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Management of diabetes during the holy month of Ramadan: An Updated Review

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Abstract

Background: The goal of this narrative review was to thoroughly analyse how diabetes patients should be managed when they decide to fast throughout the sacred month of Ramadan. Sections on dietary adjustments, lifestyle modifications, and education and support were all covered in the evaluation. Nutrition is one of the most important aspects that affect diabetes treatment during Ramadan. Throughout the month, Muslims traditionally break their fast with dates and water, followed by an iftar meal in the evening. However, this dinner frequently includes foods that are high in fat and carbohydrates, which can raise blood sugar levels and increase the risk of hyperglycemia. Hence, to maintain the best blood glucose control throughout Ramadan, diabetic people should be urged to modify their diets accordingly. For diabetes patients during Ramadan, lifestyle changes are just as important as nutritional adjustments. Regular exercise is one of the most important lifestyle changes that can improve insulin sensitivity and blood glucose control. Therefore, it's critical to motivate diabetes patients to engage in moderate exercise throughout Ramadan, such as walking, cycling, or swimming, for at least 30 minutes each day. To avoid hypoglycemia, it's also imperative to keep in mind that physical activity needs to be planned appropriately. Another crucial change in lifestyle for people with diabetes during Ramadan is to drink adequate water. Fasting frequently results in dehydration, leading to several health issues, especially in diabetic individuals who are more susceptible to dehydration due to elevated blood sugar levels. Furthermore, diabetes patients should coordinate care with their healthcare practitioner to adjust their medication schedule throughout Ramadan if they receive insulin or other blood glucose-lowering medications. Although the majority of anti-diabetic pharmaceuticals used to treat type 2

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diabetes are typically regarded as safe, it should be highlighted that the risk of hypoglycemia may be raised in people who take numerous medications that lower blood sugar. Hence, it is crucial to adjust medication timing and dosage to account for changes in diet and lifestyle during Ramadan. In conclusion, dietary adjustments, lifestyle changes, and medication management are all necessary for managing diabetes patients throughout Ramadan. Individuals with diabetes can successfully manage their condition during Ramadan with the help of healthcare professionals' guidance and education.

Keywords: Diabetes; Ramadan; Dietary Adjustments; Lifestyle Modifications; Education; Support.

1. Introduction

Ramadan, the ninth month of the Islamic year, is a fasting period observed by Muslims globally every year (Saeed Maryam, 2017). Fasting during this month is mandatory for all healthy Muslim adults, requiring them to abstain from food, drinks, smoking, and medication from dawn to sunset, which can last for approximately 11 to 20 hours, depending on location and season (Ahmed et al., 2020). Two meals, Suhur and Iftar, are consumed during Ramadan, one before dawn and the other at sunset (Beshyah et al., 2007). However, suppose a person has a medical condition that would be negatively affected by fasting during Ramadan. In that case, they are exempted from the obligation to fast for as many days as required under Islamic rules (Elhadd & Al-Amoudi, 2006).

Patients diagnosed with diabetes mellitus are often advised by doctors to avoid fasting due to difficulty managing their blood sugar levels and the potential risk of severe complications (Kobeissy et al., 2008; Pinar, 2002). However, despite this advice, some patients may fast anyway, while others may not seek their doctor's guidance (Beshyah, 2009). The Epidemiology of Diabetes and Ramadan study surveyed populations in 13 countries during Ramadan and found that 42.8% of type I diabetes patients fasted for at least 15 days. Shockingly, 10.3% of these patients were not monitored by a specialist, and 76% relied on advice from relatives regarding diabetes management (Salti et al., 2004). Highlighting the need to increase awareness among at-risk diabetic patients during Ramadan to ensure proper management during the holy month of Ramadan.

Medical Nutrition Therapy (MNT) is essential to diabetes management, especially during Ramadan fasting. Changes in dietary and lifestyle patterns during Ramadan can lead to alterations in physiological processes compared to other times of the year (El Toony et al., 2018). Prolonged fasting during Ramadan can cause insulin resistance or deficiency, leading to excessive glycogen breakdown, increased gluconeogenesis, and ketogenesis, resulting in hyperglycemia and ketoacidosis (El Toony et al., 2018; Jamoussi et al., 2017). Furthermore, long hours of fasting during the day may cause individuals to overeat and make inappropriate food choices at night, often consisting of large amounts of carbohydrate-

rich foods and sugary drinks (Babineaux et al., 2015). Therefore, proper medical nutrition therapy is crucial to manage blood glucose levels during Ramadan fasting and prevent complications associated with diabetes

