-related mortality in patients with T2DM (Table 4).<sup>41-51</sup> Thus, gliclazide pertaining to its efficacy in glycaemic control, lower risk of hypoglycaemia, less risk of CV complication and death, along with lower cost might be a suitable alternative and can be used

**Table 3: Approach to adjustment or modification of continued antidiabetic medications in patients with diabetes during fasting period (IDF 2016, Sadikot S 2017, Kalra S 2015, Jhulka S 2017, and Latt TS & Kalra S 2012)**

Anti-diabetic agents	Muslim fast	Hindu fast		Frequent	Jain fast	Low-risk	Buddhist fast
	Prolonged	Infrequent but brief	Infrequent but prolonged		High-risk		
	Ramadan	Karva chauth	Navratri	Somvaar, Mangalvaar	Tiwihar upavas, Upavas, Bela (Chhath), Tela (Asttham)	Byasana, Ekasana, Ratri Bhojan Tyag	Vaasa
Metformin	<ul style="list-style-type: none"> <li>Once daily: take at Iftar</li> <li>Twice daily: take at iftar &amp; suhur</li> <li>Thrice daily: take 2/3<sup>rd</sup> of the total daily dose at the iftar and 1/3<sup>rd</sup> at the suhur</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at night</li> <li>Twice daily: take at morning and night</li> <li>Thrice daily: omit the lunch dose and follow above</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at night</li> <li>Twice daily: take at morning and night</li> <li>Thrice daily: take 2/3 of the total daily dose at night and 1/3 at the morning</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at night</li> <li>Twice daily: take at morning and night</li> <li>Thrice daily: omit the lunch dose and follow above</li> </ul>	<ul style="list-style-type: none"> <li>Omit the therapy on the day of fast</li> </ul>	<ul style="list-style-type: none"> <li>No change required</li> </ul>	<ul style="list-style-type: none"> <li>No change required</li> </ul>
Sulfonylureas*	<ul style="list-style-type: none"> <li>Once daily: take at iftar</li> <li>Twice daily: take ½ of usual evening dose with the suhur and the usual morning dose with the Iftar</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at dinner</li> <li>Twice daily: omit the morning dose in absence of breakfast</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at dinner</li> <li>Twice daily: omit the morning dose</li> </ul>	<ul style="list-style-type: none"> <li>Omit the therapy on the day of fast</li> </ul>	<ul style="list-style-type: none"> <li>Avoided, or taken in half dose at night</li> </ul>	<ul style="list-style-type: none"> <li>Full dose at morning and half dose at night</li> </ul>	<ul style="list-style-type: none"> <li>Once daily: take at morning</li> <li>Twice daily: take 2/3<sup>rd</sup> at morning</li> </ul>
DPP-4 inhibitors	<ul style="list-style-type: none"> <li>No dose adjustments is required</li> </ul>	<ul style="list-style-type: none"> <li>No change, take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>No change, take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>Omit the therapy on the day of fast</li> </ul>	<ul style="list-style-type: none"> <li>Taken at night</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>
SGLT-2 inhibitors†	<ul style="list-style-type: none"> <li>No dose adjustment is required and the dose be taken with iftar</li> </ul>	<ul style="list-style-type: none"> <li>No change, take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>No change, take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>Omit the therapy on the day of fast</li> </ul>	<ul style="list-style-type: none"> <li>Evening dose avoided, or taken in half dose</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>
