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The Impact of Macrovascular Disease in People with Type 2 Diabetes on Ramadan Fasting Practices and Glycemic Outcomes: Insights from a Multinational Real-World Study

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Abstract

Background The International Diabetes Federation–Diabetes and Ramadan (IDF-DAR) Risk Score is widely used to guide fasting recommendations for individuals with type 2 diabetes mellitus (T2D) during the month of Ramadan. Many patients with macrovascular disease (MVD) are typically classified as high-risk and advised not to fast. However, real-world practices may differ from guideline recommendations.

Objectives This article evaluates fasting behaviors and glycemic outcomes during Ramadan among individuals with and without MVD using multinational, real-world data.

Patients and Methods This retrospective, observational cohort study analyzed data from the 2020–2022 DAR Global Survey. The survey included 12,529 Muslim adults with T2D from seven global regions. Participants with documented MVD ($n = 1,520$) were compared to those without MVD as a control ($n = 11,010$). Key outcomes included the number of fasting days, the incidence of hypoglycemia and hyperglycemia, and the frequency of breaking fast due to glycemic events. Multivariable logistic regression adjusted for clinical and demographic covariates.

Results Fewer individuals with MVD intended to fast (68.5% vs. 87.6%, $p = 0.04$), however, among those who fasted, the average number of fasting days was similar (26.9 vs. 27.7). After adjustment of all covariates such diabetes duration, age, use of insulin, level of glycosylated hemoglobin, as well as presence of other diabetes-related

Keywords
- type 2 diabetes mellitus
- macrovascular disease
- Ramadan
- hypoglycemia
- IDF-DAR
- fasting
- risk stratification

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complication, MVD was associated with higher odds of breaking fast due to hypoglycemia (adjusted odds ratio 1.25, 95% confidence interval 1.02–1.54, $p \leq 0.05$), but not with higher incidence of hypoglycemia ($p = 0.51$), hyperglycemia ($p = 0.71$), or severe events.

Conclusion Many individuals with T2D and MVD opted not to fast. However, the majority fasted during Ramadan without increased adverse outcomes apart from increased rates of breaking fast due to hypoglycemia. This data offers insights into real-world fasting behaviors and outcomes. Further studies are needed to investigate the impact of various MVD subtypes and severities.

Introduction

Fasting during the holy month of Ramadan is a deeply spiritual and culturally significant practice observed by millions of Muslims worldwide. However, for individuals with type 2 diabetes mellitus (T2D), particularly those with macrovascular disease (MVD), prolonged fasting presents a complex clinical challenge due to increased risks of glycemic instability, dehydration, and cardiovascular complications. In response, the International Diabetes Federation and the Diabetes and Ramadan (IDF-DAR) Alliance have established structured risk stratification tools, including the IDF-DAR Risk Score, to aid clinicians in determining the safety of fasting for individuals with diabetes.[1] Due to unstable MVD being considered as high risk, individuals are advised not to fast, yet real-world adherence to such recommendations remains inconsistent.[2]

Despite medical advice, many high-risk individuals choose to fast regardless, often motivated by religious, social, or personal convictions.[3] Indeed, many of these individuals complete fasting without experiencing severe complications such as hospitalization with hypoglycemia or acute metabolic decompensation.[4,5] Indeed, knowledge of exact rates of fasting in people with MVD and T2D is not well studied. Furthermore, knowledge about glycemic outcomes during fasting in this group is limited.

The present study is unique in being the largest real-world multicenter observational cohort to date, assessing fasting behavior in cases with MVD. It draws on data from the 2020–2022 IDF-DAR Global Survey, which included Muslim adults with T2D from seven diverse global regions. Focusing on patients with and without documented MVD, this analysis aimed to evaluate differences in fasting behaviors, glycemic outcomes, and risk mitigation practices. A key objective was to investigate whether individuals with MVD decided to fast or not, and in those who fasted, whether they experienced higher rates of adverse events, such as hypoglycemia or cardiovascular deterioration, compared to those without MVD.