Despite valid exemptions, there is a strong desire among those considered at high risk, such as the elderly and individuals with multiple health conditions, including diabetes mellitus (DM), to observe fasting during this month (Jabbar et al., 2017). Diabetes mellitus can manifest in various forms, including the common types such as type 2 (T2) diabetes with its diverse range, type 1 (T1) diabetes, diabetes during pregnancy and gestational diabetes, and pancreatic diabetes, as well as less common types such as cystic fibrosis-related diabetes and maturity-onset diabetes of the young (MODY) (Babineaux et al., 2015; Salti et al., 2004).

For patients with diabetes who plan to fast during Ramadan, it is crucial to undergo a pre-assessment and receive the proper education that covers various aspects such as physical activity, meal planning, glucose monitoring, medication dosage, and timing (Beano et al., 2017). While multiple groups have issued comprehensive guidance on management, the actual plan should be highly individualized (Hajek et al., 2011). Close monitoring is necessary to minimize potential complications among diabetic patients who chose to fast during the month of Ramadan (Pathan et al., 2012).

There is a dearth of literature regarding the safety of multi-drug regimens during Ramadan. Most studies and recommendations have centered on comparing the safety of monotherapies rather than multi-drug regimens during the fast (Al-Arouj et al., 2010; Akbani et al., 2005; Pathan et al., 2012)). As a result, numerous studies have been conducted to evaluate the safety of various anti-diabetic medications during Ramadan for diabetic patients who wish to observe the fast (Karamat et al., 2010). An individualized approach ensures that the clinician's expertise, the patient's preferences, and specific factors are considered (Perk et al., 2001). Multiple studies have indicated that diabetic patients who fast during Ramadan are at a considerable risk of experiencing various complications. Therefore, further research is necessary to develop better measures that ensure the safety of diabetic patients while they fulfill their religious obligation. This review discusses several factors clinicians should consider when developing a personalized management plan for diabetic patients who intend to fast.

2. Methods

The study involved a comprehensive review of the management of diabetic patients who choose to fast during the holy month of Ramadan. The review includes sections about managing diabetic patients during Ramadan through dietary modifications, lifestyle changes, and education and support.

3. Results

3.1.Dietary modifications

Diabetes management is greatly influenced by nutrition, and this is especially true during Ramadan. Muslims typically break their fast with dates and water throughout the month of Ramadan, followed by an evening meal known as iftar (Benbarka et al., 2010). This dinner frequently contains items heavy in carbohydrates and fat, which can cause blood sugar levels to jump and raise the risk of hyperglycemia (Al-Arouj et al., 2005). As a result, diabetic individuals should be encouraged to alter their diets throughout Ramadan to maintain optimal blood glucose management (Stratton, 2000). The use of a low-glycemic-index (GI) diet is one strategy that has been suggested for diabetes individuals during Ramadan (Thomas & Elliott, 2009; Balzer et al., 2015).

The glycemic index gauges how rapidly a food containing carbohydrates raises blood sugar levels (Moore et al., 2003). Blood glucose levels rise quickly in response to foods with a high GI, while levels rise more gradually and steadily in response to foods with a low GI(Brand-Miller et al., 2003). A low-GI diet can help people with diabetes better control their blood sugar, according to numerous studies (Brand-Miller et al., 2003; Franz et al., 2002). Hence, during Ramadan, diabetes patients should be counseled to eat low-GI meals such as whole grains, legumes, fruits, and vegetables while avoiding high-GI items like white bread, white rice, and sweetened beverages (Green & Higgins, 2005). The use of a high-protein diet is another dietary change that can be made during Ramadan (Gannon et al., 2003). A high-protein diet can help diabetes people better control their blood sugar, according to numerous studies (Wolever et al., 2008; Liao et al., 2020). This might be because protein can slow down glucose absorption into the bloodstream and has a lower glycemic index than carbohydrates. It is possible to encourage diabetic patients to eat lean meats, fish, eggs, and dairy products throughout Ramadan to increase their protein intake (Sargrad et al., 2005; Ali et al., 2016).