Pioglitazone	<ul style="list-style-type: none"> <li>No dose adjustments is required</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>No change, or 2/3<sup>rd</sup> take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>No change required</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>
AGIs	<ul style="list-style-type: none"> <li>No dose adjustments is required</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<ul style="list-style-type: none"> <li>Omit the therapy on the day of fast</li> </ul>	<ul style="list-style-type: none"> <li>No change required</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>
GLP-1 analogues	<ul style="list-style-type: none"> <li>The dose should be titrated 6 weeks prior to Ramadan and no dose adjustment is required</li> </ul>	<ul style="list-style-type: none"> <li>Reduce the dose to 1/2<sup>th</sup> and take at dinner</li> </ul>	<ul style="list-style-type: none"> <li>The dose should be titrated prior to Navratri</li> </ul>	<ul style="list-style-type: none"> <li>No change or reduce the dose to 1/2</li> </ul>	<ul style="list-style-type: none"> <li>Once weekly dose: No change (postpone due dose till the completion of fasting)</li> </ul>	<ul style="list-style-type: none"> <li>No change required</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>
Long-acting insulin	<ul style="list-style-type: none"> <li>Once-daily: ↓ dose by 15–30% and take at iftar</li> <li>Twice daily: Take usual morning dose at iftar &amp; 1 evening dose by 50% and take at suhur</li> </ul>	<ul style="list-style-type: none"> <li>Need no change or may reduce the dose to 2/3<sup>rd</sup></li> </ul>	<ul style="list-style-type: none"> <li>Need no change or may reduce the dose to 2/3<sup>rd</sup></li> </ul>	<ul style="list-style-type: none"> <li>reduce the dose to 2/3<sup>rd</sup></li> </ul>	<ul style="list-style-type: none"> <li>25% reduction in dose</li> </ul>	<ul style="list-style-type: none"> <li>10-20% reduction in dose</li> </ul>	<ul style="list-style-type: none"> <li>Once daily, before the main meal of 24 hour period</li> </ul>
Short-acting insulin	<ul style="list-style-type: none"> <li>Take normal dose at iftar and lunch dose at dinner</li> <li>↓ suhur dose by 50%</li> </ul>	<ul style="list-style-type: none"> <li>Reduce the dose to 1/2<sup>th</sup></li> </ul>	<ul style="list-style-type: none"> <li>Reduce the dose to 1/2<sup>th</sup></li> </ul>	<ul style="list-style-type: none"> <li>Reduce the dose to 1/2<sup>th</sup></li> </ul>	<ul style="list-style-type: none"> <li>1 bolus</li> </ul>	<ul style="list-style-type: none"> <li>2 bolus</li> </ul>	<ul style="list-style-type: none"> <li>Reduce the dose to 1/2<sup>th</sup></li> </ul>
Premixed insulin	<ul style="list-style-type: none"> <li>Once daily: Take normal dose at iftar</li> <li>Twice daily: Take 1/2 of evening dose with suhur and the usual morning dose with the iftar</li> <li>Thrice Daily; Omit afternoon dose and adjust iftar and suhur doses</li> </ul>	<ul style="list-style-type: none"> <li>30:70 or 25:75: reduce the dose to 2/3<sup>rd</sup></li> <li>50:50: reduce the dose to 1/2<sup>th</sup></li> </ul>	<ul style="list-style-type: none"> <li>30:70 or 25:75: reduce dose to 2/3<sup>rd</sup></li> <li>50:50: reduce the dose to 1/2<sup>th</sup></li> </ul>	<ul style="list-style-type: none"> <li>reduce the dose to 2/3<sup>rd</sup> and prefer 30:70 or 25:75</li> </ul>	<ul style="list-style-type: none"> <li>30:70 at night or 50:50 at day</li> </ul>	<ul style="list-style-type: none"> <li>50:50 once daily</li> </ul>	<ul style="list-style-type: none"> <li>Can be given once daily, before the main meal of the 24 hour period</li> </ul>