This study contributes to a growing body of evidence advocating for a patient-centered approach to risk stratification during Ramadan.[6] A comprehensive risk score remains critical for guiding clinicians and identifying modifiable risk factors that help individuals with diabetes reduce fasting-related complications, thereby supporting both metabolic control and spiritual observance.[7,8]

Patients and Methods

Study Framework and Location

This investigation utilized a retrospective, observational cohort design, drawing upon data collected through the 2020–2022 DAR Global Survey. The survey comprised Muslim adults diagnosed with T2D. It was conducted across seven global regions: the Gulf states, the Middle East, Türkiye, the United Kingdom, Africa, the Indian subcontinent, and Southeast Asia. Information was gathered during routine outpatient appointments within approximately 10 weeks after the conclusion of Ramadan. This specific analysis focuses on comparing patients with confirmed MVD to those without it, aiming to evaluate how MVD affects the safety and management of fasting practices.

Study Population

Among the 12,529 individuals surveyed, 1,520 participants (12.1%) had documented macrovascular complications, forming the MVD group. MVD encompasses the presence of conditions such as coronary artery disease, peripheral vascular disease, and cerebrovascular disease. The remaining 11,010 participants (87.9%) without MVD constituted the control group. All individuals were regularly followed up in outpatient settings during the data collection period. Since the analysis utilized previously recorded data, no prospective sample size determination was carried out.

Measured Variables and Study Endpoints

Key outcomes included the rate, frequency, and duration of both hypoglycemic and hyperglycemic episodes experienced during Ramadan, along with any associated clinical interventions, such as hospitalization or third-party assistance, during these episodes. The primary exposure factor under review was the extent of fasting throughout Ramadan and the subsequent month of Shawwal. Continuous data—including age, glycosylated hemoglobin (HbA1c) levels, diabetes duration, and the number of fasting days—were expressed as means with standard deviations. Categorical

outcomes, such as incidence of hypoglycemia, were presented as counts and percentages.

Data Acquisition Process

Structured questionnaires, completed during standard outpatient visits, were used to collect data. These forms were administered by health care professionals trained in the survey protocol. Collected information included demographic profiles, diabetes history, glycemic control (HbA1c), and ongoing treatment regimens, including both insulin-based and noninsulin therapies.

Statistical Analysis

Multivariable logistic regression was used to examine the association between fasting and glycemic events during Ramadan in individuals with T2D and those with or without macrovascular complications. Covariates were included in the multivariable models if they showed a statistically significant association with the outcome in bivariate analyses. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were reported. A p-value of ≤ 0.05 was considered statistically significant. No imputation techniques were applied in this study due to the nature and proportion of missingness. All analyses were conducted using IBM SPSS Statistics version 30.

Results

Patient Characteristics

Compared to controls, the MVD group was older (mean age 61.9 vs. 54.3 years), had a longer diabetes duration (13.7 vs. 9.4 years), higher systolic blood pressure (136 vs. 127.3 mm Hg), low-density lipoprotein cholesterol (106.4 vs. 89.6 mg/dL), and HbA1c (8.7% vs. 8.3%). They were also more likely to be male (58.1% vs. 46.2%). No significant differences were observed in body mass index or diastolic blood pressure. Patients with MVD were less frequently prescribed metformin (66.3% vs. 82.1%) and sulfonylureas (31% vs. 40.2%), with higher use of glucagon like peptide-1 agonists (5.1% vs. 2.6%) and all forms of insulin, particularly short-acting (32.7% vs. 15%) and intermediate/long-acting insulin (40.3% vs. 24.9%) (►**Table 1**).

Table 1 Baseline demographic, clinical characteristics, and therapies among people with T2D with or without MVD

Characteristic	MVD	Control	*p*-Value
Sex distribution: [*N* (%)]			
Total	1,520 (21.1%)	11,010 (87.9%)	–
Female	637 (41.9%)	5,922 (53.8%)	< 0.0001
Male	881 (58.1%)	5,080 (46.2%)	
Risk factors [Mean (SD)]			
Age (y)	61.9 (10.9)	54.3 (11.7)	0.02
Duration of diabetes (y)	13.7 (8.5)	9.4 (7)	0.05
HbA1c (%)	8.7 (2.1)	8.3 (1.9)	0.08
Latest BMI (kg/m^2)	27.4 (4.3)	27.9 (7)	0.9
Latest systolic BP (mm Hg)	136 (18.1)	127.3 (27.1)	0.01
Latest diastolic BP (mm Hg)	79 (11.4)	76.8 (16.2)	0.8
Latest LDL cholesterol (mg/dL)	106.4 (36.9)	89.6 (52.8)	0.02
Medications [*N* (%)]			
Metformin	1,008 (66.3%)	9,044 (82.1%)	0.15
Sulfonylureas	471 (31%)	4,425 (40.2%)	0.1
DPP4 inhibitors	449 (29.5%)	3,618 (32.9%)	0.5
Thiazolidinedione	101 (6.6%)	447 (4.1%)	0.05
SGLT2 inhibitors	349 (23%)	2,031 (18.4%)	0.2
GLP1 RAs	77 (5.1%)	291 (2.6%)	0.01
Alpha-glucosidase inhibitor	38 (2.5%)	214 (1.9%)	0.4
Intermediate/long-acting insulin	613 (40.3%)	2,738 (24.9%)	0.003
Short-acting Insulin	497 (32.7%)	1,651 (15%)	< 0.0001
Premixed insulin	340 (22.4%)	1,599 (14.5%)	0.01
Any insulin	970 (63.8%)	4,498 (40.9%)	0.004

