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Metabolic and Clinical Implications of Ramadan Fasting in Postmenopausal Women with Diabetes: A Narrative Review

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Abstract

Background: Ramadan fasting results in substantial alterations in meal timing, fluid consumption, physical activity, and the administration schedule of glucose-lowering medications. Postmenopausal women with diabetes are especially susceptible due to the association between oestrogen decline and increased visceral adiposity, insulin resistance, dyslipidaemia, sarcopenia, and osteoporosis. Furthermore, diabetes elevates the risk of cardiovascular and renal complications. This review evaluates the potential metabolic effects, safety considerations, and clinical implications of Ramadan fasting in this population.

Methods: A narrative review and critical appraisal of Ramadan fasting studies in adults with type 2 diabetes and postmenopausal women was conducted, with an emphasis on randomized and prospective studies evaluating glycaemic control, hypoglycaemia, body weight, pharmacological therapy, education, and monitoring.

Results: Ramadan fasting has been associated with modest improvements in body weight, glycaemic control, and lipid profiles, although the evidence remains heterogeneous. Randomized trials indicate that the choice of treatment strategy significantly affects the safety of fasting in postmenopausal women. In a multinational randomized trial involving 506 adults with type 2 diabetes, structured Ramadan education and medication adjustments led to a significant reduction in severe hypoglycaemia. Sitagliptin was associated with a lower incidence of symptomatic hypoglycaemia compared to sulfonylureas (6.7% vs 13.2%), and the LIRA-Ramadan trial reported a reduced rate of symptomatic hypoglycaemia with liraglutide compared to sulfonylurea (~2% vs 11%). Similarly, dapagliflozin resulted in less hypoglycaemia than sulfonylurea (6.9% vs 28.8%), although the use of SGLT2 inhibitors necessitates careful monitoring for dehydration and volume depletion. Studies in postmenopausal women without diabetes suggest possible reductions in adiposity and triglyceride levels. However, there is a lack of dedicated trials in postmenopausal women with diabetes, and evidence regarding effects on muscle mass, bone health, falls, and long-term cardiovascular outcomes remains limited.

Conclusion: Ramadan fasting appears feasible for carefully selected postmenopausal women with diabetes when supported by individualized risk assessment, optimized medication regimens, regular glucose monitoring, sufficient hydration, balanced nutrition, and resistance exercise. Further dedicated trials that incorporate continuous glucose monitoring, assessments of body composition, muscle strength, and bone health outcomes are warranted.

Keywords: Ramadan fasting; Postmenopause; type 2 diabetes; hypoglycaemia; metabolic health.

Introduction

Ramadan fasting is something that hundreds of millions of Muslims around the world do every year. During this time, they abstain from eating or drinking anything from dawn till sunset. So, most of their eating happens between sunset, when they have a meal called Iftar, and the early morning meal, called Suhoor [1]. The daily routine changes; when food to be eaten, how many calories to be taken, how much water to be drink, how active to be, how much sleep to be get, and even when medicine be taken [1]. It is a big adjustment, but it is a special time for Muslims to focus on their faith and connect with their community.

Many people with diabetes still fast even though they do not have to. Some people with serious health problems are exempt from fasting, but a lot of them with diabetes choose to do it anyway. A survey called the DAR Global Survey 2022 found that fasting is common among people with type 2 diabetes ,85.1% of them fasted for at least one day, and on average, they fasted for around 27.6 days [2]. This is interesting because although many diabetic patients advised against fasting, but the results of this survey [2] showed that a lot of them are still choosing to do it.

Women who have gone through menopause and have diabetes are a special group that needs attention. When women go through menopause, their bodies change in ways that can increase their risk of health problems [3]. Postmenopause women may gain weight around waist which indicate increase in visceral fat [3], it can lead to insulin resistance [4]. Having diabetes on top of that makes their risk of heart disease and other metabolic problems even higher [5]. These women may also have other health issues, such as osteoporosis or osteopenia [6], muscle loss [7], high blood pressure [5], and kidney disease [5], which can make it harder for them to fast safely. All these factors combined make it important to carefully consider their health and well-being during fasting Ramadan.

So, when it comes to Ramadan fasting for people with diabetes, it's not just about cutting calories, it is a lot more complicated than that. We must think about how fasting affects the body, how it interacts with diabetes, and how it impacts other things like aging, nutrition, medication, sleep, and exercise. All these factors are connected and

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play a role in how Ramadan fasting affects someone with diabetes.

Menopause, Diabetes and Metabolic Vulnerability (Figure 1)

Menopause represents permanent cessation of ovarian reproductive function and is characterised by marked reductions in oestrogen [8]. Oestrogen deficiency is accompanied by changes in body-fat distribution, lipid metabolism, vascular function, glucose homeostasis and skeletal metabolism [8]. Visceral adiposity tends to increase after menopause even without major changes in overall body weight [9]. Increased abdominal adiposity contributes to insulin resistance through increased free fatty acid flux, adipose inflammation and altered adipokine signalling [10]. The combination of diabetes and menopause therefore creates a metabolically vulnerable phenotype characterised by:

Oestrogen decline → visceral adiposity → insulin resistance → dysglycaemia → vascular inflammation → increased cardiovascular risk.

Diabetes can also make some other health problems worse, like problems with the endothelium lining blood vessels, stress on the body's cells, and damage to tissues. And to make matters worse, menopause can also increase the risk of heart disease in other ways [8]. These interactions are clinically relevant when considering Ramadan because prolonged daytime fasting alters glucose availability, hepatic glucose production, insulin concentrations, fatty acid oxidation and ketogenesis [5].

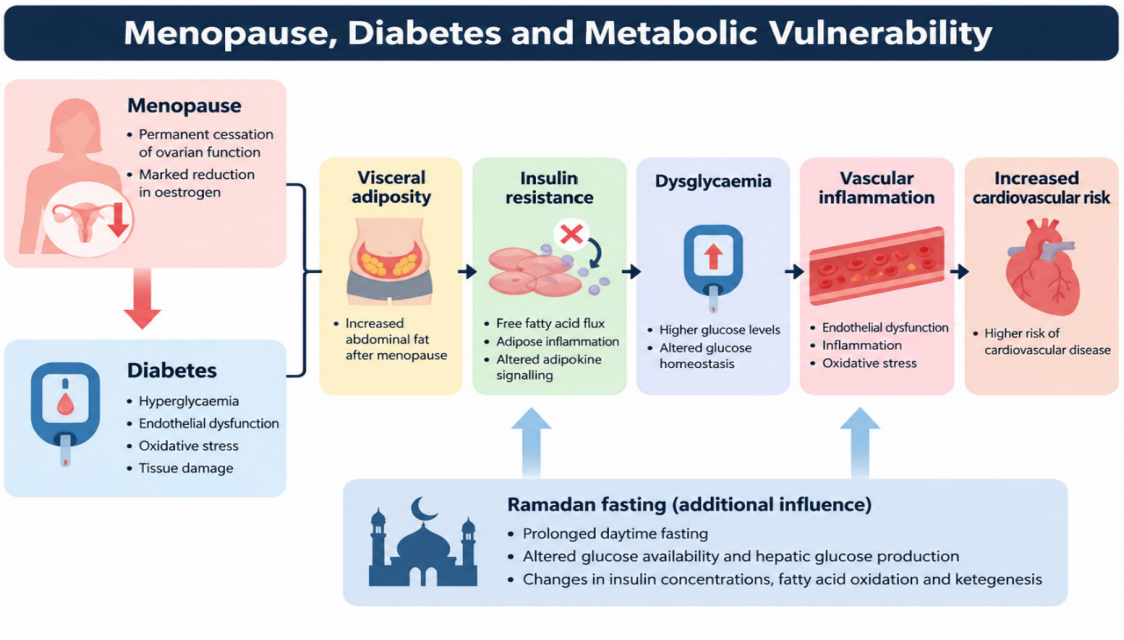

Figure 1: *Menopause, Diabetes and Metabolic vulnerability.*

Metabolic Adaptation to Ramadan Fasting

When we eat, the glucose from our food is the main source of energy for our body, but after a few hours without eating with the decrease of blood glucose level, the amount of insulin in our bloodstream goes down, and the amount of glucagon goes up [11].

Our body will react firstly, by breaking down stored glycogen in liver and muscles into glucose. As fasting continues: Reduced food intake → ↓ insulin → ↑ glucagon → glycogenolysis → lipolysis → fatty acid oxidation → mild ketogenesis.

In metabolically healthy individuals these changes are usually well tolerated, but with diabetes, this adaptation will be altered.