AGIs, alpha-glucosidase inhibitors; DPP-4, dipeptidyl peptidase-4; SGLT-2, sodium-glucose co-transporter-2; \*Gliclazide and glimepiride should be preferred among all other sulphonylureas † Elderly patients, patients with renal impairment, hypotensive individuals, those at risk of dehydration or those taking diuretics should not be treated with SGLT2 inhibitors.

safely during fasting periods in Indian patients.<sup>14,38-40</sup> Moreover, glibenclamide should be avoided and other SUs can be used with caution during the fasting

period.<sup>14,38</sup>  
**DPP-4 inhibitors**  
 They can be safely used during

fasting period due to the reduced risk of hypoglycaemia, as they work by increasing insulin secretion in a glucose-dependent manner. However,

**Table 4: Studies investigating efficacy and safety of antidiabetic agents during fasting**

Author et al.	N	Intervention	Outcomes/conclusion
Randomized clinical trials			
Azar S T et al. 2016 <sup>41</sup>	343	Liraglutide vs sulphonylureas (gliclazide, glimepiride, glipizide, glibenclamide): outcomes	<ul style="list-style-type: none"> <li>Similar ↓ in fructosamine levels were observed for both groups during Ramadan: (liraglutide, -12.8 μmol/L; sulphonylurea, -16.4 μmol/L; p = 0.43)</li> <li>No severe hypoglycemic episodes were reported by either group</li> <li>More subjects in the glibenclamide stratum (14.8%) experienced hypoglycemic episodes than in the glimepiride/gliclazide/glipizide stratum (9.8%)</li> </ul>
Hassanein M 2014 <sup>42</sup>	557	Vildagliptin (A) vs gliclazide (B) + metformin: Hypoglycemic events	<ul style="list-style-type: none"> <li>Confirmed hypoglycemia (A vs B): 3.0% vs 7.0% (p = 0.039)</li> <li>Adjusted mean change pre- to post-Ramadan in HbA1c (A vs B): 0.05% ± 0.04% vs -0.03% ± 0.04% (p = 0.165).</li> <li>Adjusted mean ↓ weight: -1.1 ± 0.2 kg (p = 0.987) for both group</li> <li>No significant change in any parameter found in either group</li> </ul>
Malha LP 2014 <sup>43</sup>	69	Vildagliptin vs sulphonylureas (Glimepiride/ gliclazide): hypoglycemia event	<ul style="list-style-type: none"> <li>HbA1c from baseline to the last visit was similar for both groups</li> <li>Hypoglycemic events was not statistically significant (p = 0.334) between the groups</li> <li>Vildagliptin may be a better agent than sulphonylureas</li> </ul>
Brady EM et al. 2014 <sup>44</sup>	99	Liraglutide (A) vs sulphonylureas (B) (gliclazide, glipizide or glibenclamide):	<ul style="list-style-type: none"> <li>There were no episodes of severe hypoglycemia in either group, however, self-recorded episodes of blood glucose ≤ 3.9 mmol/L: A &lt; B (p &lt; 0.0001)</li> <li>Change in HbA1c 3 weeks post-Ramadan: A &gt; B; 10.54% vs 10.27% (p = 0.03)</li> <li>Body weight 3 weeks post-Ramadan: A &gt; B; 12.23 kg vs 10.42 kg (p = 0.02)</li> </ul>
Aravind SR 2012 <sup>45</sup>	870	Sitagliptin (A) vs sulphonylureas (B) (Glimepiride/ gliclazide/ glibenclamide) ± metformin: overall incidence of symptomatic hypoglycemia	<ul style="list-style-type: none"> <li>Hypoglycemic events in Indian patients (A vs B): 4.1% vs 7.7% (Gliclazide &lt; glimepiride &lt; glibenclamide; 1.8% &lt; 5.2% &lt; 9.1%)</li> <li>No patient discontinued treatment and no events required medical assistance</li> </ul>
Al Sifri S 2011 <sup>46</sup>	1066	Sitagliptin vs sulphonylureas (Glimepiride/ gliclazide/ glibenclamide): overall incidence of symptomatic hypoglycemia	<ul style="list-style-type: none"> <li>Risk of symptomatic hypoglycemia: Sitagliptin, 6.7%; gliclazide, 6.6%; glimepiride, 12.4%; glibenclamide, 19.7%</li> <li>No reported events that required medical assistance or were considered severe during Ramadan</li> <li>The incidence of hypoglycemia was lower with gliclazide relative to the other sulphonylureas and similar to that observed with sitagliptin</li> </ul>
Observational studies			
Shete A et al. 2013 <sup>47</sup>	97	Vildagliptin vs sulphonylureas (Glimepiride/ gliclazide/ glibenclamide/ glipizide)	<ul style="list-style-type: none"> <li>Hypoglycemic episodes were reported in low frequencies in both the vildagliptin and the sulphonylurea groups [0 vs 2 patients, respectively]</li> <li>HbA1c ↓ by -0.43% in the vildagliptin group (P = 0.009) while 10.01% in the sulphonylurea group (P = 0.958)</li> <li>Both treatment groups were well tolerated during Ramadan</li> </ul>
Aravind S R 2011 <sup>48</sup>	1378	Glimepiride/ gliclazide/ glibenclamide ± metformin: overall incidence of symptomatic hypoglycemia	<ul style="list-style-type: none"> <li>Symptomatic hypoglycemia drug wise: glibenclamide, 25.6%; glimepiride, 16.8%; gliclazide, 14.0%</li> <li>Symptomatic hypoglycemia country wise: Israel, 40%; Malaysia, 24%; UAE, 18%; India, 13%; Saudi Arabia, 10%</li> </ul>
Zargar AH 2010 <sup>49</sup>	136	Gliclazide MR 60 mg monotherapy, switched to evening administration of the same dose during Ramadan	<ul style="list-style-type: none"> <li>↓ Mean FPG by 0.01 mmol/l (p = 0.3) with evening medication by the end of the fast.</li> <li>Hypoglycemic episodes: before Ramadan, 3.7%; during, 2.2%; after Ramadan, 1.5%</li> <li>Gliclazide evening administration safely maintains glycaemic control during the fast</li> </ul>
Sari et al, 2004 <sup>50</sup>	40	Repaglinide vs sulphonylureas (glimepiride & gliclazide): outcomes	<ul style="list-style-type: none"> <li>Only 1 hypoglycemic event reported in glimepiride patient</li> <li>↑ triglyceride levels from BL: Repaglinide (p = 0.024), SU (p = 0.002)</li> <li>↑ HDL-cholesterol from BL: Repaglinide (p = 0.022)</li> </ul>