3.2.Lifestyle modifications

Diabetic patients must make lifestyle changes during Ramadan in addition to dietary changes to provide the best blood glucose management (Tourkmani et al., 2019). In terms of lifestyle modifications, regular physical activity is one of the most significant lifestyle changes (Almalki & Alshahrani, 2016). Exercise has been demonstrated to help people with diabetes with insulin sensitivity and blood glucose management (Benaji et al., 2006). Consequently, it is important to encourage diabetic patients to exercise moderately throughout Ramadan, such as walking, cycling, or swimming, for at least 30 minutes daily (Al Suwaidi, 2011). However, it's crucial to remember that physical activity should be scheduled properly to prevent hypoglycemia, which can happen if it's done during the fasting phase (Cryer et al., 2003).

A critical lifestyle modification during Ramadan for diabetic patients is drinking enough water

(Hassanein et al., 2021). Dehydration brought on by fasting during Ramadan is common and can result in a variety of health problems, including electrolyte imbalances, kidney stones, and urinary tract infections (Benaji et al., 2006). Diabetes patients are more likely to get dehydrated because high blood sugar levels can cause greater fluid and urine loss (Hassanein et al., 2021). Also, diabetic people should not engage in intense activity before or late at night before iftar due to the significant risk of hypoglycemia and dehydration (Tourkmani et al., 2019). As a result, it's critical to encourage diabetic patients to hydrate adequately throughout the non-fasting phase. These beverages include water, unsweetened fruit juice, and herbal tea (Tootee & Larijan, 2021).

Another crucial component of managing diabetes during Ramadan is medication control (Jabbar et al., 2017). Particularly if they are taking insulin or other blood-glucose-lowering medicines, diabetic individuals should coordinate care with their healthcare provider to modify their medication schedule throughout Ramadan (Elhadd et al., 2018). Although the management of potential dangers associated with their usage is greatly influenced by the kind, dosage, and timing of anti-diabetic drugs each patient takes, the majority of anti-diabetic medications used to treat type 2 diabetes are usually regarded as safe (Thomas et al., 2006). However, it should be noted that the risk of hypoglycemia may be increased in individuals who take many drugs that drop blood sugar (Cesur et al., 2007). Ramadan can significantly increase the risk of hypoglycemia, particularly in individuals who take basal insulin in combination with a DPP4I, metformin, or other glucose-lowering medications (Jabbar et al., 2017). Therefore, it is critical to modify the timing and dosage of medicine to reflect the modifications in food and lifestyle practices during Ramadan (Mafauzy, 2002).

Insulin analogues have been suggested as a strategy for diabetic individuals during Ramadan. Insulin analogs are artificial versions of the hormone with a quicker onset of action and a shorter half-life than regular insulin (Bin-Abbas, 2008). Research has shown that using insulin analogs during Ramadan can help diabetic people better control their blood glucose levels (Bin-Abbas, 2008; Loh et al., 2019). Other blood glucose-lowering drugs may also be taken during Ramadan in addition to insulin analogs. For instance, it has been demonstrated that sodium-glucose cotransporter 2 (SGLT2) and dipeptidyl peptidase-4 (DPP-4) inhibitors are efficient in regulating blood glucose levels in diabetic individuals during Ramadan (Elhadd et al., 2018; (Bajaj et al., 2019). It is crucial to remember that these medications may raise the risk of hypoglycemia; thus, their use should be closely managed.

3.3.Education and support

Finally, Ramadan-focused education is essential for all diabetes patients to increase their awareness of potential hazards and develop practical mitigation techniques (Hassanein et al., 2019). High-

risk people who decide to fast should have access to a lot of information and support to reduce any potential hazards, especially those related to hyper- and hypoglycemia (Bravis et al., 2010). It should be underlined that in all educational programs, the best blood glucose monitoring should be taken into account as the primary concern for minimizing the risk of problems (Kumthekar, 2010). Diabetic individuals should receive guidance and support to effectively control their diabetes during Ramadan (Cameron et al., 2014).

Healthcare professionals should inform their patients about the advantages and risks of fasting and dietary and lifestyle changes that can be made to reduce the risks (Chamsi-Pasha & Aljabri, 2014). Also, patients should be instructed on how to keep track of their blood sugar levels throughout Ramadan and what to do if their sugar levels spike or fall dangerously low (Bravis et al., 2010).

During Ramadan, diabetic individuals may gain support from their healthcare practitioner, family, and community in addition to education. In addition to encouragement and assistance with meal preparation and physical activity, family members and the community can also offer support and information to help diabetic individuals manage their diabetes during Ramadan (Sahay & Nagesh, 2018).