Inadequate insulin activity may permit excessive hepatic glucose production, whereas glucose lowering medication may produce hypoglycaemia during prolonged fasting [11]. When we go from fasting to eating a big meal after a fast, like Iftar, it can be a great load for our body to accommodate, with more carbs, blood glucose can spike fast after eating. So, a woman might have low blood sugar levels when she's still fasting, but then her levels can get high after she eats, which is called hyperglycaemia. This can be a big change, which represent a real challenge to our body. It is like our body is getting a shock from the sudden surge of glucose. This is why just looking at HbA1c levels may not give a complete picture of blood sugar control during Ramadan. Fluctuation in blood glucose needs to be considered.

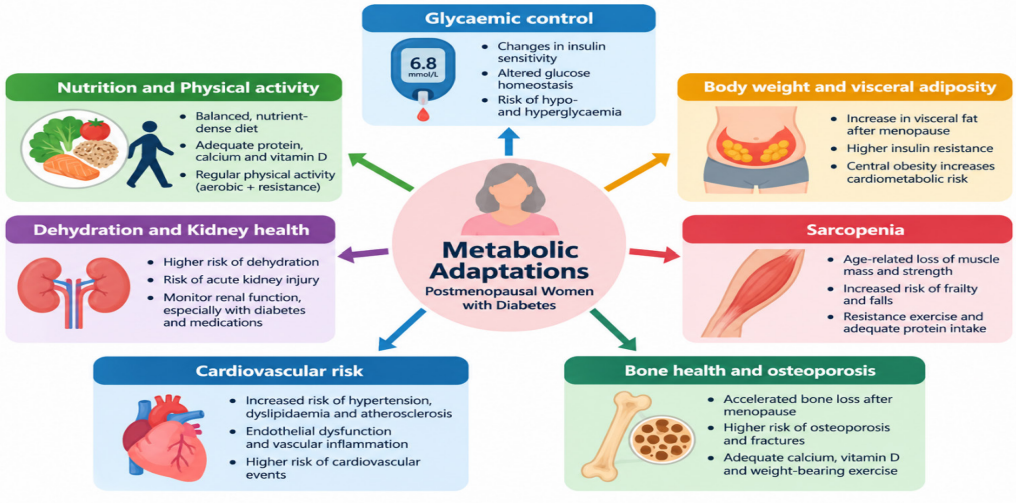

Figure 2: *Metabolic adaptation in postmenopausal women.*

Effects on Glycaemic Control (Figure 3)

Evidence regarding Ramadan fasting and glycaemic control is heterogeneous. Ramadan fasting has been shown to have a significant impact on people with type 2 diabetes. In a recent study that looked at 34 clinical trials and over 11,900 adults with the condition, it was found that fasting during Ramadan can lower blood sugar levels [12]. On average, fasting glucose levels decreased by about 11.5 mg/dL, and HbA1c levels decreased by around 0.46 percentage points [12]. However, it is worth noting that people's bodies react differently to fasting, so these results can vary greatly from person to person. This means that doctors and patients can't assume that everyone with type 2 diabetes will have the same response to Ramadan fasting. Some research has shown that fasting during Ramadan can have mixed effects on blood sugar control, for example, one study of 88 people with type 2 diabetes found that their blood glucose levels got worse during Ramadan, even though they lost weight and had better cholesterol levels [13]. More recent studies have also found that Ramadan can affect blood sugar control in different ways, sometimes making it better and sometimes making it worse [12,14]. This can be a problem for people with diabetes, because they need to keep their blood sugar levels under control to stay healthy. Using special devices such as Continuous Glucose Monitoring devices (CGM) to track glucose levels all the time or at certain moments can give us more information. In a study done by Al Hayek et al [15] included 93 people with type 2 diabetes who use CGM, researchers found that participants had better average glucose levels, less variation in their glucose levels, and spent more time in their target range during Ramadan [15]. However, they also spent a bit more time with glucose levels below 54 mg/dL, which is a concern [15]. This shows that tracking glucose levels can help people with diabetes make better decisions and have more control over their condition. So, it is not necessarily that Ramadan is always good or bad for blood sugar control. How it affects you really depends on a few things: your starting blood sugar levels, the medications you are taking, what you eat, how active you are, how long you fast, how well you understand what you're doing, and how often you check your blood sugar.

Hypoglycaemia remains one of the principal hazards of Ramadan fasting for people with diabetes. A large study called EPIDIAR [16] included 12,914 people with diabetes; 1,070 (8.7%) patients with type 1 diabetes and 11,173 (91.3%) patients with type 2 diabetes) found that participants had a lot more severe episodes of low blood glucose during Ramadan than at other times of the year; type 1 diabetes, 0.14 vs. 0.03 episode/month, $P = 0.0174$; type 2 diabetes, 0.03 vs. 0.004 episode/month, $P < 0.0001$) [16]. Another study, called CREED [17], discovered that people taking insulin had a much higher risk of low blood sugar than those taking just oral medication (16.8% vs 5.3%), and if they had low blood glucose before, they were even more likely to have it during Ramadan (odds ratio 7.80; 95% CI 5.31–11.45). This is important to know, especially for people with diabetes who are fasting during Ramadan.

As women get older, especially after menopause, they need to be careful about hypoglycaemia. Age can affect how their bodies react to it and make it harder for them to notice the symptoms [18]. If they have osteoporosis or are frail, the problems that come with hypoglycaemia like feeling dizzy, falling, breaking bones, having heart rhythm problems, and trouble thinking clearly can be even more serious. Medicine plays a big role here, drugs like insulin and those that boost insulin production need careful handling when it comes to dosage and timing, more so than other treatments that do not carry a high risk of causing hypoglycaemia, It is worth noting that checking blood glucose levels does not break the Ramadan fast, so patients should do it if their situations needed.

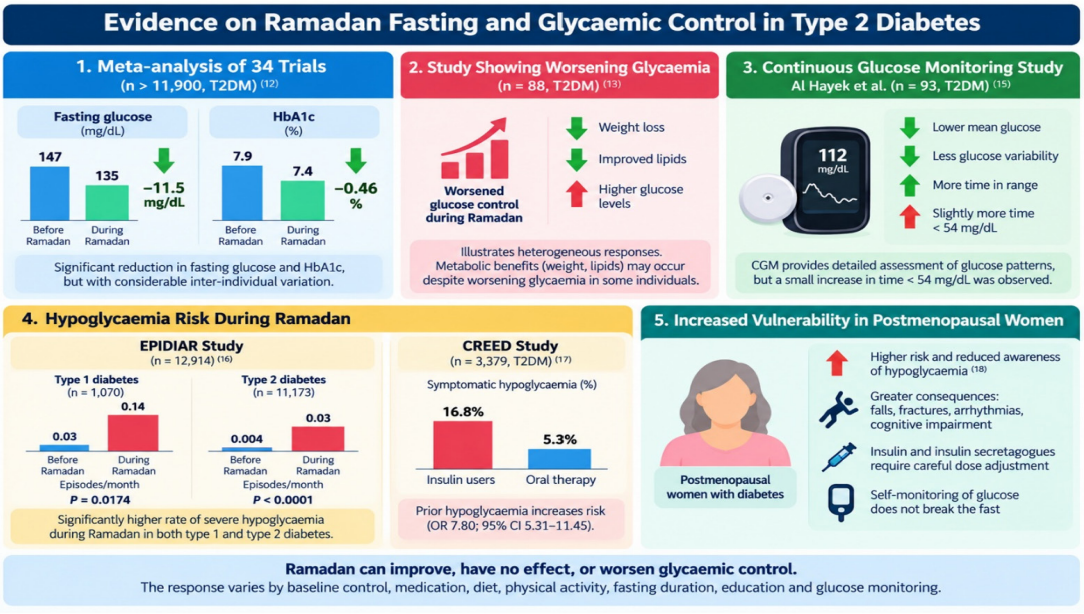

Figure 3: *Effect of Ramadan fasting on glycaemic control in type 2 diabetes.*

Evidence Specifically in Postmenopausal Women

There is a big gap in research when it comes to postmenopausal women with diabetes, we just do not have enough direct evidence. This is a significant problem, and it is something that needs to be addressed. Research on women after menopause who do not have diabetes can teach us a lot about how their bodies work. A study comparing premenopausal and postmenopausal Saudi women found that Ramadan intermittent fasting was associated with reductions in waist-to-hip ratio, body fat and fat mass [11]. LDL cholesterol decreased particularly among postmenopausal women [11]. However, nutrient intake including several vitamins and minerals also declined. A new study looked at 62 healthy women and found that they lost weight and body fat during Ramadan [19]. Their waist size and blood pressure also went down, which is a good finding [19]. Another finding that High Density Lipoprotein (HDL) increased, and they had less inflammation in their bodies [19]. These changes happened in both

younger and older women, which is interesting findings [19]. It seems that fasting during Ramadan can have some positive effects on our health, like lowering triglycerides and body-fat percentage. Overall, the study [19] found that the women's health improved in many ways during this time. This is a hopeful discovery, but we should not assume it automatically applies to women with diabetes after menopause, especially if they are taking insulin, sulfonylureas, or a bunch of other medications. This distinction is fundamental when interpreting the evidence.