↓, decrease/reduction; ↑, increase/elevated; BL, baseline; FPG, fasting plasma glucose; HbA1c, glycated haemoglobin; HDL, high density lipoprotein; UAE, United Arab Emirates

precautions should be taken when they are used in combination with SUs.<sup>25</sup> Vildagliptin and sitagliptin are the mostly used DPP-4 inhibitors in the studies during the fasting period (Table 4). *Al Sifri et al.* compared the substitution of sitagliptin with SU with continuation of SUs during the Ramadan fasting and found that sitagliptin is associated with less hypoglycaemic episodes compared to SUs but similar hypoglycaemic episodes as gliclazide.<sup>46</sup> The STEADFAST study compared vildagliptin and gliclazide treatment during Ramadan period and did not find any significant difference between two treatments in

terms of hypoglycaemic episodes.<sup>42</sup> The observational studies such as VECTOR, VERDI, and VIRTUE also reported higher efficacy and safety of vildagliptin during fasting period.<sup>52-54</sup> however, gliclazide having similar efficacy and safety as vildagliptin might stand as an alternative option for Indian patients due to its lower cost.

#### SGLT-2 inhibitors

They can be safely used in the treatment of T2DM during fasting due to low risk of hypoglycaemia; however, fasting for long period without taking fluids may aggravate risk of hypotension and dehydration

associated with these agents.<sup>55</sup> Their usage should be restricted in patients at high risk of complications including elderly patients, patients with renal impairment, hypotensive individuals, and those at risk of dehydration or taking diuretics<sup>14,20</sup> (Table 4).

#### Thiazolidinedione

Thiazolidinedione (pioglitazone) may be used during fasting period due to the low risk of hypoglycaemia; however, weight gain is a concern in overweight and obese patients when it is used during fasting.<sup>14, 21,56</sup>

#### Alpha-glucosidase inhibitors

There are no RCTs available

which studied the outcomes of alpha-glucosidase inhibitors (AGIs) during the fasting period. Acarbose, miglitol, and voglibose can be safely used without any dose adjustment during the fasting period. However, ineffectiveness as monotherapy and concerns regarding the GI side effects reduces their applicability in T2DM patients during the fasting period.<sup>14</sup>

#### Glucagon-like peptide-1 receptor agonists

Liraglutide, exenatide, albiglutide, lixisenatide, and dulaglutide constitute the family of glucagon-like peptide (GLP)-1 receptor agonists. The important advantage associated with these agents is weight loss and low risk of hypoglycaemia; thus, they are chosen over other agents especially in overweight and obese patients during the fasting period.<sup>21</sup> Several trials (Table 4) have been published including the Treat 4 Ramadan trial and LIRA-Ramadan trial that investigated the efficacy and safety of liraglutide during fasting period,<sup>41,44</sup> and did not find any significant difference between liraglutide and SU concluded that both agents can be safely used during fasting.<sup>41,44</sup> GI upset was common with the usage of liraglutide.<sup>57</sup> Furthermore, some patients don't prefer these injectable agents due to their religious views.<sup>14</sup>

#### Insulins

Many T2DM patients use insulin as a treatment option however the higher risk of hypoglycaemia and multiple injections reduces its usage in T2DM patients especially during the fasting period.<sup>14,21</sup> Insulin analogues (basal, prandial and premix) are generally recommended over regular human insulin due to a number of advantages, including lower rates of hypoglycaemia.<sup>58</sup> Studies related to the use of insulin are described in Table 4.<sup>59-62</sup> Patients who are using insulin should practice the SMBG monitoring system and communicate their readings to physicians regularly in order to reduce the risk of complications<sup>2</sup> (Table 3).

#### Post-fast debriefing

Patient with diabetes and undergoing fasting should share their experience related to physical and mental health, symptoms, complications, steps taken to prevent complication, and about their quality of life during the fasting period.<sup>2</sup>

#### Special populations

Pregnant women, children, elderly, patients with comorbidities, and poorly controlled T1DM are group of patients requiring special attention during the fasting and feasting period. Unless stable disease, these people are categorized as high risk for fasting in various guidelines and need special precautions with strict monitoring (Table 1).<sup>13,20-24</sup>

Pregnant women with diabetes are generally managed with insulin preparations during the fasting period. Elderly patients, who wish to fast for a prolonged period, are at increased risk of hypoglycaemia, hyperglycaemia and metabolic decompensation including hyperosmolar coma, DKA, dehydration and thrombosis.<sup>63-68</sup> It is mandatory to examine the functional capacity, cognition, mental health, and comorbidities in elderly people with diabetes during the pre-fast period in order to reduce the complications. Moreover, SGLT-2 inhibitors should not be used in this group of patients due to the risk of dehydration and volume contraction.<sup>14</sup>

#### Conclusion

The panel concludes that appropriate lifestyle modifications including physical activity, nutrition plan, pre-fast counselling and structured diabetes education plan along with proper treatment dose adjustment or modification are important to ensure a safe fasting or feasting period.