Abbreviations: BMI, body mass index; BP, blood pressure; DPP4, dipeptidyl peptidase-4; GLP-1 RA, glucagon like peptide -1 receptor agonist; HbA1c, glycosylated hemoglobin; LDL, low-density lipoprotein; MVD, macrovascular disease; SD, standard deviation; SGLT-2, sodium-glucose co-transporter 2; T2D, type 2 diabetes mellitus.

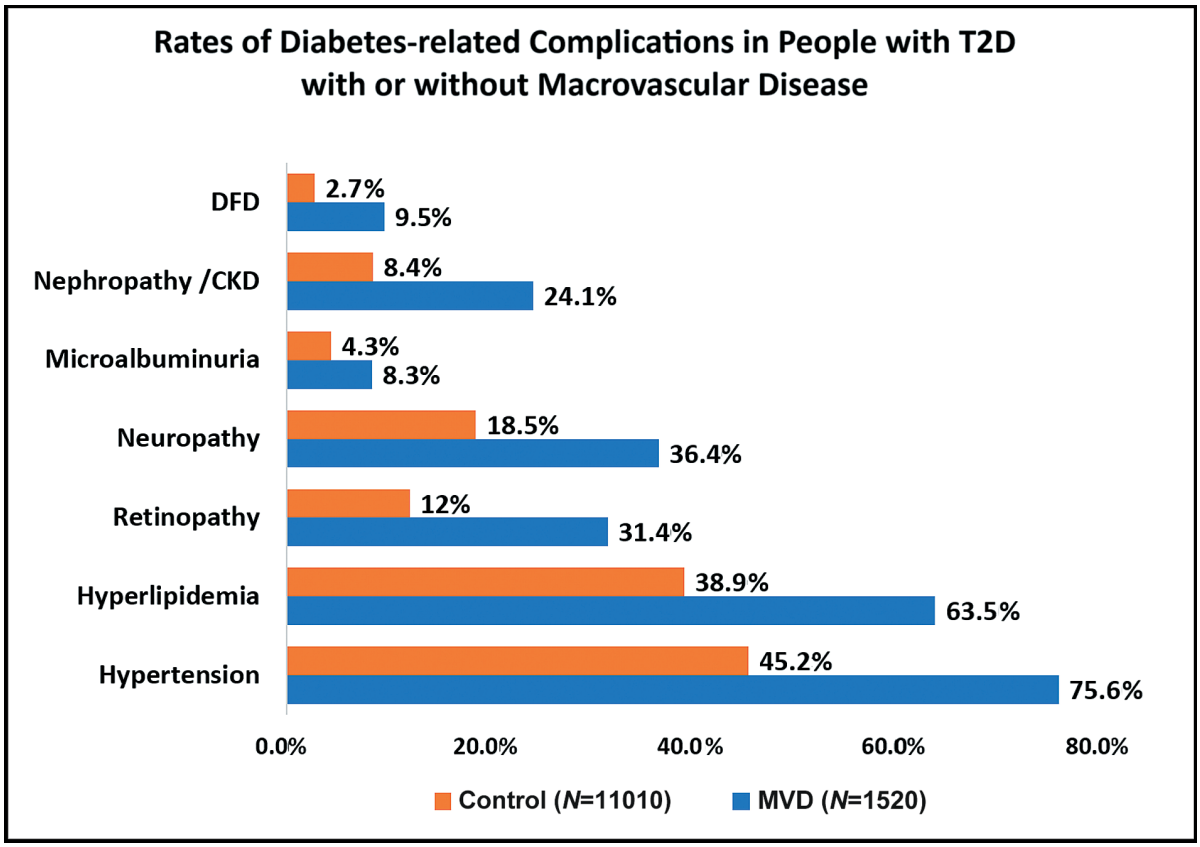

Fig. 1 Rates of diabetes-related complications among people with type 2 diabetes mellitus (T2D) with or without macrovascular disease (MVD). FD, diabetic foot disease; CKD, chronic kidney disease.