4. Discussion

The management of diabetes is a critical component of overall health, and maintaining ideal blood glucose levels requires modifications to diet and lifestyle. This is especially important during Ramadan because the daily fast and changes in eating habits can greatly impact how well people with diabetes maintain their blood sugar. The many dietary and lifestyle changes that can be made during Ramadan to effectively manage diabetes are covered in this narrative review.

Diabetes patients who fast throughout Ramadan run the risk of developing several problems. The risk of complications that could be fatal is particularly high for type 1 diabetes patients in general. Individuals with type 1 diabetes who are poorly managed, have a history of recurrent hypoglycemia, or are unaware of their hypoglycemia are at a very high risk of developing severe hypoglycemia. On the other hand, an excessive reduction in the insulin dosage in these individuals (to prevent hypoglycemia) may put them at risk for hyperglycemia and diabetic ketoacidosis.

Several studies reported improved glycemic control, decreased medication use, and reduced risk of hypoglycemia in patients who received nutrition therapy during Ramadan fasting. The study also highlighted the importance of individualized nutrition therapy that considers the patient's medical history, medication regimen, and cultural and social factors. The use of a low-glycemic index (GI) diet is one of the main dietary changes advised for people with diabetes during Ramadan. While foods with a low GI are absorbed more gradually and continuously, resulting in more stable blood sugar levels, foods with a

high GI can suddenly cause blood sugar levels to jump. Research has demonstrated that a low-GI diet can greatly enhance diabetics' control of blood glucose (Brand-Miller et al., 2003; Franz et al., 2002). Diabetic patients should be advised to stay away from high-GI meals like white bread, white rice, and sweetened beverages during Ramadan and to eat low-GI foods instead, including whole grains, legumes, fruits, and vegetables.

A high-protein diet has also been recommended as a dietary change for people with diabetes during Ramadan in addition to a low-GI diet. Protein has a lower glycemic index than carbs and can slow down the absorption of glucose into the system. Research has revealed that a high-protein diet can help people with diabetes better manage their blood glucose levels (Wolever et al., 2008; Liao et al., 2020). Diabetic patients can improve their protein consumption throughout Ramadan by consuming lean meats, fish, eggs, and dairy products.

For diabetic patients during Ramadan, lifestyle adjustments are also essential. Frequent exercise can help people with diabetes maintain their blood sugar levels and insulin sensitivity (Benaji et al., 2006). However, physical activity should be planned appropriately to avoid hypoglycemia, which can happen during fasting. During Ramadan, diabetic patients should engage in moderate exercise such as walking, cycling, or swimming for at least 30 minutes each day.

For diabetes individuals, staying hydrated during Ramadan is another essential lifestyle change. Dehydration is a typical side effect of fasting and can cause several medical issues, such as electrolyte imbalances, kidney stones, and urinary tract infections. Dehydration is more likely to occur in people with diabetes because of the increased fluid and urine loss brought on by high blood sugar levels. Thus, diabetes patients should maintain sufficient fluid intake during the non-fasting phase.

It is also imperative for diabetes patients to maintain medication control during Ramadan. Diabetes patients should work closely with their healthcare practitioner to adjust their medication schedule during Ramadan if they are taking insulin or other blood glucose-lowering drugs. Since insulin analogs act more quickly and have a shorter half-life than conventional insulin, they have been recommended as a solution for people with diabetes during Ramadan.

5. Conclusion

In conclusion, fasting during Ramadan can be difficult for those with diabetes, but it is feasible for them to do so safely and productively with the right treatment. The management of diabetes during Ramadan should include dietary adjustments, lifestyle changes, medication control, as well as education, and support. A customized management plan that takes into consideration each patient's needs and preferences and offers direction and support throughout the fasting period should be created in close

consultation with the patient by healthcare professionals.