Body Weight and Visceral Adiposity

Losing weight and getting rid of abdominal fat are a big issue for many women after menopause. Fasting during Ramadan can be a good chance to make some small changes to how our bodies use energy [20]. However, fasting alone does not guarantee weight loss. High-calorie Iftar meals, fried foods, desserts and sweetened beverages may completely compensate for the daytime caloric deficit [21]. Some individuals gain weight during Ramadan [21]. For postmenopausal women with obesity and diabetes, nutritional counselling should emphasise dietary quality rather than simply fasting duration. A practical Iftar meal might include vegetables, legumes or salad, a moderate portion of whole-grain carbohydrate, and high-quality protein. Refined carbohydrates and concentrated sweets should be limited. The goal should be metabolic improvement without malnutrition or excessive lean-mass loss.

Sarcopenia

Sarcopenia is an under-recognised risk for Skeletal muscles,it deserves particular attention in postmenopausal women. As women get older and their oestrogen levels drop, they tend to lose muscle mass and strength over time [22]. Having diabetes can make this problem worse [23]. When diabetes and muscle loss occur together, it can lead to poor blood glucose control, falls, and frailty, ultimately resulting in worse outcomes [23]. This combination can have serious consequences for overall health [23]. Decreasing protein or calories intake during Ramadan, might leads lose weight, but some of that weight loss could be from muscle mass, which is not good for postmenopausal women health.

Consequently, the therapeutic goal should not simply be: “lose weight during Ramadan.”

A more appropriate objective is: ↓ visceral fat + preserve muscle + maintain strength + improve metabolic health. To get the most out of your protein, it's a good idea to spread it out between meals, like Iftar and Suhoor. Protein can be taken from lots of different foods, such as fish, chicken, eggs, dairy products, and legumes. It's also important to choose foods that are right for the patient, based on what he/she likes and how well their kidneys are working. Resistance exercise two or more times weekly, where clinically appropriate, may help preserve muscle mass and function.

Bone Health and Osteoporosis

Bone health represents another important distinction between younger adults and postmenopausal women. Oestrogen deficiency accelerates bone resorption and increases osteoporosis risk [24]. Postmenopausal women are also particularly susceptible to osteosarcopenia, the combination of osteoporosis and sarcopenia, which is associated with falls, fractures and frailty [24]. Ramadan fasting itself has not been convincingly demonstrated to cause clinically significant bone loss over one month [25]. The greater concern is inadequate nutritional intake. Calcium, vitamin D and protein intake should therefore be assessed, particularly in women already diagnosed with osteoporosis [26]. People with diabetes are more likely to fall due to related problems like neuropathy, retinopathy, and hypoglycaemia [27]. So, when choosing medications and blood pressure goals, it's essential to avoid causing low blood sugar or blood pressure [26].

Cardiovascular Risk

Postmenopausal women with diabetes frequently have clustering of cardiovascular risk factors including central obesity, hypertension, dyslipidaemia and insulin resistance [28]. Fasting during Ramadan can have a small but positive effect on certain health measures. A recent study on diabetes [12] found that Ramadan fasting can significantly Lower Low-Density Lipoprotein (LDL) and triglycerides, but it doesn't seem to have a big impact on High Density Lipoprotein (HDL). Research on healthy women after menopause has also shown some positive changes. Al Zunaidy et al [19] found that body fat, triglycerides, and certain inflammation signs have gotten better between beginning and end of Ramadan [19]. But we should not forget about the risks to heart health. For women with serious heart problems, like those who have had a recent heart attack or have other major health issues, it is crucial to take a closer look at their individual situation before trying fasting [29].

Dehydration and Kidney Health

Ramadan differs from other forms of intermittent fasting in that it involves complete abstinence from fluids. Postmenopausal women with diabetes may have increased susceptibility to dehydration because of age, hyperglycaemia-induced osmotic diuresis, CKD, antihypertensive therapy, diuretics or SGLT2 inhibitors [30]. SGLT2 inhibitors are important because they help get rid of extra glucose and fluid in the body through urine [30]. Studies done during Ramadan have mostly shown that these inhibitors are safe for the kidneys, but some people have reported feeling dehydrated [30]. In a meta-analysis done by Kamrul-Hasan et al [31], researchers found that people taking SGLT2 inhibitors were more likely to feel dizzy when standing up and have low blood pressure problems (The risks of postural dizziness (RR = 6.39, 95%CI: 1.58-25.80, $P = 0.009$, $I^2 = 44\%$), hypotension or postural hypotension (RR = 4.43, 95%CI: 1.35-14.55, $P = 0.01$, $I^2 = 31\%$), were higher in the SGLT2i group compared to the non-SGLT2i group [31]. This means that doctors need to carefully look at each person's individual risks before prescribing these medications. Adequate hydration between Iftar and Suhoor is therefore essential.

Nutrition

During Ramadan the nutritional strategy for postmenopausal women with diabetes should simultaneously address glycaemic control, cardiovascular risk, muscle preservation and bone health [31]. Iftar should avoid large quantities of refined carbohydrate and sugary beverages [1]. Vegetables, whole grains, legumes, unsaturated fats and lean proteins should predominate [1]. Eating a good meal before starting your day is important, especially when it comes to Suhoor [33]. Having something that's got a mix of carbs that release energy slowly, some protein, fibre, and healthy fats can really help keep you full for longer and stop your blood sugar levels from spiking up and down too quickly [1]. Protein is crucial for keeping our muscles healthy and strong. We also need enough calcium and vitamin D to keep our bones in good shape [33]. Ramadan should therefore represent time-restricted healthy nutrition rather than time-restricted unhealthy eating.

Physical Activity

Staying active is still important during Ramadan, but health care providers should adjust exercise schedule and exercise intensity to fit for the patients’ needs. For many women, it is acceptable to do some light exercise while fasting [1]. Exercise right before breaking fast, known as Iftar, can be a problem. It can increase the risk of hypoglycaemia, or getting dehydrated, especially if the woman taking insulin

[1]. Resistance exercise is particularly valuable after menopause because it simultaneously improves insulin sensitivity, skeletal-muscle function and bone loading [34]. A practical approach may include walking or light activity during fasting hours and structured resistance exercise after Iftar when hydration and nutrition are available. Tarawih prayers also contribute to daily physical activity and should be considered when estimating total exercise exposure [35].

Sleep and Circadian Health

Ramadan frequently changes sleep architecture because of late evening meals, Tarawih prayers, early Suhoor and altered social schedules [1]. Not getting enough sleep over a long period can make it harder for your body to regulate blood sugar, control hunger, and stay awake during the day [36]. This is especially important for women who have gone through menopause, as they often have trouble sleeping anyway [36]. Maintaining a consistent sleep schedule, limiting excessive caffeine late at night and avoiding unnecessarily large late meals may therefore contribute to metabolic health [1]. Ramadan diabetes management should address sleep as well as food and medication.

Pre-Ramadan Risk Assessment

Every postmenopausal woman with diabetes who intends to fast should ideally undergo structured assessment before Ramadan [35].

The evaluation should consider (Figure 4):

- Diabetes type and duration
- HbA1c and glucose variability
- Previous severe or recurrent hypoglycaemia
- Insulin or sulfonylurea treatment
- Renal function
- Cardiovascular disease
- Dehydration risk
- Frailty and functional status
- Osteoporosis and falls history
- Nutritional status
- Cognitive impairment
- Ability to perform glucose monitoring.

When it comes to managing diabetes during Ramadan in postmenopausal women, the current approach focuses on assessing each person's individual risk rather than treating everyone with diabetes the same. Recently, new guidelines were released in late 2025 by the DAR, ADA, and IDF, which provide updated advice on how to fast more safely for people with diabetes [35]. Women who are considered high risk should get straightforward advice about the possible risks and the exceptions that are allowed for people who might be harmed by fasting, due to their religious beliefs [37].