Patients with MVD and T2D also had a significantly ($p < 0.001$) greater burden of comorbidities, including hypertension (75.6% vs. 45.2%), hyperlipidemia (63.5% vs. 38.9%), retinopathy (31.4% vs. 12%), neuropathy (36.4% vs. 18.5%), microalbuminuria (8.3% vs. 4.3%), chronic kidney disease (24.1% vs. 8.4%), and diabetic foot disease (9.5% vs. 2.7%) (►**Fig. 1**).

Self-monitoring of blood glucose (SMBG) patterns during Ramadan was similar between the MVD and control groups, with no significant differences in frequency. Around half maintained their usual SMBG frequency, and about a quarter in each group reported not monitoring at all.

Ramadan-focused education was reported by 57.7% of the MVD group and 59.4% of controls. Most received education during routine clinic visits (75.3% vs. 67.6%), with smaller proportions attending group sessions, using apps, or receiving leaflets. Notably, leaflet use was significantly lower among the MVD group (12.1% vs. 21.4%). Session durations were brief in both groups, with most lasting under 15 minutes (►**Fig. 2**).

Fasting and Glycemic Events during Ramadan

Fewer individuals with MVD intended to fast during Ramadan compared to the controls (68.5% vs. 87.6%, $p = 0.04$). Despite this, the average number of fasting days was comparable between groups (26.9 vs. 27.7 days), with approximately two-thirds of participants in each group fasting for the full 30 days. The intention to fast during Shawwal was slightly higher among the MVD group (31.7% vs. 26.1%), although this difference was not statistically significant (►**Table 2**).

Macrovascular complications were associated with reduced odds of fasting (AOR 0.61, 95% CI 0.44–0.86, $p \leq 0.01$) and increased odds of breaking fast due to hypoglycemia (AOR 1.25, 95% CI 1.02–1.54, $p \leq 0.05$), after adjusting for neuropathy, nephropathy, retinopathy, hypertension, hyperlipidemia, age, sex, duration of diabetes, HbA1c, diabetic foot complications, and insulin therapy. No associations were found between macrovascular complications and the incidence of hypoglycemia ($p = 0.51$), hyperglycemia ($p = 0.71$), severe glycemic events ($p = 0.10$–0.67), or breaking fast due to hyperglycemia ($p = 0.43$) (►**Fig. 3**).

Discussion

This cross-sectional analysis from the 2020–2022 DAR Global Survey, to the best of our knowledge, is the largest study to examine fasting practices and clinical outcomes among patients with T2D and MVD. The IDF-DAR risk calculator comprises 14 items assessing individual characteristics (e.g., age, physical activity, pregnancy), diabetes-related factors (type, duration, complications, treatment), and Ramadan-specific variables (fasting duration, prior experience). Patients with unstable cardiovascular disease are classified as high risk and generally advised not to fast. In contrast, stable MVD with no additional comorbidities is classified as