6. Declarations

a. Conflict of Interest Statement

The authors have no conflict of interest to declare.

b. Funding Disclosure

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7. References

Ahmed, S. H., Chowdhury, T. A., Hussain, S., Syed, A., Karamat, A., Helmy, A., Waqar, S., Ali, S., Dabhad, A., Seal, S. T., Hodgkinson, A., Azmi, S., & Ghouri, N. (2020). Ramadan and diabetes: A narrative review and practice update. *Diabetes Therapy*, *11*(11), 2477–2520. https://doi.org/10.1007/s13300-020-00886-y

Akbani, M. F., Saleem, M., Gadit, W. U., Ahmed, M., Basit, A., & Malik, R. A. (2005). Fasting and feasting safely during Ramadan in the patient with diabetes. *Practical Diabetes International*, *22*(3), 100–104. https://doi.org/10.1002/pdi.767

Al Suwaidi, J. (2011). The impact of diurnal fasting during Ramadan on the lipid profile, HS-CRP, and serum leptin in stable cardiac patients. *Vascular Health and Risk Management*, 7. https://doi.org/10.2147/vhrm.s22894

Al-Arouj, M., Assaad-Khalil, S., Buse, J., Fahdil, I., Fahmy, M., Hafez, S., Hassanein, M., Ibrahim, M. A., Kendall, D., Kishawi, S., Al-Madani, A., Nakhi, A. B., Tayeb, K., & Thomas, A. (2010). Recommendations for management of diabetes during Ramadan. *Diabetes Care*, *33*(8), 1895–1902. https://doi.org/10.2337/dc10-0896

Al-Arouj, M., Bouguerra, R., Buse, J., Hafez, S., Hassanein, M., Ibrahim, M. A., Ismail-Beigi, F., El-Kebbi, I., Khatib, O., Kishawi, S., Al-Madani, A., Mishal, A. A., Al-Maskari, M., Nakhi, A. B., & Al-Rubean, K. (2005). Recommendations for management of diabetes during Ramadan. *Diabetes Care*, *28*(9), 2305–2311. https://doi.org/10.2337/diacare.28.9.2305

Ali, S., Davies, M. J., Brady, E. M., Gray, L. J., Khunti, K., Beshyah, S. A., & Hanif, W. (2016). Guidelines for managing diabetes in Ramadan. *Diabetic Medicine*, *33*(10), 1315–1329. https://doi.org/10.1111/dme.13080

Almalki, M. H., & Alshahrani, F. (2016). Options for controlling type 2 diabetes during Ramadan. *Frontiers in Endocrinology*, *7*. https://doi.org/10.3389/fendo.2016.00032

Babineaux, S. M., Toaima, D., Boye, K. S., Zagar, A., Tahbaz, A., Jabbar, A., & Hassanein, M. (2015). Multi-country retrospective observational study of the management and outcomes of patients with type 2 diabetes during Ramadan in 2010 (creed). *Diabetic Medicine*, *32*(6), 819–828. https://doi.org/10.1111/dme.12685

Bajaj, H. S., Abouhassan, T., Ahsan, M. R., Arnaout, A., Hassanein, M., Houlden, R. L., Khan, T., Khandwala, H., & Verma, S. (2019). Diabetes Canada position statement for people with types 1 and 2 diabetes who fast during Ramadan. *Canadian Journal of Diabetes*, *43*(1), 3–12. https://doi.org/10.1016/j.jcjd.2018.04.007

Balzer, B. W. R., Atkinson, F. S., Bell, K. J., & Steinbeck, K. S. (2015). Low glycemic index dietary interventions in cystic fibrosis. *Diet and Exercise in Cystic Fibrosis*, 209–219. https://doi.org/10.1016/b978-0-12-800051-9.00025-0

Beano, A. M., Zmaili, M. A., Gheith, Z. H., Naser, A. M., Momani, M. S., Yousef, A.-M. F., & Zayed, A. A. (2017). Predetermined anti-diabetic drug regimen adjustments during Ramadan fasting: An observational study of safety. *Endocrinology and Metabolism*, *32*(2), 265. https://doi.org/10.3803/enm.2017.32.2.265

Benaji, B., Mounib, N., Roky, R., Aadil, N., Houti, I. E., Moussamih, S., Maliki, S., Gressier, B., & El Ghomari, H. (2006). Diabetes and ramadan: Review of the literature. *Diabetes Research and Clinical Practice*, *73*(2), 117–125. https://doi.org/10.1016/j.diabres.2005.10.028

Benbarka, M. M., Khalil, A. B., Beshyah, S. A., Marjei, S., & Awad, S. A. (2010). Insulin pump therapy in Moslem patients with type 1 diabetes during Ramadan fasting: An observational report. *Diabetes Technology & Therapeutics*, *12*(4), 287–290. https://doi.org/10.1089/dia.2009.0130