#### References

- Nair PM, Khawale PG. Role of therapeutic fasting in women's health: An overview. *Journal of Mid-Life Health* 2016; 7:61.
- Kalra S, Bajaj S, Gupta Y, Agarwal P, Singh SK, Julka S, Chawla R, Agrawal N. Fasts, feasts and festivals in diabetes-1: Glycemic management during Hindu fasts. *Indian Journal of Endocrinology and Metabolism* 2015; 19:198.
- Kannan S, Mahadevan S, Seshadri K, Sadacharan D, Velayutham K. Fasting practices in Tamil Nadu and their importance for patients with diabetes. *Indian Journal of Endocrinology and Metabolism* 2016; 20:858.
- Julka S, Sachan A, Bajaj S, Sahay R, Chawla R, Agrawal N, Saboo B, Unnikrishnan AG, Baruah MP, Parmar G, Kalra S. Glycemic management during Jain fasts. *Indian Journal of Endocrinology and Metabolism* 2017; 21:238.
- Latt TS, Kalra S. Managing diabetes during fasting-A focus on Buddhist Lent. *Diabetes Voice* 2012; 57:42-5.
- Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutrition Journal* 2010; 9:57.
- Bashir MI, Pathan M, Raza SA, Ahmad J, Azad Khan AK, Ishfaq O, et al. Role of oral hypoglycemic agents in the management of type 2 diabetes mellitus during Ramadan. *Indian J Endocr Metab* 2012; 16:503-7.
- Michalsen A, Li C. Fasting therapy for treating and preventing disease-current state of evidence. *Complementary Medicine Research* 2013; 20:444-53.

#### Executive summary

- A structured diabetes education should be planned for patients with diabetes along with their family members in order to observe a safe fasting.
- Patient with diabetes should break their fast if the blood glucose level is <70 mg/dL (3.9 mmol/L) or >300 mg/dL (16.7 mmol/L) or when complications develop.
- Patients with stable T2DM can undergo fasting safely; however, their frequency and dose of medications need to be adjusted or modified.
- Metformin can be safely used during fasting, however, some dose modification might be required.
- Hypoglycaemia is the major concern associated with SUs. However, gliclazide in this class has lowest risk of hypoglycaemia and CV complications with higher glycaemic efficacy. Moreover, owing to its low cost, gliclazide can be widely used in Indian population during the fasting period.
- DPP-4 inhibitors like vildagliptin and sitagliptin can be used during fasting; however higher cost might restrict their use in Indian population.
- The SGLT-2 inhibitors should be cautiously used in elderly and frail patients due to their volume contraction, infection and dehydration effects.
- Thiazolidinedione and alpha-glucosidase inhibitors can be safely used; however weight gain and GI upset are the respective complications that indicate treatment individualization.
- GLP-1 receptor analogues can be used safely during fasting because of their weight loss effect and low risk of hypoglycaemia, however, high cost, GI side effects, and injectable nature reduces their applicability, especially during fasting.
- Insulin requires dose modification during the fasting period. Patients who are using insulin should be strictly monitored for hypoglycaemic complications.

- Gupta NJ, Kumar V, Panda S. A camera-phone based study reveals erratic eating pattern and disrupted daily eating-fasting cycle among adults in India. *PLoS one* 2017; 12:e0172852.
- International Diabetes Federation. The International Federation (IDF) Diabetes Atlas, Eighth Edition. 2017. Available from: <http://www.diabetesatlas.org/across-the-globe.html> [Last accessed on 20 Jan 2018]
- Babineaux SM, Toaima D, Boye KS, Zagar A, Tahbaz A, Jabbar A, Hassanein M. Multi-country retrospective observational study of the management and outcomes of patients with Type 2 diabetes during Ramadan in 2010 (CREED). *Diabet Med* 2015; 32:819-28.
- Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C, Jabbar A. 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; 27:2306-11.
- Al-Arouj M, Bouguerra R, Buse J, Hafez S, Hassanein M, Ibrahim MA, Ismail-Beigi F, El-Kebbi I, Khatib O, Kishawi S, Al-Madani A. Recommendations for management of diabetes during Ramadan. *Diabetes Care* 2005; 28:2305-11.
- Sadikot S, Jothydev K, Zargar AH, Ahmad J, Arvind SR, Saboo B. Clinical practice points for diabetes management during RAMADAN fast. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 2017 Jun 13.
- Akbani MF, Saleem M, Gadit WU, Ahmed M, Basit A, Malik RA. Fasting and feasting safely during Ramadan in the patient with diabetes. *Practical Diabetes* 2005; 22:100-4.