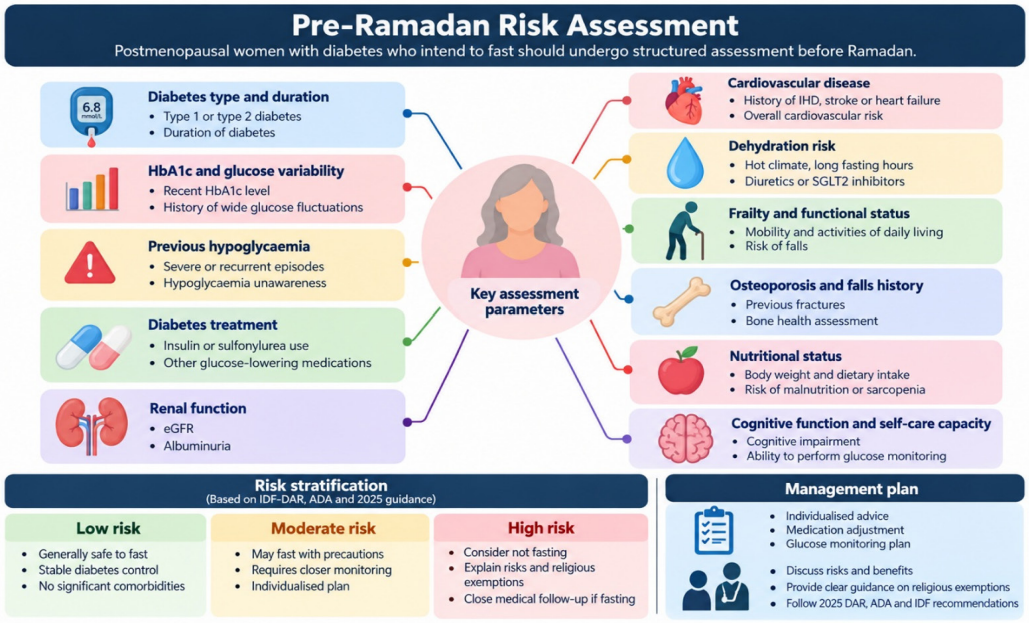

Figure 4: *Pre-Ramadan Risk Assessment.*

Ramadan-Focused Education

Education may be one of the most effective interventions for reducing complications. A recent study of 320 people with type 2 diabetes [38] found that getting educated before Ramadan can make a big difference. It showed [38] that people who got special training before fasting had fewer episodes of low blood sugar, it dropped from 19.5% to 4.1%. This education also helped them have better control over their diabetes overall. Education should include glucose monitoring, hydration, meal composition, medication adjustment, physical activity and recognition of symptoms requiring interruption of the fast. Durning fasting, it is crucial to know when to stop. If the blood glucose levels get too low or too high, patient should breakfast. Also, if patient get severely ill, dehydrated, or experience other serious symptoms, fasting must be stopped. It is essential to follow patient personalized Ramadan diabetes plan and stay up to date with the latest guidelines to determine when to breakfast. The plan should outline specific thresholds for breaking fast, so it is important to follow guidelines to stay safe and healthy.

An Integrated Clinical Approach For postmenopausal women with diabetes

Ramadan management can be conceptualised as (Figure 5):

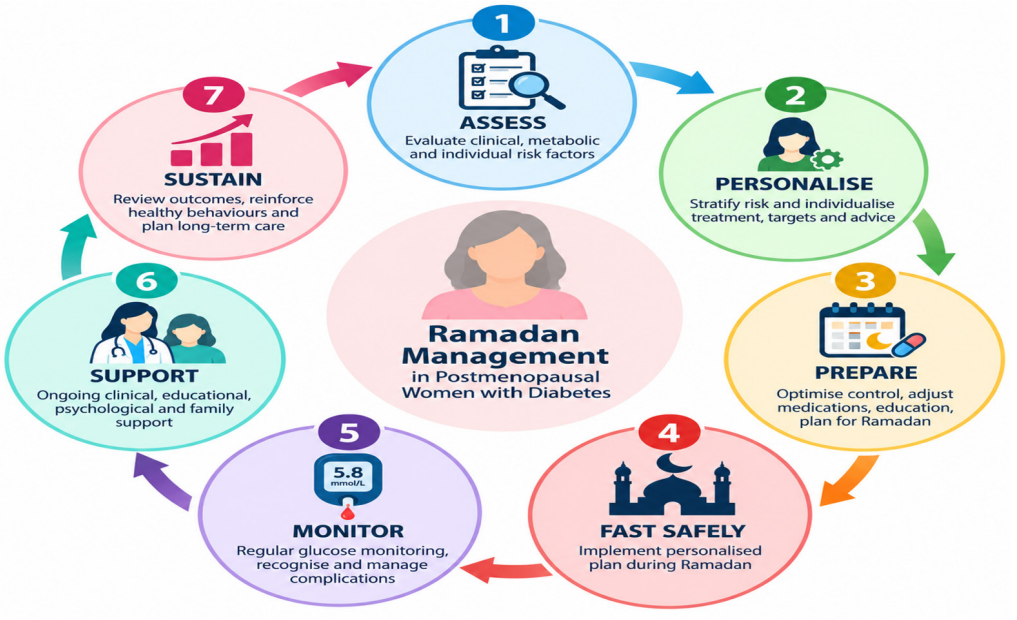

Figure 5: *Ramadan management framework.*

Ramadan Management in Postmenopausal Women with Diabetes; a stepwise Approach (Figure 6)

ASSESS: Evaluate glycaemia, cardiovascular disease, CKD, osteoporosis, frailty, nutrition and medication.

PERSONALISE: Determine individual fasting risk and modify therapy appropriately. PREPARE Provide structured education regarding nutrition, hydration, glucose monitoring, physical activity and medication timing.

FAST SAFELY: Avoid excessive Iftar carbohydrate, maintain Suhoor nutrition and preserve hydration overnight.

MONITOR: Use self-monitoring or CGM where appropriate to identify hypoglycaemia and post-Iftar hyperglycaemia.

SUPPORT: Maintain access to the diabetes team and encourage family involvement where appropriate.

SUSTAIN: Continue beneficial behaviours after Ramadan rather than returning immediately to previous unhealthy dietary and activity patterns.

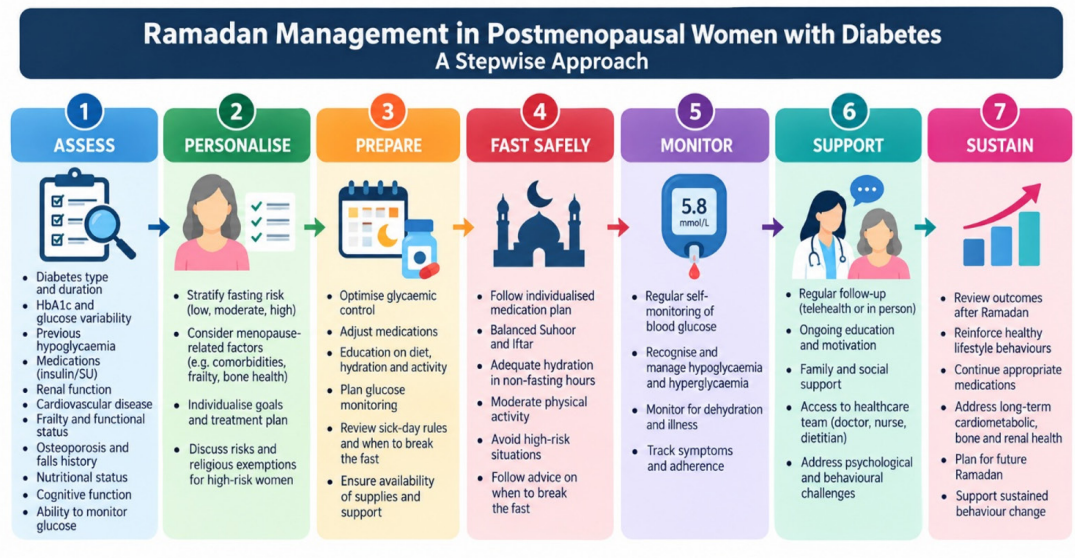

Figure 6: *Ramadan Management in Postmenopausal Women with Diabetes; a stepwise Approach.*

Research Gaps

There is a big gap in our knowledge when it comes to Ramadan fasting and its effects on postmenopausal women with diabetes. Most research on diabetes during Ramadan includes both men and women of different ages. But when it comes to studies that focus on women after menopause, they usually only look at women who are otherwise healthy from a metabolic standpoint.

Future prospective studies should therefore specifically recruit postmenopausal women with type 2 diabetes and assess:

CGM metrics + body composition + muscle strength + bone markers + hydration + inflammatory markers + menopausal symptoms + quality of life.

Studies should also examine whether Ramadan related metabolic changes persist three, six and twelve months later. This kind of research can help us go beyond just wondering if fasting is good for us, and instead figure out how to make Ramadan a part of an overall healthy lifestyle, especially for people with diabetes as they age.

Clinical Trial Evidence Relevant to Postmenopausal Women with Diabetes (table 1)

We do not have many studies that focus specifically on postmenopausal women with diabetes during Ramadan. However, some important research provides useful insights into managing blood sugar levels, preventing low blood sugar, choosing the right medication, and educating patients. While we need to be careful when applying these findings to postmenopausal women, they can still help guide treatment and care.

Optimizing Ramadan Fasting Randomized Controlled Trial.