Beshyah, S. (2009). Fasting during the month of ramadan for people with diabetes: Medicine and Fiqh United at last. *Ibnosina Journal of Medicine and Biomedical Sciences*, *01*(02), 58–60. https://doi.org/10.4103/1947-489x.211054

Beshyah, S. A., Benbarka, M. M., & Sherif, I. H. (2007). Practical management of diabetes during ramadan fast. *Libyan Journal of Medicine*, *2*(4), 185–189. https://doi.org/10.3402/ljm.v2i4.4731

Bin-Abbas, B. S. (2008). Insulin pump therapy during Ramadan fasting in type 1 diabetic adolescents. *Annals of Saudi Medicine*, *28*(4), 305. https://doi.org/10.4103/0256-4947.51709

Brand-Miller, J., Hayne, S., Petocz, P., & Colagiuri, S. (2003). Low–glycemic index diets in the management of diabetes. *Diabetes Care*, *26*(8), 2261–2267. https://doi.org/10.2337/diacare.26.8.2261

Bravis, V., Hui, E., Salih, S., Mehar, S., Hassanein, M., & Devendra, D. (2010). Ramadan education and awareness in diabetes (READ) programme for Muslims with type 2 diabetes who fast during Ramadan. *Diabetic Medicine*, *27*(3), 327–331. https://doi.org/10.1111/j.1464-5491.2010.02948.x

Cameron, F. J., Amin, R., de Beaufort, C., Codner, E., & Acerini, C. L. (2014). Diabetes in adolescence. *Pediatric Diabetes*, *15*(S20), 245–256. https://doi.org/10.1111/pedi.12169

Cesur, M., Corapcioglu, D., Gursoy, A., Gonen, S., Ozduman, M., Emral, R., Uysal, A. R., Tonyukuk, V., Yilmaz, A. E., Bayram, F., & Kamel, N. (2007). A comparison of glycemic effects of glimepiride, repaglinide, and insulin glargine in type 2 diabetes mellitus during Ramadan fasting. *Diabetes Research and Clinical Practice*, *75*(2), 141–147. https://doi.org/10.1016/j.diabres.2006.05.012

Chamsi-Pasha, H., & Aljabri, K. S. (2014). The diabetic patient in Ramadan. *Avicenna Journal of Medicine*, *04*(02), 29–33. https://doi.org/10.4103/2231-0770.130341

Cryer, P. E., Davis, S. N., & Shamoon, H. (2003). Hypoglycemia in diabetes. *Diabetes Care*, *26*(6), 1902–1912. https://doi.org/10.2337/diacare.26.6.1902

El Toony, L. F., Hamad, D. A., & Omar, O. M. (2018). Outcome of focused pre-ramadan education on metabolic and glycaemic parameters in patients with type 2 diabetes mellitus. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *12*(5), 761–767. https://doi.org/10.1016/j.dsx.2018.04.036

Elhadd, T. A., & Al-Amoudi, A. A. (2006). Recommendations for management of diabetes during Ramadan. *Diabetes Care*, *29*(3), 744–745. https://doi.org/10.2337/diacare.29.03.06.dc05-2102

Elhadd, T., Dabbous, Z., Bashir, M., Elzouki, A., Ghadban, W., Baagar, K., Benjamin, S., Hassanien, M., Saeed, A. A., Dukhan, K., Malik, R. A., & Abou-Samra, A.-B. (2018). Incidence of hypoglycaemia in patients with type-2 diabetes taking multiple glucose lowering therapies during ramadan: The PROFAST ramadan study. *Journal of Diabetes & Metabolic Disorders*, *17*(2), 309–314. https://doi.org/10.1007/s40200-018-0374-2

Franz, M. J., Bantle, J. P., Beebe, C. A., Brunzell, J. D., Chiasson, J.-L., Garg, A., Holzmeister, L. A., Hoogwerf, B., Mayer-Davis, E., Mooradian, A. D., Purnell, J. Q., & Wheeler, M. (2002). Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. *Diabetes Care*, *25*(1), 148–198. https://doi.org/10.2337/diacare.25.1.148

Gannon, M. C., Nuttall, F. Q., Saeed, A., Jordan, K., & Hoover, H. (2003). An increase in dietary protein improves the blood glucose response in persons with type 2 diabetes. *The American Journal of Clinical Nutrition*, *78*(4), 734–741. https://doi.org/10.1093/ajcn/78.4.734

