



Ramadan Fasting in Individuals with Diabetic Retinopathy: A Retrospective Cohort Study from the Diabetes and Ramadan Global Survey

Bachar Afandi^{1,2} Alaa Attwan³ Georgios Ponirakis⁴ Rayaz Malik⁴ Reem Alamoudi⁵
Inass Shaltout⁶ Rashed Malek⁷ Mohamed Habib⁸ Samih Abed Odhaib⁹ Zannah Hussein¹⁰
Khadija Hafidh^{11,12} Mohamed Hasannien^{12,13}

¹ Department of Endocrinology, Tawam Hospital and STMC, Al Ain, United Arab Emirates

² Department of Medicine, College of Medicine and Health Sciences, UAE University, Al Ain, United Arab Emirates

³ Department of Ophthalmology, Moorfields Eye Hospital, Dubai, United Arab Emirates

⁴ Medicine Department, Weill Cornell Medicine-Qatar, Doha, Qatar

⁵ Department of Endocrinology, King Abdulaziz Medical City, King Saud Bin Abdulaziz University, Jeddah, Saudi Arabia

⁶ Department of Medicine, Faculty of Medicine, Cairo University, Cairo, Egypt

⁷ Diabetes Clinic, Setif University Ferhat Abbas, Setif, Algeria

⁸ Scientific Support Office, Diabetes and Ramadan International Alliance, Alexandria, Egypt

Address for correspondence Bachar Afandi, MD, Medicine Department, Tawam Hospital, Al Ain, P.O. Box 15258, United Arab Emirates (e-mail: bafandi@seha.ae).

⁹ Thi Qar Specialized Diabetes Endocrine and Metabolism Center, College of Medicine, Sumer University, Thi Qar, Iraq

¹⁰ Medical Endocrine Unit, Internal Medicine Department, Endocrine Institute Hospital Putrajaya, Putrajaya, Malaysia

¹¹ Department Diabetes and Endocrinology, Rashid Hospital, Dubai, United Arab Emirates

¹² Department of Medicine, Mohammed Bin Rashid University, Dubai, United Arab Emirates

¹³ Department of Endocrinology, Dubai Hospital, Dubai, United Arab Emirates

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Abstract

Background Data on the impact of diabetic retinopathy (DR) on Ramadan fasting are limited. DR is not currently considered in pre-Ramadan risk stratification. However, its association with longer diabetes duration, poor glycemic control, and insulin use may increase vulnerability to adverse events during fasting.

Objectives To evaluate fasting safety in patients with DR using data from the Diabetes and Ramadan (DaR) Global Survey.

Patients and Methods This retrospective cohort study analyzed data from the DaR Global Survey conducted in 2020 and 2022 across multiple world regions. Patients with confirmed DR (DR group, $n = 1,795$) were compared with individuals without DR (control group, $n = 10,735$). Demographic and clinical data were collected through structured post-Ramadan clinic interviews. Primary outcomes included self-reported hypoglycemia, hyperglycemia, emergency visits, hospitalizations, and fasting interruption. Multivariate logistic regression was used to adjust for age, sex, diabetes duration, glycated hemoglobin (HbA1c), and insulin use.

Results Individuals with DR had longer diabetes duration, comparable HbA1c, and greater insulin use compared with those without DR. DR was independently associated with a 45% lower likelihood of fasting during Ramadan (adjusted odds ratio [AOR]: 0.55, $p \leq 0.0001$). Among those who fasted, hypoglycemia rates were similar in the DR (16.2%) and non-DR (14.6%) groups ($p = 0.5$), but hyperglycemia was more prevalent in

Keywords

- diabetic retinopathy
- Ramadan fasting
- hypoglycemia
- hyperglycemia
- risk assessment
- diabetes education
- fasting complications

DR (24.1 vs. 13.8%; $p < 0.001$). DR was also independently associated with breaking the fast due to hypoglycemia (AOR: 1.34), hypoglycemia requiring medical attention (AOR: 1.76), and hyperglycemia (AOR: 1.50).

Conclusions DR was independently linked to lower fasting rates and higher risks of hypoglycemia, hyperglycemia, and medical interventions during Ramadan. These findings underscore the importance of incorporating DR assessment into fasting risk stratification tools to improve patient safety.