16. Census 2011, Press Information Bureau, Government of India, Ministry of Home Affairs, data on Population by Religious Communities. Available from: <http://pib.nic.in/newsite/PrintRelease.aspx?relid=126326>
17. Joshi AS, Varthakavi PK, Bhagwat NM, Chadha MD, Parmar G. Fasts, feasts, and festivals in diabetes: Glycemic management during Parsi rituals. *Indian Journal of Endocrinology and Metabolism* 2015; 19:680.
18. Arason TG, Bowen MW, Mansell KD. Effects of intermittent fasting on health markers in those with type 2 diabetes: A pilot study. *World Journal of Diabetes* 2017; 8:154.
19. Karamat MA, Syed A, Hanif W. Review of diabetes management and guidelines during Ramadan. *JR Soc Med* 2010; 103:139-47.
20. International Diabetes Federation (IDF), in collaboration with the Diabetes and Ramadan (DAR) International Alliance. Diabetes and Ramadan: Practical Guidelines, April 2016, Available at <https://www.idf.org/sites/default/files/IDF-DAR-Practical-Guidelines-Final-Low.pdf>
21. Hassanein M, Al-Arouj M, Hamdy O, Bebakar WM, Jabbar A, Al-Madani A, Hanif W, Lessan N, Basit A, Tayeb K, Omar MA. Diabetes and Ramadan: practical guidelines. *Diabetes Research and Clinical Practice* 2017.
22. Al-Arouj M, Assaad-Khalil S, Buse J, Fahdil I, Fahmy M, Hafez S, Hassanein M, Ibrahim MA, Kendall D, Kishawi S, Al-Madani A. Recommendations for management of diabetes during Ramadan update 2010. *Diabetes Care* 2010; 33:1895-902.
23. Pathan MF, Sahay RK, Zargar AH, Raza SA, Khan AA, Ganie MA, Siddiqui NI, Amin F, Ishtiaq O, Kalra S. South Asian Consensus Guideline: use of insulin in diabetes during Ramadan. *Indian Journal of Endocrinology and Metabolism* 2012; 16:499.
24. Ibrahim M, Al Magd MA, Annabi FA, Assaad-Khalil S, Ba-Essa EM, Fahdil I, Karadeniz S, Meriden T, Misha AA, Pozzilli P, Shera S. Recommendations for management of diabetes during Ramadan: update 2015. *BMJ Open Diabetes Research & Care* 2015; 3:e000108.
25. Almalki MH, Alshahrani F. Options for Controlling Type 2 Diabetes during Ramadan. *Front Endocrinol (Lausanne)* 2016; 7:32.
26. Rathor MY, Fauzi AM, Omar AM. Update on the management of diabetes during Ramadan fast for healthcare practitioners. *The International Medical Journal of Malaysia* 2014; 13:67-72.
27. Arble DM, Bass J, Behn CD, Butler MP, Challet E, Czeisler C, et al. Impact of Sleep and Circadian Disruption on Energy Balance and Diabetes: A Summary of Workshop Discussions. *Sleep* 2015. Epub 2015/11/14.
28. Ahmad J, Pathan MF, Jaleel MA, Fathima FN, Raza SA, Khan AA, Ishtiaq O, Sheikh A. Diabetic emergencies including hypoglycemia during Ramadan. *Indian Journal of Endocrinology and Metabolism* 2012; 16:512.
29. Loke SC, Rahim KF, Kanesvaran R, Wong TW. A prospective cohort study on the effect of various risk factors on hypoglycaemia in diabetics who fast during Ramadan. *The Medical Journal of Malaysia* 2010; 65:3-6.
30. Bravis V, Hui E, Salih S, Mehar S, Hassanein M, Devendra D. Ramadan Education and Awareness in Diabetes (READ) programme for Muslims with Type 2 diabetes who fast during Ramadan. *Diabet Med* 2010; 27:327-31.
31. Strich D, Teomim R, Gillis D. The basal insulin dose; a lesson from prolonged fasting in young individuals with type 1 diabetes. *Pediatric Diabetes* 2015; 16:629-33.
32. Zabeen B, Tayyeb S, Benarjee B, Baki A, Nahar J, Mohsin F, Nahar N, Azad K. Fasting during Ramadan in adolescents with diabetes. *Indian Journal of Endocrinology and Metabolism* 2014; 18:44.
33. Unnikrishnan AG, Lodha S, Sharma SK. Consensus on Insulin Dose Modification During Fasting in Type 2 Diabetes. *The Journal of the Association of Physicians of India* 2017; 65:7-15.
34. 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; 29:709-15.
35. Gupta L, Khandelwal D, Singla R, Gupta P, Kalra S. Pragmatic dietary advice for diabetes during Navratris. *Indian Journal of Endocrinology and Metabolism* 2017; 21:231.