Green, S., & Higgins, J. P. T. (n.d.). Preparing a Cochrane Review. *Cochrane Handbook for Systematic Reviews of Interventions*, 11–30. https://doi.org/10.1002/9780470712184.ch2

Hajek, P., Myers, K., Dhanji, A.-R., West, O., & McRobbie, H. (2011). Weight change during and after Ramadan fasting. *Journal of Public Health*, *34*(3), 377–381. https://doi.org/10.1093/pubmed/fdr087

Hassanein, M., Abdelgadir, E., Bashier, A., Rashid, F., Saeed, M. A., Khalifa, A., Eltayb, F., Abuelkheir, S., Abdellatif, M., Sayyah, F., Khalifa, S., & Alawadi, F. (2019). 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 Research and Clinical Practice*, *150*, 288–295. https://doi.org/10.1016/j.diabres.2018.12.013

Hassanein, M., Alamoudi, R. M., Kallash, M.-A., Aljohani, N. J., Alfadhli, E. M., Tony, L. E., Khogeer, G. S., Alfadhly, A. F., Khater, A. E. M., Ahmedani, M. Y., Buyukbese, M. A., Shaltout, I., Belkhadir, J., Hafidh, K., Chowdhury, T. A., Hussein, Z., & Elbarbary, N. S. (2021). Ramadan fasting in people with type 1 diabetes during COVID-19 pandemic: The DAR Global Survey. *Diabetes Research and Clinical Practice*, *172*, 108626. https://doi.org/10.1016/j.diabres.2020.108626

Jabbar, A., Hassanein, M., Beshyah, S. A., Boye, K. S., Yu, M., & Babineaux, S. M. (2017). Creed study: Hypoglycaemia during Ramadan in individuals with type 2 diabetes mellitus from three continents. *Diabetes Research and Clinical Practice*, *132*, 19–26. https://doi.org/10.1016/j.diabres.2017.07.014

Jamoussi, H., Ben Othman, R., Chaabouni, S., Gamoudi, A., Berriche, O., Mahjoub, F., Sebai, I., & Amrouche, C. (2017). Interest of the therapeutic education in patients with type 2 diabetes observing the fast of ramadan. *Alexandria Journal of Medicine*, *53*(1), 71–75. https://doi.org/10.1016/j.ajme.2016.01.002

Karamat, M. A., Syed, A., & Hanif, W. (2010). Review of Diabetes Management and guidelines during ramadan. *Journal of the Royal Society of Medicine*, *103*(4), 139–147. https://doi.org/10.1258/jrsm.2010.090254

Kobeissy, A., Zantout, M., & Azar, S. (2008). Suggested insulin regimens for patients with type 1 diabetes mellitus who wish to fast during the month of ramadan. *Clinical Therapeutics*, *30*(8), 1408–1415. https://doi.org/10.1016/j.clinthera.2008.08.007

Kumthekar, A. (2010). Drug-induced hyperglycemia and hypoglycemia. *Practical Management of Diabetes*, 195–195. https://doi.org/10.5005/jp/books/11384_29

Liao, J., Wang, T., Li, Z., Xie, H., & Wang, S. (2020). Experiences and views of people with diabetes during Ramadan fasting: A qualitative meta-synthesis. *PLOS ONE*, *15*(11). https://doi.org/10.1371/journal.pone.0242111

Loh, H. H., Lim, L. L., Loh, H. S., & Yee, A. (2019). Safety of ramadan fasting in young patients with type 1 diabetes: A systematic review and meta-analysis. *Journal of Diabetes Investigation*, *10*(6), 1490–1501. https://doi.org/10.1111/jdi.13054

Mafauzy, M. (2002). Repaglinide versus glibenclamide treatment of type 2 diabetes during Ramadan fasting. *Diabetes Research and Clinical Practice*, *58*(1), 45–53. https://doi.org/10.1016/s0168-8227(02)00104-3

Mohd Yusof, B.-N., Yahya, N. F., Hasbullah, F. Y., Wan Zukiman, W. Z., Azlan, A., Yi, R. L., Marczewska, A., & Hamdy, O. (2021). Ramadan-focused nutrition therapy for people with diabetes: A narrative review. *Diabetes Research and Clinical Practice*, *172*, 108530. https://doi.org/10.1016/j.diabres.2020.108530

Moore, H., Summerbell, C., Hooper, L., Cruickshank, K., Vyas, A., Johnstone, P., Ashton, V., & Kopelman, P. (2003). Dietary advice for treatment of type 2 diabetes mellitus in adults. *The Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.cd004097