A recent study by Ibrahim et al [35], looked at 506 adults with type 2 diabetes from five countries where most people are Muslim. The people in the study were divided into two groups: one got special help to manage their diabetes during Ramadan, and their medication was adjusted according to the latest guidelines, while the other group just got the usual care they would normally get [35]. The treatment made a big difference in keeping people safe while they fasted [35]. It greatly reduced the number of times people had very low blood glucose known as severe hypoglycaemia. In fact, people who got special help to manage their condition during Ramadan had a much lower risk of this happening, about 1/5th as often as those who did not get this help. Both groups saw improvements in their blood sugar control, but the group that got special help during Ramadan did even better. This study [35] is important for women who are past menopause, it shows that whether fasting during Ramadan is safe and it does not just depend on whether patient fast, but also on how patient prepare for and handle the fasting. For an older postmenopausal woman with diabetes, structured preparation should therefore incorporate not only glycaemic assessment but also kidney function, cardiovascular disease, falls risk, frailty, nutrition and medication burden.

Sitagliptin versus Sulfonylurea Randomized Trial

This study was done by Al Sifri et al [39]. It is a large study with over 1,000 adults who had type 2 diabetes and were planning to fast during Ramadan. These adults were already taking certain medications, like sulfonylureas, and sometimes metformin too. The researchers wanted to see what would happen if they switched some of these adults to a new medication called sitagliptin, which they would take every day, instead of their usual sulfonylurea medication. Among evaluable participants, symptomatic hypoglycaemia occurred in: Sitagliptin: 6.7% Sulfonylurea: 13.2%. Sitagliptin therefore reduced the relative risk of symptomatic hypoglycaemia by approximately 49% (RR 0.51; 95% CI 0.34–0.75; P<0.001). Another study [52] with 870 people in India and Malaysia had similar findings. This time, people taking sitagliptin had fewer cases of low blood sugar - 3.8% compared to 7.3% for those taking sulfonylurea [52]. This is a big difference, and it is good news for people who take sitagliptin. The study [52] shows that sitagliptin can help control blood sugar levels without causing as many problems as possible with low blood sugar. For women after menopause, these findings are especially significant, because low blood glucose can have effects that go beyond just lowering glucose levels right away. It can cause dizziness, make you lose your balance, or even faint, which can increase the risk of falls and fractures in women who already have weak bones or muscle loss.

Liraglutide versus Sulfonylurea During Ramadan in Patients with Type 2 Diabetes (LIRA-Ramadan)

This study looked at how well two medicines, liraglutide and sulfonylurea, worked for adults with type 2 diabetes who were planning to fast [40]. Both medicines were used along with metformin. The goal was to see which one was better for these patients. During Ramadan, the control of blood sugar levels was similar in both treatment groups when measured using fructosamine. But when it came to hypoglycaemia episodes that caused symptoms, there was a big difference, only about 2% of people taking liraglutide had them, compared to 11% of those taking sulfonylurea. Thankfully, no one had a severe episode of sever hypoglycaemia. This study is relevant to postmenopausal women with type 2 diabetes and obesity because GLP-1 receptor agonists may facilitate weight reduction while presenting relatively low intrinsic hypoglycaemic risk when not combined with insulin or sulfonylureas. Losing weight might not be entirely good for older women after menopause. It is still crucial for them to keep their muscle mass by eating enough protein and doing strength exercises, especially when they are taking weight loss medicine or fasting during Ramadan and not eating as much as they normally would. This is important because they need to stay healthy and strong, even as they lose weight.

Dapagliflozin versus Sulfonylurea Trial

A randomized, open-label study investigated dapagliflozin in 110 adults with type 2 diabetes receiving metformin plus sulfonylurea before Ramadan [41]. Participants were randomized either to switch from sulfonylurea to dapagliflozin 10 mg daily or continue sulfonylurea. Hypoglycaemia occurred in: Dapagliflozin: 6.9% Sulfonylurea: 28.8% (P = 0.002). The relative risk of reported or documented hypoglycaemia in the 4th week of Ramadan was substantially lower with dapagliflozin (RR=0.24, 95%CI: 0.09, 0.68; p=0.002). The research shows that SGLT2 inhibitors are relatively safe for people with lhypoglycaemia risks during Ramadan. However, women who have gone through menopause need special attention. This is because SGLT2 inhibitors can cause the body to release more glucose in the urine and increase urine production, which can be a concern. Older women with CKD, low blood pressure, diuretic treatment or limited ability to maintain adequate overnight hydration may therefore be vulnerable to volume depletion.

The Canagliflozin in Ramadan Tolerance Observational Study (CRATOS)

This study compared canagliflozin with sulfonylureas in adults with type 2 diabetes fasting during Ramadan [42]. This prospective study included 162 patients receiving canagliflozin and 159 receiving sulfonylureas. Symptomatic hypoglycaemia was significantly less frequent with canagliflozin, with an adjusted odds ratio of 0.273 (95% CI: 0.104, 0.719) compared with sulfonylurea therapy. But there is a catch: canagliflozin was linked to more instances of severe dehydration, with a three and a half times higher risk (odds ratio: 3.5 [95% CI: 1.3, 9.2). This finding is especially relevant to postmenopausal women. Reduced thirst perception with ageing, antihypertensive treatment, diuretics, CKD and prolonged fasting may amplify dehydration and orthostatic hypotension. Thus: Having a lower risk of low blood glucose does not mean completely safe during fasting. Medication choice should reflect the complete clinical phenotype.

Multi-Country Retrospective Observational Study of the Management and Outcomes of Patients with Diabetes during Ramadan (CREED Stud).

This study evaluated 3,250 people with type 2 diabetes across Asia, North Africa, Europe and the Middle East [43]. Hypoglycaemia during Ramadan occurred in approximately: 16.8% of insulin-treated participants (5.6% Europe, 6.1% Middle East, 8.7% in Asia and 38% North Africa) while it happened in 5.3% of participants receiving oral therapy. Most importantly, a history of hypoglycaemia before Ramadan strongly predicted hypoglycaemia during Ramadan: OR 7.80 (95% CI 5.31–11.45). This provides an important clinical massage for postmenopausal women: When it comes to figuring out if someone can safely fast during Ramadan, a history of low blood sugar levels is

a major red flag. A history of recurrent hypoglycaemia combined with osteoporosis, falls, frailty or insulin treatment should trigger particularly careful risk assessment.

Ramadan-Focused Education Studies Structured education is among the most consistently beneficial interventions studied during Ramadan.

The Ramadan Education and Awareness in Diabetes (READ) programme for Muslims with Type 2 diabetes who fast during Ramadan [44] evaluated structured Ramadan education incorporating meal planning, physical activity, glucose monitoring, hypoglycaemia recognition and medication adjustment. People who got education lost about 0.7 kg, but those who didn't get education gained around 0.6 kg ($P < 0.001$). Also, the number of times their blood sugar got too low went down in the group that got education, while it went up a lot in the group that did not (from nine to five in the group with education, compared with an increase in group without education from nine to 36 ($P < 0.001$). Another prospective controlled intervention involving 262 people with type 2 diabetes [45] demonstrated significant improvements in hypoglycaemia scores and HbA1c following individualized Ramadan education and medication adjustment. The hypoglycaemic scores during Ramadan in the group with education was 6.36±6.17 while it was 13.46±5.30 in the non-education intervention group (P<0.001). The HbA1c score during Ramadan for the educated group was 8.26±1.54 while it was 9.54±1.38 for the non-educated group (P<0.001).

Another systematic review [46] subsequently found an approximately 81% reduction in the odds of hypoglycaemia among fasting patients receiving Ramadan-focused education compared with conventional care (OR 0.19; 95% CI 0.08–0.46). For postmenopausal women, education should extend beyond traditional diabetes advice to include adequate protein, calcium and vitamin D intake; resistance exercise; hydration; falls prevention; sleep; and maintenance of muscle and bone health.

Telemonitoring Randomized Trial

A small randomized controlled study investigated whether telemonitoring could enhance Ramadan diabetes management [47]. Thirty-seven adults with type 2 diabetes were randomized to Ramadan-focused education alone or education supplemented by telemonitoring, personalized feedback and goal setting. Telemonitoring significantly reduced the likelihood of hypoglycaemia: OR 0.13 (95% CI 0.03–0.61). Although small and exploratory, this study introduces an important concept for postmenopausal women: Ramadan care can extend beyond a single pre-Ramadan consultation. CGM, flash glucose monitoring, smartphone applications and remote clinical support may permit dynamic treatment modification throughout the fasting month.

What Do These Trials Mean for Postmenopausal Women?

Fasting during Ramadan does not have to mean that patient will experience hypoglycaemia, with the right medication, adjusting the dosage, learning about how to manage your condition, and keeping a close monitoring, patient can cut down the risk of hypoglycaemia.