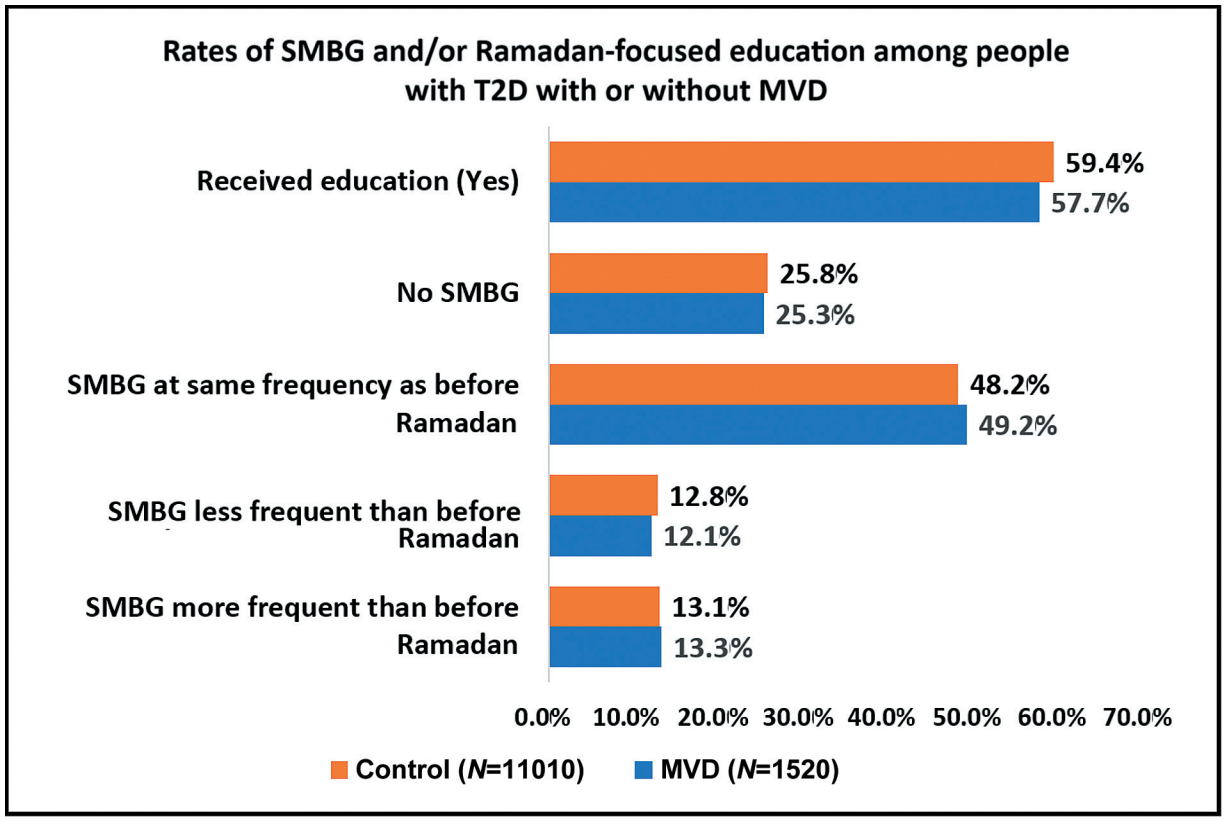

Fig. 2 Rates of self-monitoring of blood glucose (SMBG) and/or Ramadan-focused education among people with type 2 diabetes mellitus (T2D) with or without macrovascular disease (MVD).

Table 2 Rates of fasting among people with T2D with or without MVD

Characteristic		MVD	Controls	*p*-Value
Number (%)		1,520 (21.1%)	11,010 (87.9%)	–
Intention for RF (yes)		1,041 (68.5%)	9,647 (87.6%)	0.04
Number of fasted days	1–7 d	44 (4.2%)	241 (2.5%)	0.07
	30 d	669 (64.3%)	3,690 (66.3%)	0.8
	Mean duration (d)	26.9 (6.6)	27.7 (5.5)	0.8
Intention for Shawal[a] (post) RF (yes)		329 (31.7%)	2,876 (26.1%)	0.2

Abbreviations: MVD, macrovascular disease; RF, Ramadan fasting; T2D, type 2 diabetes mellitus.
[a]Shawal fasting = Optional fasting of 6 days within the following lunar month (Shawal).

low or moderate risk for fasting, depending on other contributing factors. Consequently, all people with T2D and MVD require individualized risk assessment to determine fasting eligibility.[6] Despite these risks, many patients still fast against medical advice.[9]

The baseline characteristics of patients with MVD and T2D show a very different profile compared with those without MVD. Many of these characteristics are addressed independently in the risk calculation, such as duration of diabetes, type of therapy, presence of nephropathy, and level of glycemic control. However, the question remains on the impact of MVD in people with T2D on the decision of fasting as well as on glycemic outcome in those who fasted. Our findings indicate that patients with MVD and diabetes were significantly less likely to fast during Ramadan compared to those without MVD (68.5% vs. 87.6%, $p = 0.04$). Logistic regression analysis further confirmed that MVD was independently associated with reduced odds of fasting (AOR 0.61, 95% CI 0.44–0.86, $p \leq 0.01$). These results may reflect partial adherence to risk-based recommendations by both patients and health care providers in this subgroup. However, despite the lower intention to fast, the actual number of mean fasting days was similar between the two groups, that is, 26.9 (6.6) in MVD versus 27.7 (5.5) in the control. This suggests that patients may have perceived their health as stable enough to fast, or probably that positive day-to-day fasting experiences may have encouraged continuation despite earlier intentions not to fast. These findings highlight an important