Pathan, M. F., Sahay, R. K., Zargar, A. H., Raza, S. A., Azad Khan, A. K., Ganie, M. A., Siddiqui, N. I., Amin, F., Ishtiaq, O., & Kalra, S. (2012). South Asian consensus guideline: Use of insulin in diabetes during Ramadan. *Indian Journal of Endocrinology and Metabolism*, *16*(4), 499. https://doi.org/10.4103/2230-8210.97992

Perk, G., Ghanem, J., Aamar, S., Ben-Ishay, D., & Bursztyn, M. (2001). The effect of the fast of ramadan on ambulatory blood pressure in treated hypertensives. *Journal of Human Hypertension*, *15*(10), 723–725. https://doi.org/10.1038/sj.jhh.1001262

Pinar, R. (2002). Management of people with diabetes during Ramadan. *British Journal of Nursing*, *11*(20), 1300–1303. https://doi.org/10.12968/bjon.2002.11.20.10768

Saeed Maryam, A. (2017). Impact of optimum diabetes care on the safety of fasting in Ramadan in adult patients with type 1 diabetes mellitus. https://doi.org/10.26226/morressier.59d51843d462b80296ca3797

Sahay, R., & Nagesh, V. (2018). Type 1 diabetes mellitus and fasting during Ramadan. *Ramadan and Diabetes Care*, 117–117. https://doi.org/10.5005/jp/books/13049_14

Salti, I., Bénard Eric, Detournay, B., Bianchi-Biscay, M., Le Brigand, C., Voinet Céline, & Jabbar, A. (2004). A population-based study of diabetes and its characteristics during the fasting month of ramadan in 13 countries. *Diabetes Care*, *27*(10), 2306–2311. https://doi.org/10.2337/diacare.27.10.2306

Sargrad, K. R., Homko, C., Mozzoli, M., & Boden, G. (2005). Effect of high protein vs high carbohydrate intake on insulin sensitivity, body weight, hemoglobin a1c, and blood pressure in patients with type 2 diabetes mellitus. *Journal of the American Dietetic Association*, *105*(4), 573–580. https://doi.org/10.1016/j.jada.2005.01.009

Stratton, I. M. (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): Prospective Observational Study. *BMJ*, *321*(7258), 405–412. https://doi.org/10.1136/bmj.321.7258.405

Thomas, D., & Elliott, E. J. (2009). Low glycaemic index, or low glycaemic load, diets for diabetes mellitus. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.cd006296.pub2

Thomas, N., Bharani, Ameen, M., Abraham, S., Job, V., John, B., Karol, R., Kavitha, M. L., Thomas, K., Seshadri, M. S., & Vasan, S. (2006). A double-blind, randomized, multicenter study evaluating the effects of pioglitazone in fasting Muslim subjects during Ramadan. *International Journal of Diabetes in Developing Countries*, *26*(2), 70. https://doi.org/10.4103/0973-3930.28276

Tootee, A., & Larijan, B. (2021). Ramadan fasting and diabetes, latest evidence and technological advancements: 2021 update. *Journal of Diabetes & Metabolic Disorders*, *20*(1), 1085–1091. https://doi.org/10.1007/s40200-021-00806-2

Tourkmani, A. M., Alharbi, T. J., Bin Rsheed, A. M., AlRasheed, A. N., AlBattal, S. M., Abdelhay, O., Hassali, M. A., Faya, S. I., Assiri, E. S., Al Ghishiayan, K. I., Alrasheedy, A. A., & Abbas, M. A. F. (2019). Impact of ramadan focused education program on medications adjustment for patients with type 2 diabetes in a primary health care institution in Saudi Arabia. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(1), 161–165. https://doi.org/10.1016/j.dsx.2018.07.012

Wolever, T. M. S., Gibbs, A. L., Mehling, C., Chiasson, J.-L., Connelly, P. W., Josse, R. G., Leiter, L. A., Maheux, P., Rabasa-Lhoret, R., Rodger, N. W., & Ryan, E. A. (2008). The Canadian trial of carbohydrates in diabetes (CCD), a 1-y controlled trial of low-glycemic-index dietary carbohydrate in type 2 diabetes: No effect on glycated hemoglobin but reduction in C-reactive protein. *The American Journal of Clinical Nutrition*, *87*(1), 114–125. https://doi.org/10.1093/ajcn/87.1.114