Studies have shown that some medicines, like sulfonylureas, can cause low blood sugar more often than others, such as DPP-4 inhibitors, GLP-1 receptor agonists, or SGLT2 inhibitors (Table 1). But switching to a different medicine does not make all the risks eliminated. For instance, SGLT2 inhibitors can cause dehydration and other problems if patient not been careful. Patient must think about staying hydrated and watching out for volume depletion when taking these medicines. It is not just about avoiding low blood sugar; it is about being aware of all the possible side effects. When it comes to postmenopausal women, their treatment should not be based solely on their age.

For example, a 52-year-old woman with type 2 diabetes who is doing well on metformin is very different from a 72-year-old woman who's on insulin and dealing with kidney disease, osteoporosis, and a history of low blood sugar and falls. These two women have different health profiles, even if they are both postmenopausal. The younger woman's body is handling her diabetes well, while the older woman has more complex health issues that need to be considered. It's not just about their age, but about their overall health and how their bodies are responding to treatment.

A more appropriate framework is therefore:

Menopause + diabetes + medication + cardiovascular/renal disease + muscle/bone health + previous hypoglycaemia + functional status → individualized Ramadan fasting risk.

Critical Appraisal of the Ramadan Diabetes Trials (Figure 7)

Research on diabetes during Ramadan shows that teaching patients how to manage their condition, adjusting their medication, and choosing medications that are less likely to cause low blood glucose can help keep them safe while fasting [46]. But when it comes to women with diabetes who have gone through menopause, we must be careful when applying these findings. The main problem is that most of the large studies on this topic did not focus specifically on postmenopausal women or look at how menopause affects the results. This means we cannot be sure if the same approaches will work for these women.

Optimizing Ramadan Fasting RCT The multinational randomized controlled trial [35] by Ibrahim et al. is among the strongest studies because 506 adults with type 2 diabetes were randomized across five Muslim-majority countries to Ramadan-focused education plus guideline-directed treatment adjustment or usual care. The intervention significantly reduced severe hypoglycaemia and produced greater improvement in HbA1c. This study has some major advantages. For one, the randomization process helps to reduce bias, making it more reliable than other studies that don't use this method. Also, since the study is being done in multiple countries, the results can be applied to different cultures and locations. The way the study is designed, with a combination of education and medication, is also more like how things are done in real-life medical practice. What's important here is that the study found a significant reduction in severe hypoglycaemia, which is a major concern. This is especially relevant because it shows that the approach used in the study can have a real impact on patient care. One of the drawbacks of this study is that about a quarter of the people who were eligible to participate decided not to join in. This could mean that the people who did participate were more motivated or confident about fasting, which might affect the results. Another issue was that some participants dropped out along the way - 12.6% of those in the intervention group and 8.7% of the control group were lost to follow-up. Additionally, the intervention itself was complex, involving multiple factors, which makes it hard to pinpoint exactly what led to the benefits: was it the education, the changes to medication, the closer contact with clinicians, or a combination of these factors? The trial had a major flaw; it was not tailored to postmenopausal women. So, it's unclear if the treatment would have the same benefits and risks for women dealing with osteoporosis, muscle loss, frailty, kidney disease, or the body changes that come with menopause. This is a significant gap, as these conditions are common in postmenopausal women, and the trial's results may not apply to them. As a result, we can't be sure if the treatment would be safe and effective for this specific group of women. This finding provides solid proof that having a clear plan in place before

Ramadan is a good idea, especially for managing health. However, when it comes to women with diabetes who are past menopause, the evidence is not as direct.

Table 1: *Key trials summaries.*

Study	Population/design	Intervention	Major finding	Relevance to postmenopausal women
Ibrahim et al. [35]	506 adults with T2D; multinational RCT	Structured Ramadan care vs usual care	Severe hypoglycaemia OR 0.20	Supports individualized pre-Ramadan assessment
Al Sifri et al. [39]	1,066 T2D; RCT	Sitagliptin vs sulfonylurea	Hypoglycaemia 6.7% vs 13.2%	Lower hypoglycaemia may reduce falls risk
India/Malaysia trial [52]	870 T2D; randomized	Sitagliptin vs sulfonylurea	3.8% vs 7.3% hypoglycaemia	Confirms medication-dependent fasting risk
LIRA-Ramadan [40]	T2D; randomized trial	Liraglutide vs sulfonylurea	Symptomatic hypoglycaemia ~2% vs 11%	Relevant to diabetes plus obesity
Dapagliflozin Ramadan trial [41]	110 T2D; randomized	Dapagliflozin vs sulfonylurea	6.9% vs 28.8% hypoglycaemia	Low hypo risk but hydration important
CRATOS trial [42]	321 T2D; prospective comparative	Canagliflozin vs sulfonylurea	Less hypoglycaemia but more volume depletion	Particularly important with ageing/CKD
CREED trial [43]	3,250 T2D; observational	Real-world Ramadan fasting	Previous hypoglycaemia OR 7.80	Past hypoglycaemia is a major risk marker
READ trial [44]	T2D; education intervention	Ramadan education	Fewer hypoglycaemic events; prevented weight gain	Supports structured lifestyle education
Telemonitoring RCT [47]	37 T2D	Telemonitoring + education	Hypoglycaemia OR 0.13	Supports CGM/remote-support model

Al Sifri et al [39] Sitagliptin versus Sulfonylurea This large randomized open-label trial enrolled 1,066 adults with type 2 diabetes. Symptomatic hypoglycaemia occurred in 6.7% of patients switched to sitagliptin compared with 13.2% continuing sulfonylurea therapy, corresponding to an approximately 49% relative reduction. This study has some major advantages. For one, it's based on a huge sample, which means the results are more reliable than many other studies on Ramadan and medicine. The fact that the study was randomized and used an active comparator design also makes it stronger. Plus, the researchers were specifically looking at hypoglycaemia, which is a significant health issue, and they planned to focus on it from the start. A new study with 870 people from India and Malaysia had similar results, making it more likely that one type of treatment is better than another at preventing low blood sugar when you haven't eaten. This treatment, called DPP-4 inhibition, was compared to another common treatment, sulfonylurea therapy, and it seems to cause less low blood sugar when you're fasting. There are some limitations to this study. For one, it was an open-label trial, which means that people knew what they were getting. Also, patients had to write down when they had low blood sugar episodes in a diary, rather than having their glucose levels monitored all the time. This can lead to biased results, especially when it comes to low blood sugar episodes that happen at night or during the day without any symptoms. The comparison using sulfonylurea was also inconsistent. This is because different medications within this group have unique effects on blood sugar levels, making it tough to draw conclusions about the group. This study is mainly focused on finding out which treatment works better for people with diabetes during Ramadan, specifically in terms of reducing symptomatic hypoglycaemia. It's not trying to answer the bigger question of how Ramadan fasting affects diabetes overall. Instead, it's looking at how different treatments compare in managing this specific issue during the fasting period. For women who have gone through menopause, especially those with brittle bones or at risk of falling, it's important to avoid low blood sugar levels. However, this study didn't directly look at how often low blood sugar happened in these women.

LIRA-Ramadan [40] compared liraglutide with sulfonylurea, both combined with metformin. Fructosamine improvement during Ramadan was similar but documented symptomatic hypoglycaemia occurred in approximately 2% with liraglutide versus 11% with sulfonylurea. Liraglutide also produced greater reductions in HbA1c and body weight. This study has some key advantages. For one, it was designed with a randomized and active-controlled approach, which gives us pretty strong evidence to compare. The participants were randomly selected at least ten weeks before Ramadan started, so their treatments had time to stabilize before they began fasting. The study also looked at several important health outcomes, including low blood sugar, weight, and blood sugar control. There are some limitations to this study. For one, it was an open-label trial, which means that people knew what they were getting. This can affect how they performed and what they reported. Another issue is that the researchers used fructosamine instead of HbA1c to measure blood sugar control during Ramadan. While fructosamine is good for looking at short-term changes in blood sugar, it's not as commonly used in clinics and doesn't give a complete picture of how blood sugar levels are varying. This might make it harder to understand the results. One thing to consider is that people who got liraglutide already had lower fructosamine levels when Ramadan started. So, some of the differences between treatments happened before Ramadan even began, not because of the fasting itself. For women after menopause, losing more weight might be a good thing when it comes to obesity, but it's not necessarily a positive outcome. This is because the study didn't figure out if the weight loss was from fat or muscle. There's good evidence that liraglutide is safer than sulfonylurea when it comes to the risk of low blood sugar. However, we don't know much about how these two treatments compare when it comes to preserving muscle, keeping bones healthy, or how they affect women after menopause - there just isn't enough research on these topics.