Introduction

The Diabetes and Ramadan (DaR) risk calculator categorizes patients with diabetes into low-, medium-, and high-risk groups based on their risk of developing complications while fasting during Ramadan. Risk stratification incorporates cardiovascular disease (CVD), nephropathy, frailty, prior hypoglycemia, glycated hemoglobin (HbA1c), duration of diabetes, and insulin use, but not diabetic retinopathy (DR).¹

DR is strongly associated with poorer glycemic control, longer duration of diabetes, presence of comorbid complications, and complex treatment regimens, raising concern regarding fasting safety.^{2–4} Thus, the presence of DR may be associated with a sicker, metabolically vulnerable subgroup, prone to hypoglycemia or hyperglycemia. DR is a leading cause of vision loss in the Middle East and worldwide^{5,6} and is characterized by microvascular changes such as microaneurysms, hemorrhages, exudates, cotton-wool spots, and neovascularization.^{7,8} The management of DR includes laser photocoagulation, antivascular endothelial growth factor intravitreal injections, and steroid implants^{9,10} to limit retinal damage and preserve or restore vision. However, beyond vision loss, DR may reflect underlying vascular fragility and systemic disease burden, which could increase the risk of fasting. Given that the cornerstone of DR management remains optimal glycemic control,¹¹ adverse glycemic outcomes during fasting may themselves impact DR.

The impact of Ramadan fasting specifically in patients with DR has not been adequately explored.^{12,13} Evaluating outcomes in people with diabetes mellitus (DM) who fast during Ramadan may help determine whether DaR risk stratification tools should incorporate DR. This is a subanalysis of the DaR global survey database,¹⁴ the first large-scale, multinational study investigating the impact of DR on adverse outcomes concerning fasting during Ramadan, after adjusting for all other confounders.

Methods

Study Design and Setting

This retrospective observational cohort study utilized data from the DaR Global Survey (2020–2022), which involved Muslim patients with type 2 diabetes mellitus (T2DM) across six regions: the Gulf, Middle East, Turkey, the United Kingdom, Africa, the Indian subcontinent, and Southeast Asia.

Data were collected during routine outpatient visits within 10 weeks of completing the Ramadan fast.

Participants

A total of 12,529 fasting Muslims with T2DM were included in the study. Of these, 1,795 (14.3%) patients had confirmed DR, whereas 10,735 (85.7%) had no DR. DR status was confirmed by physician report during the clinic visit. All participants were regular clinic attendees during the study period.

Variables

Key outcomes included the frequency of fasting, incidence, frequency, and duration of hypoglycemia and hyperglycemia during Ramadan fasting, as well as related interventions. Hypoglycemia was defined as self-reported symptoms consistent with low glucose, with or without confirmation by capillary blood glucose; severe hypoglycemia was defined as requiring assistance or medical attention. Hyperglycemia was defined as self-reported elevated glucose or symptoms attributed to high glucose, with severe cases requiring medical attention. Continuous variables (e.g., age, HbA1c, diabetes duration, fasting days) were summarized as means $\pm$ standard deviation, whereas categorical outcomes (e.g., hypoglycemia incidence) were reported as frequencies and percentages.

Data Collection

Data were collected through structured questionnaires administered by trained health care professionals during clinic visits. Demographics, diabetes duration, HbA1c, and treatment regimens (insulin and noninsulin therapies) were recorded. For analysis, age, diabetes duration, and HbA1c were also categorized.

Statistical Analysis

Data from 2020 and 2022 were combined. Descriptive statistics summarized baseline characteristics, and comparisons between cohorts were conducted using Pearson's chi-square test for categorical variables. Multivariate logistic regression was used to estimate odds ratios (ORs) for fasting outcomes, adjusting for age, sex, diabetes duration, HbA1c, and insulin use. Because several outcomes were common ($>10\%$), crude relative risks were also calculated from the raw data to provide context. The potential for ORs to overestimate effect sizes in this setting is acknowledged in the Discussion section. A p -value <0.05 was considered

Table 1 Characteristics of the patients

Characteristic	Diabetic retinopathy cohort	Control cohort	p-Value
Total number	1,795	10,735	–
Females	985 (54.9%)	3,967 (52.6%)	0.6
Males	807 (45.1%)	3,565 (47.4%)	
Age (y)	60.5 (10.9)	54.3 (11.7)	0.01
Duration of diabetes (y)	14.9 (8.2)	9.1 (6.9)	0.01
HbA1c (%)	8.3 (1.9)	8.3 (1.9)	1.0
Body mass index (kg/m ²)	28.4 (7.8)	27.7 (6.8)	0.8
Systolic BP (mm Hg)	131 (31.6)	127.2 (26.9)	0.8
Diastolic BP (mm Hg)	76.4 (18.5)	76.7 (16.2)	0.9
LDL cholesterol (mg/dL)	87.6 (45.4)	91.3 (52.8)	0.8

BP, blood pressure; HbA1c, glycosylated Hemoglobin; LDL, low-density lipoprotein.