36. Birdie AK. Impact of Navratras festival on the subjective wellbeing of vegetarian customers in hospitality sector. *Int J Soc Sci Manage* 2015; 2:333-8.
37. Patel V, Morrissey J, Goenka N, James D, Shaikh S. Diabetes care in the Hindu patient: cultural and clinical aspects. *The British Journal of Diabetes & Vascular Disease* 2001; 1:132-5.
38. Kalra S, Aamir AH, Raza A, Das AK, Azad Khan AK, Shrestha D, Qureshi MF, Md Fariduddin, Pathan MF, Jawad F, Bhattarai J, Tandon N, Somasundaram N, Katulanda P, Sahay R, Dhungel S, Bajaj S, Chowdhury S, Ghosh S, Madhu SV, Ahmed T, Bulughapitiya U. Place of sulfonylureas in the management of type 2 diabetes mellitus in South Asia: A consensus statement. *Indian J Endocrinol Metab* 2015; 19:577-96.
39. Chan SP, Colagiuri S. Systematic review and meta-analysis of the efficacy and hypoglycemic safety of gliclazide versus other insulinotropic agents. *Diabetes Research and Clinical Practice* 2015; 110:75-81.
40. Mbanya JC, Al-Sifri S, Abdel-Rahim A, Satman I. Incidence of hypoglycemia in patients with type 2 diabetes treated with gliclazide versus DPP-4 inhibitors during Ramadan: A meta-analytical approach. *Diabetes Res Clin Pract* 2015; 109:226-232.
41. Azar ST, Ecthay A, Wan Bebakar WM, Al Araj S, Berrah A, Omar M, Mutha A, Tornøe K, Kaltoft MS, Shehadeh N. Efficacy and safety of liraglutide compared to sulphonylurea during Ramadan in patients with type 2 diabetes (LIRA-Ramadan): a randomized trial. *Diabetes Obes Metab* 2016; 18:1025-33.
42. Hassanein M, Abdallah K, Schweizer A. A double-blind, randomized trial, including frequent patient-physician contacts and Ramadan-focused advice, assessing vildagliptin and gliclazide in patients with type 2 diabetes fasting during Ramadan: the STEADFAST study. *Vasc Health Risk Manag* 2014; 10:319-26.
43. Malha LP, Taan G, Zantout MS, Azar ST. Glycemic effects of vildagliptin in patients with type 2 diabetes before, during and after the period of fasting in Ramadan. *Therapeutic Advances in Endocrinology and Metabolism* 2014; 5:3-9.
44. Brady EM, Davies MJ, Gray LJ, et al. A randomized controlled trial comparing the GLP-1 receptor agonist liraglutide to a sulphonylurea as add-on to metformin in patients with established type 2 diabetes during Ramadan: the Treat 4 Ramadan Trial. *Diabetes, Obesity and Metabolism* 2014; 16:527-36.
45. Aravind SR, Ismail SB, Balamurugan R, et al. Hypoglycemia in patients with type 2 diabetes from India and Malaysia treated with sitagliptin or a sulfonylurea during Ramadan: a randomized, pragmatic study. *Current Medical Research and Opinion* 2012; 28:1289-96.
46. Al Sifri S, Basiouny A, Ecthay A, et al. The incidence of hypoglycaemia in Muslim patients with type 2 diabetes treated with sitagliptin or a sulphonylurea during Ramadan: A randomised trial. *Int J Clin Pract* 2011; 65:1132-40.
47. Shete A, Shaikh A, Nayeem KJ, et al. Vildagliptin vs sulphonylurea in Indian Muslim diabetes patients fasting during Ramadan. *World Journal of Diabetes* 2013; 4:358.
48. Aravind SR, Tayeb KA, Ismail SB, et al. Hypoglycaemia in sulphonylurea-treated subjects with type 2 diabetes undergoing Ramadan fasting: a five-country observational study. *Current Medical Research and Opinion* 2011; 27:1237-42.
49. Zargar AH, Siraj M, Jawa AA, Hasan M, Mahtab H. Maintenance of glycaemic control with the evening administration of a long acting sulphonylurea in male type 2 diabetic patients undertaking the Ramadan fast. *International Journal of Clinical Practice* 2010; 64:1090-4.
50. Sari R, Balci MK, Akbas SH, Avci B. The effects of diet, sulfonylurea, and Repaglinide therapy on clinical and metabolic parameters in type 2 diabetic patients during Ramadan. *Endocrine Research* 2004; 30:169-77.