The Treat 4 Ramadan trial looked at how well liraglutide worked compared to sulfonylurea when added to metformin [48]. This study was small, with only 99 adults taking part from two sites in the UK. About half of the participants were men, and the average age was 52 years. This study has a good design, but it's limited by the small number of participants. This makes it harder to get reliable results, especially for rare outcomes like severe hypoglycaemia. Also, since the study only took place in two locations in the UK, it's not clear how well the findings apply to other countries where people fast for different lengths of time, have different diets, and celebrate Ramadan in different ways. The average age of the participants was around 52, but that doesn't necessarily mean they were all postmenopausal women. Unfortunately, the study didn't provide any specific information about menopause-related outcomes. So, the study called Treat 4 Ramadan gives us some positive signs about using GLP-1RA during Ramadan, but it doesn't give us strong direct proof that it's a good idea for women with diabetes who are past menopause.

Dapagliflozin versus Sulfonylurea Trial A recent study looked at what happened when 110 adults with diabetes switched from taking metformin and sulfonylurea to taking metformin and dapagliflozin [41]. The results showed that low blood sugar, also known as hypoglycaemia, occurred in about7% of the people who made the switch. This is a big difference compared to the 29% of people who kept taking sulfonylurea and experienced low blood sugar. This study [41] has some key advantages. For one, it uses randomization and directly compares its results to a commonly used treatment for low blood sugar, which helps to establish a clear cause-and-effect relationship. Also, the difference it found was quite large. There are some limitations to consider. For one, the number of people in the study was small, with only 110 participants. Also, the follow-up period was relatively short. Another thing to keep in mind is that the treatment was open label, which means it could have affected how symptoms were reported. The study was therefore better powered to detect common hypoglycaemic events than uncommon but potentially serious complications such as diabetic ketoacidosis, acute kidney injury or severe dehydration. This is a big concern for women after menopause. As they get older, they may have kidney problems, be taking medication for high blood pressure, or just not be as healthy as they used to be. Just because a treatment can help prevent low blood sugar episodes, it doesn't mean it's the best or safest choice for everyone who fasts.

Ramadan-Focused Education Studies Education interventions are attractive because they address multiple modifiable fasting behaviours simultaneously [45]. Controlled studies have reported improved medication adjustment and reduced hypoglycaemia with structured Ramadan education. For example, a 262-participant intervention study found improvement in hypoglycaemia scores following education and treatment adjustment [45]. But when you look at all the evidence, it's not as clear cut as some studies might make it seem. Researchers looked at studies on how to help people with health issues during Ramadan. They found that there isn't much strong evidence to support certain methods, like special education programs or using telemedicine. They also looked at different medication strategies, but again, the evidence was not very convincing. When it comes to education programs specifically designed for Ramadan [14,30], the studies didn't show a clear reduction in low blood sugar, but there might be some improvement in blood sugar control overall. This is based on a review of studies from 2023 that tried to find the best ways to help people with health issues during Ramadan [14]. The problem is that many of these studies had limitations, making it hard to draw firm conclusions. This distinction is important: observational and non-randomized educational studies frequently report substantial benefits, but their results may partly reflect differences in motivation, healthcare contact, adherence and baseline characteristics. Education is still very important because patients need to know how to take their medicine, check their blood sugar, eat right, and stay hydrated. They also need to understand when it's okay to stop fasting. This information is crucial for their care and well-being.

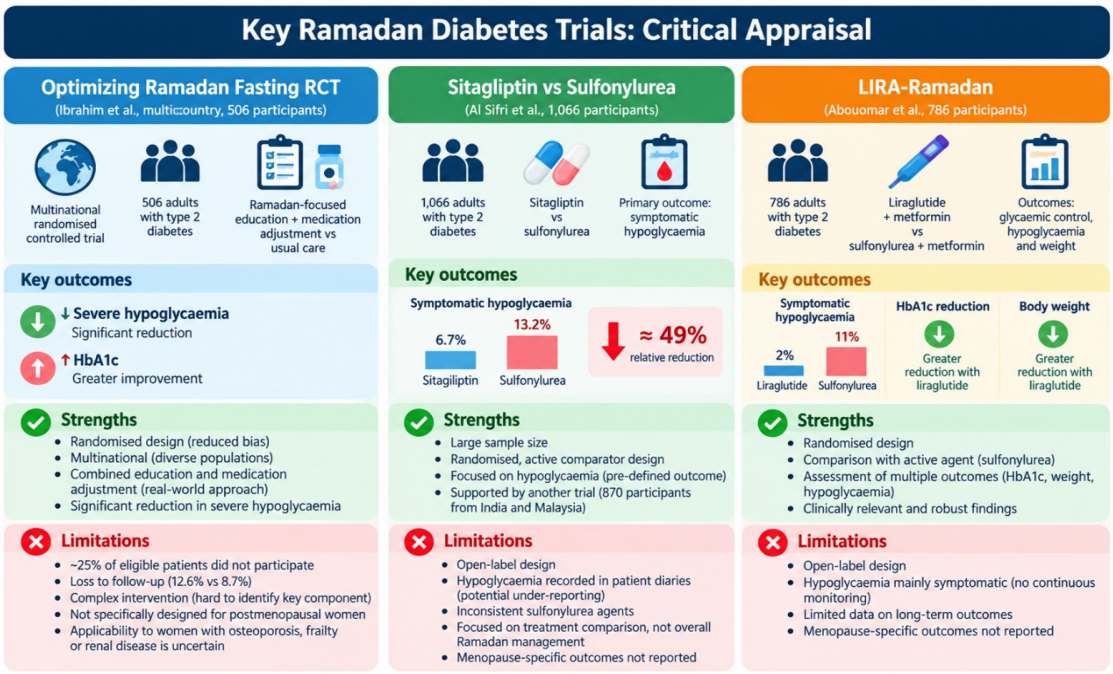

Figure 7: *Summary of critical appraisal of key studies.*

Cross-Trial Methodological limitations (Figure 8)

Absence of Postmenopausal-Specific Trials. This is the most important limitation for the present review. The big studies on diabetes during Ramadan looked at a wide range of adults, but they usually didn't break down the results by specific groups. menopausal status → years since menopause → hormone therapy → osteoporosis → sarcopenia → body composition. Consequently, the evidence supporting Ramadan fasting specifically in postmenopausal diabetic women is largely indirect.

Open-Label Designs Many clinical trials during Ramadan are not blind studies. This is because the treatments being tested are often very different from one another, making it hard to keep patients and doctors from knowing who's getting what. When people know what treatment they're getting, it can affect how they report their symptoms, what they eat, how often they check their blood sugar, and even how their doctors treat them. This is especially important when the main goal is to study symptoms of low blood sugar that people experience and report themselves.

Inadequate Continuous Glucose Assessment. Many earlier studies relied on symptoms, capillary glucose or patient diaries. These methods may underestimate:

- Asymptomatic hypoglycaemia
- Nocturnal hypoglycaemia
- Late-afternoon glucose decline
- Post-Iftar hyperglycaemic excursions
- Glucose variability.

CGM-derived outcomes such as time in range, time below range, time above range and coefficient of variation would provide substantially richer assessment.

Short Follow-up. Most research looks at what happens during Ramadan or just before and after it. So, it's unclear if the positive changes in weight, blood sugar control, or cholesterol levels are lasting. For women after menopause, it's important to keep track of their health for a longer time. This is because some serious health issues, like muscle loss, brittle bones, fractures, and heart disease, can take a long time to develop.

Selected Study Populations. When it comes to Ramadan, some people can fast without any issues. These individuals are usually healthy enough to be considered good candidates for fasting during this time. Patients with severe CKD, unstable cardiovascular disease, recurrent severe hypoglycaemia, frailty or complex multimorbidity may be excluded or under-represented. The apparent safety demonstrated by clinical trials should therefore not automatically be generalized to high-risk postmenopausal women.

Heterogeneity of Ramadan Exposure. Ramadan is not a standardized intervention. Fasting duration varies by latitude and season. Ambient temperature, hydration opportunities, sleep patterns, cultural foods, physical activity and Iftar composition also differ markedly between countries. Consequently: Ramadan fasting in Dubai ≠ Ramadan fasting in London ≠ Ramadan fasting in Malaysia. This makes it tough to apply the results to everyone, because people's experiences can be different.

Comparator Choice. Several medication trials compare newer glucose-lowering agents with sulfonylureas. Because sulfonylureas inherently carry greater hypoglycaemic risk, demonstrating fewer hypoglycaemic episodes with DPP-4 inhibitors, GLP-1 receptor agonists or SGLT2 inhibitors is biologically plausible. So, these studies give us some useful information about how the new drug works, but we shouldn't think that it makes fasting during Ramadan completely safe for everyone. They help us compare how the new drug works, but that's all. We can't assume it's safe for all Muslims to fast during Ramadan just because of these studies.