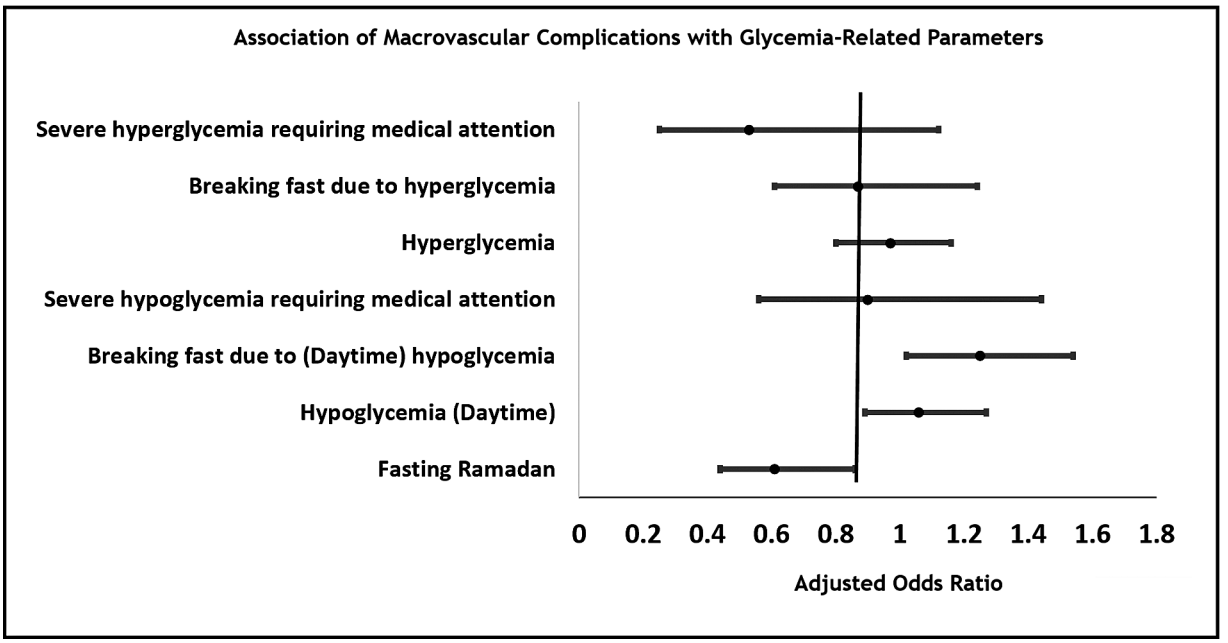

Fig. 3 Association of macrovascular complications with hypoglycemia/hyperglycemia-related outcomes during Ramadan fasting.

fact that, considering a patient's perception of their ability to fast, is also important in risk stratification.

While the overall self-reported rates of hypoglycemia and hyperglycemia during fasting were not significantly different between groups, patients with MVD were significantly more likely to break their fast due to hypoglycemia (AOR 1.25, 95% CI 1.02–1.54, $p \leq 0.05$). This finding hypothetically suggests that individuals with MVD may be more mindful of early hypoglycemic symptoms, more concerned about their safety due to comorbid conditions, or more compliant with physician instructions to break the fast at the first sign of dysglycemia. Their general condition may contribute to heightened attention and a lower threshold for action. Indeed, breaking the fast early may indicate an adaptive response and might explain why severe hypoglycemia rates were not significantly elevated in the MVD group despite their higher overall risk.

Findings from previous studies support these observations. In the EPIDIAR, CREED, and similar research, glycemic excursions were common during Ramadan across risk categories, but patient responses varied widely.[3–5,9] While some studies report an increase in hypoglycemia and hyperglycemia during Ramadan, others have found stable or improved glycemic control.[10–13] This variation highlights the impact of individual behaviors, health literacy, and clinical guidance on shaping outcomes. For patients with MVD, even brief or mild hypoglycemia may prompt conservative action—especially if accompanied by fear of complications or prior adverse experiences. Therefore, the uniform event rates may have masked important differences in risk perception, treatment adherence, and patient decision-making during fasting.