51. Simpson SH, Lee J, Choi S, Vandermeer B, Abdelmoneim AS, Featherstone TR. Mortality risk among sulfonylureas: a systematic review and network meta-analysis. *Lancet Diabetes Endocrinol* 2015; 3:43-51.
52. Hassanein M, Hanif W, Malik W, et al. Comparison of the dipeptidyl peptidase-4 inhibitor vildagliptin and the sulphonylurea gliclazide in combination with metformin, in Muslim patients with type 2 diabetes mellitus fasting during Ramadan: Results of the VECTOR study. *Curr Med Res Opin* 2011; 27:1367-74.
53. Halimi S, Levy M, Huet D, et al. Experience with vildagliptin in type 2 diabetic patients fasting during Ramadan in France: Insights from the VERDI study. *Diabetes Ther* 2013; 4:385-98.
54. Al-Arouj M, Hassoun A, Medlej R, et al. The effect of vildagliptin relative to sulphonylureas in Muslim patients with type 2 diabetes fasting during Ramadan: The VIRTUE study. *Int J Clin Pract* 2013; 67:957-63.
55. Dutta D, Biswas K, Sharma M, Maskey R, Baruah MP, Amin MF. Managing diabetes during Navratris with special focus on Durga pujas. *Journal of Social Health and Diabetes* 2015; 3:84.
56. Vasan S, Thomas N, Bharani AM, Abraham S, Job V, John B, Karol R, Kavitha ML, Thomas K, Seshadri MS. A double-blind, randomized, multicenter study evaluating the effects of pioglitazone in fasting Muslim subjects during Ramadan. *Int J Diabetes Dev Ctries* 2006; 26:70-6.
57. Mudher Michael E. Effectiveness and Safety of Newer Antidiabetic Medications for Ramadan Fasting Diabetic Patients. *Journal of Diabetes Research* 2016; 2016.
58. Grunberger G. Insulin analogues—are they worth it? Yes! *Diabetes Care* 2014; 37:1767-70.
59. Bakiner O, Erorter ME, Bozkirli E, Tutuncu NB, Demirag NG. Repaglinide plus single-dose insulin glargine: a safe regimen for low-risk type 2 diabetic patients who insist on fasting in Ramadan. *Acta Diabetol* 2009; 46:63-65.
60. Cesur M, Corapcioglu D, Gursoy A, Gursoy A, Gonen S, et al. A comparison of glycemic effects of glimepiride, repaglinide, and insulin glargine in type 2 diabetes mellitus during Ramadan fasting. *Diabetes Res Clin Pract* 2007; 75:141-47.
61. Shehadeh N, Maor Y. Effect of a new insulin treatment regimen on glycaemic control and quality of life of Muslim patients with type 2 diabetes mellitus during Ramadan fast—an open-label, controlled, multicentre, cluster randomised study. *International Journal of Clinical Practice* 2015; 69:1281-8.
62. Akram J, De Verga V. Insulin lispro (Lys(B28), Pro(B29)) in the treatment of diabetes during the fasting month of Ramadan. *Ramadan Study Group. Diabet Med* 1999; 16:861-6.
63. Pathan F. Pregnancy and fasting in the Pakistan Medical Association 2015; 65(5 Suppl 1):530-2.
64. Ismail NA, Raji HO, Wahab NA, Mustafa N, Kamaruddin NA, Jamil MA. Glycemic control among pregnant diabetic women on insulin who fasted during Ramadan. *Iranian Journal of Medical Sciences* 2011; 36:254.
65. Azlin N, Mohamed I, Adam R, Sufian SS, Wahab NA, Mustafa N, Kamaruddin NA, Jamil MA. Safety and tolerability of once or twice daily neutral protamine hagedorn insulin in fasting pregnant women with diabetes during Ramadan. *Journal of Obstetrics and Gynaecology Research* 2011; 37:132-7.
66. Afandi BO, Hassanein MM, Majd LM, Nagelkerke NJ. Impact of Ramadan fasting on glucose levels in women with gestational diabetes mellitus treated with diet alone or diet plus metformin: a continuous glucose monitoring study. *BMJ Open Diabetes Research and Care* 2017; 5:e000470.
67. El-Hawary A, Salem N, Elsharkawy A, Metwali A, Wafa A, Chalaby N, El-Gilany A, Abo-Elmagd M, El-Ziny M. Safety and metabolic impact of Ramadan fasting in children and adolescents with type 1 diabetes. *Journal of Pediatric Endocrinology and Metabolism* 2016; 29:533-41.
68. Azzoug S, Mahgoun S, Chentli F. Diabetes mellitus and Ramadan in elderly patients. *J.P.M.A. The Journal of the Pakistan Medical Association* 2015; 65(5 Suppl 1):533-6.