Surrogate Rather Than Patient-Important Outcomes. Trials commonly report: HbA1c, fructosamine, glucose, weight and hypoglycaemia. Much less information exists regarding falls, fractures, hospitalization, cardiovascular events, acute kidney injury, quality of life, frailty, muscle strength and mortality. This is especially important for women who have gone through menopause.

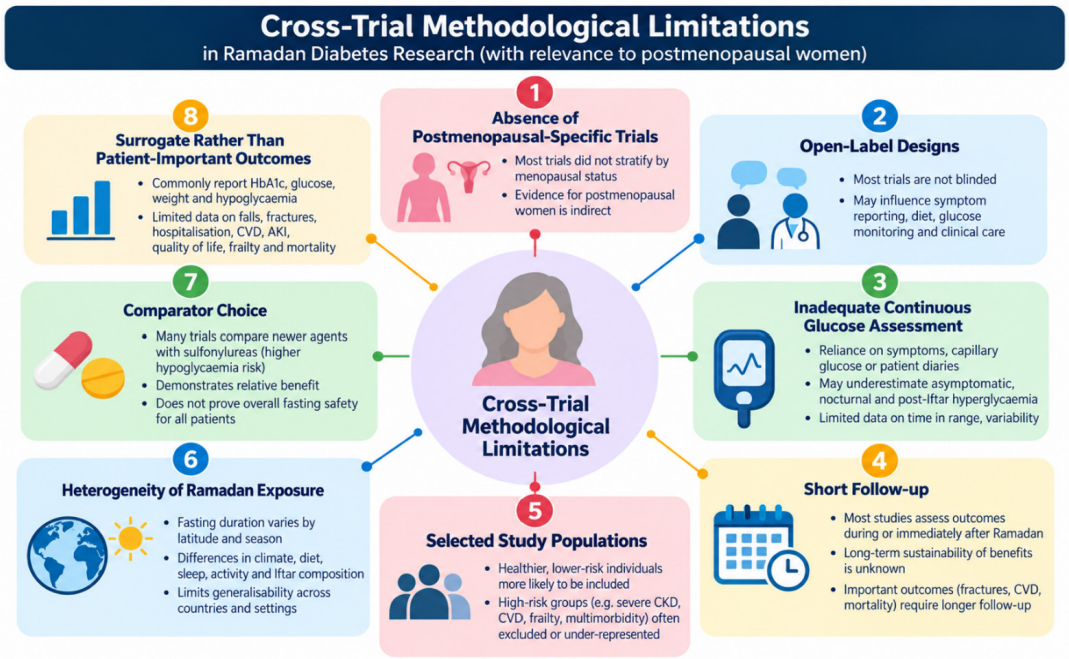

Figure 8: *Cross-Trial Methodological limitations.*

The International Diabetes Federation-Diabetes and Ramadan Alliance (IDF-DAR) Fasting Risk Assessment Calculator for postmenopausal women (Figure 9)**.**

Although the IDF-DAR Fasting Risk Assessment Calculator has demonstrated predictive validity in diverse adult populations with diabetes, its performance remains unvalidated specifically in postmenopausal women [48-50]. While existing validation studies have included female participants, they have not reported discrimination, calibration, or fasting-related outcomes stratified by menopause status [48-50]. Metabolic changes associated with menopause, in addition to age-related comorbidities, frailty, and treatment-related hypoglycaemia, may affect fasting risk in this population. Therefore, the IDF-DAR calculator should be applied in conjunction with comprehensive, individualized clinical assessment rather than as a sole decision-mak-

ing tool. Prospective studies assessing its predictive performance in postmenopausal women are needed.

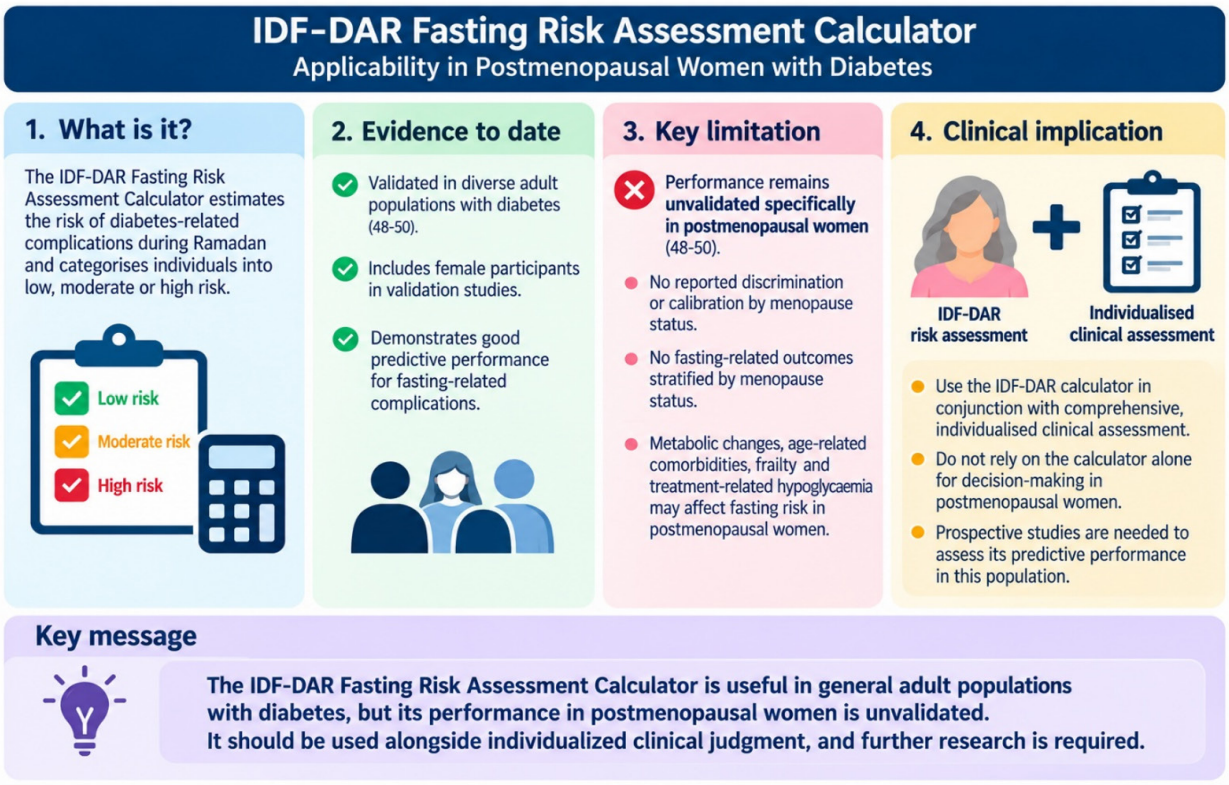

Figure 9: *Applicability of IDF-DAR in postmenopausal women with diabetes.*

Conclusion

When women go through menopause, their bodies change in many ways. They have less oestrogen, which can lead to weight gain around the waist, problems with insulin, and a higher risk of heart disease. They may also lose muscle and bone mass. If a woman with these changes also has diabetes, her body is under even more stress. Fasting during Ramadan can be challenging for these women. While it might help some women lose weight and improve their blood sugar and cholesterol levels, it is not a guarantee and may not work for everyone. In fact, fasting can be tough on the body, especially for women who are already dealing with diabetes and the changes that come with menopause. When women fast during Ramadan, especially after menopause, they face some big health concerns. These include low blood sugar, high blood sugar, dehydration, problems from medicines, and not eating enough nutrients. But one thing that is important for postmenopausal women is keeping their muscle and bone strength. This is different from other people who fast, and it's something that needs special attention. The strongest clinical approach is therefore not to consider Ramadan fasting simply as caloric restriction. It should be viewed as a multidimensional lifestyle intervention involving nutrition, physical activity, sleep, medication, hydration, self-monitoring and behavioural change. When it comes to fasting during Ramadan, some women can do it safely if they take the right steps. This means getting a check-up before Ramadan, adjusting their medication, keeping an eye on their glucose levels, eating enough protein and nutrients, exercising regularly, and drinking plenty of water. For these women, fasting might even have some health benefits. But for women with serious health issues, it's probably best to avoid fasting altogether to stay safe. Ramadan is more than just a month of fasting; it is a chance to make healthy changes that last. The good habits you start during Ramadan, like eating well, being active, and managing your weight and glucose levels, can stick with you after the month is over. With the right guidance and support, Ramadan can be a great opportunity for women with diabetes to get their metabolism on track, age healthily, and make lasting lifestyle changes. This is especially true for postmenopausal women, who can use Ramadan as a chance to take control of their health and make positive changes that will benefit them for years to come. By making healthy choices during Ramadan, women can set themselves up for long-term success and a healthier, happier life.

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