The limited adoption of SMBG and Ramadan-specific education among MVD patients is a critical concern. Only 57.7% of MVD patients received any Ramadan-focused structured education, and only 13.3% increased SMBG frequency during Ramadan, despite the heightened risk profile. Previous studies have demonstrated that targeted Ramadan-focused structured education, combined with continuous glucose monitoring (CGM) and pre-Ramadan treatment adjustments, can reduce the risk of glycemic events in high-risk patients.[4,14] This finding highlights the need for concerted efforts to enhance and scale up access to Ramadan-focused structured education. To achieve this, implementation strategies should include the use of mobile health applications, broader educational initiatives targeting allied health care professionals, and active engagement of religious leaders to ensure culturally sensitive and widely accessible guidance, especially to high-risk patients with diabetes.

While some evidence suggests that religious fasting has cardiometabolic benefits, including improved blood pressure and lipid profiles, these long-term benefits must be weighed against the short-term glycemic risks in vulnerable populations.[15,16] In particular, patients with MVD who already exhibit longer diabetes duration, higher HbA1c, and extensive comorbidities require tailored risk mitigation strategies. The adverse cardiovascular effects of hypoglycemia are well documented, including arrhythmia and ischemia.[17,18] Yet, many patients still lack the resources or education needed to respond effectively to glucose fluctuations during fasting.[19] In a prior study of high-risk patients with coronary heart disease using CGM, hypoglycemia was frequent and often unrecognized or unaddressed, reflecting potential gaps in health literacy or access.[2,4] However, this study did not prove the causal association of hypoglycemia with arrhythmia and ischemia. Similarly, a recent study by Rashid et al further underscores the variable cardiovascular risk profile during Ramadan in patients with diabetes.[20] Among patients admitted with cardiac conditions before, during, and after Ramadan, those with diabetes had a higher prevalence of preexisting CVD and were more likely to be hospitalized with congestive heart failure (CHF). Interestingly, during

Ramadan, CHF admissions declined in this group, while ischemic heart disease admissions increased. These opposing trends were not observed in individuals without diabetes.[19] This pattern may suggest that Ramadan fasting alters the clinical expression of cardiovascular stress in people with diabetes, potentially lowering volume-related CHF while increasing ischemic risk. Such findings reinforce the importance of cardiovascular profiling in Ramadan risk stratification, particularly in patients with MVD.

Despite the large sample size and the multicountry design of this study, several limitations must be acknowledged. The cross-sectional design limits the establishment of causal relationships between fasting, glycemic events, and observed clinical outcomes. Indeed, the severity of the MVD was not established in our cohort. Key behavioral factors such as smoking, dietary habits, physical activity, and medication adherence were not captured. Some important variables, such as socioeconomic status, education level, season, or climate variation in different regions, could influence the outcomes. Unfortunately, these data were not available in the data set used for this study. This limits the ability to fully interpret glycemic variations. Furthermore, reliance on self-reported data for hypoglycemia and hyperglycemia may have introduced recall bias, especially in high-risk groups. We also acknowledge the potential sampling bias as the cohort was drawn from patients attending outpatient clinics; there is a possibility that more frail or less adherent patients may be underrepresented.

Conclusion

Patients with T2D and MVD represent a vulnerable subgroup during Ramadan fasting. Our findings suggest that patients with MVD are less likely to fast, but those who do are more likely to break the fast due to hypoglycemia, despite similar overall rates of glycemic events. This may reflect earlier symptom recognition or stronger adherence to medical advice, serving as a protective response. These findings highlight the need for individualized strategies and studies to achieve safer fasting in this high-risk group. Future studies should integrate CGM and stratify MVD by clinical severity to refine fasting guidelines.

Authors' Contributions

All authors contributed toward conception, data collection, writing, and final approval of the manuscript.

Compliance with Ethical Principles

Ethical approval was granted for the initial DAR Global Survey from Dubai Health Authority.

Data Availability Statement

The data supporting this article can be made available by a reasonable request to the corresponding author.

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Conflict of Interest

None declared.

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