Note: Results are shown as number (%) for categorical values or mean (standard deviation) for continuous variables.

statistically significant. Analysis was performed using IBM SPSS Statistics version 26.

Results

Patient Characteristics

The DR cohort consisted of 985 females (54.9%) and 807 males (45.1%). The non-DR cohort consisted of 3,967 (52.6%) females and 3,565 (47.4%) males. Those with DR were older (60.5 ± 10.9 vs. 54.3 ± 11.7 years, $p = 0.01$), had a longer duration of diabetes (14.9 ± 8.2 vs. 9.1 ± 6.9 years, $p = 0.01$) but had very similar HbA1c values ($8.3 \pm 1.9\%$ in both groups, $p = \text{not significant}$) compared with those without DR (► **Table 1**).

Medication

Metformin use (82.2 vs. 81.5%, $p = 0.9$), sulfonylurea use (37.4 vs. 40.5%, $p = 0.6$), and DPP-4 inhibitor use (36.5 vs. 33.1%, $p = 0.5$) were comparable between the DR and non-DR cohorts (► **Table 2**). However, thiazolidinedione (TZD) use (7.8 vs. 3.9%, $p = 0.004$), GLP-1 receptor agonist use (4.9 vs. 2.7%, $p = 0.02$), and insulin use (64.6 vs. 39.1%, $p < 0.0001$) were higher in the DR cohort compared with the non-DR cohort.

Complications

The prevalence of hypertension (72.6 vs. 44.9%, $p = 0.002$), hyperlipidemia (61.4 vs. 38.5%, $p = 0.003$), neuropathy (45.7 vs. 16.5%, $p < 0.001$), nephropathy (29 vs. 7.2%, $p < 0.001$), microalbuminuria (13.7 vs. 3.3%, $p < 0.001$) and macrovascular

Table 2 Medications used by the study participants

Medication	Retinopathy cohort	Controls	p-Value
Total number of patients	653	10,735	
Noninsulin therapies			
Metformin	1,296 (82.2%)	8,755 (81.5%)	0.9
Sulfonylureas	548 (37.4%)	4,348 (40.5%)	0.6
DPP4 inhibitors	513 (36.5%)	3,554 (33.1%)	0.5
Thiazolidinedione	125 (7.8%)	423 (3.9%)	0.004
Sodium-Glucose Cotransporter 2 inhibitors	362 (23.9%)	2,018 (18.8%)	0.16
Glucagon-like peptide-1 Receptor Analogues	73 (4.9%)	295 (2.7%)	0.02
Alpha glucosidase inhibitor	47 (1.7%)	205 (1.9%)	0.7
Insulins			
Intermediate-/long-acting insulins	772(43%)	2,579 (24%)	0.04
Short-acting insulins	583(32.5%)	1,565 (14.6%)	<0.0001
Premixed insulins	468(26.1%)	1,471 (13.7%)	0.0002
Any insulin	1,158 (64.6%)	4,199 (39.1%)	<0.0001

DPP-4, Dipeptidyl peptidase-4.

Counts are not mutually exclusive.

Table 3 Complications and comorbidities in the study participants

Complications	Retinopathy cohort	Controls	p-Value
Number	1,795	10,735	
Hypertension	1,304 (72.6%)	4,820 (44.9%)	0.002
Hyperlipidemia	1103 (61.4%)	4,142 (38.5%)	0.003
Neuropathy	820 (45.7%)	1,769 (16.5%)	<0.0001
Microalbuminuria	246 (13.7%)	352 (3.3%)	<0.0001
Nephropathy/ chronic kidney disease	521 (29%)	769 (7.2%)	<0.0001
Macrovascular disease	478 (26.6%)	1041 (9.7%)	<0.0001
Diabetic foot disease	175 (9.7%)	267 (2.5%)	<0.0001

Note: Counts are not mutually exclusive.

disease (26.6 vs. 9.7%, $p < 0.001$), diabetic foot disease (9.7 vs. 2.4%, $p < 0.001$) was significantly higher in the DR compared with non-DR cohorts (►Table 3).

Self-monitoring and Education

Self-monitoring of blood glucose (SMBG) was performed by approximately 48% of participants in both the DR and non-DR groups, with no major change in frequency compared with pre-Ramadan practice. Notably, 23.1% of the DR cohort and 26.2% of the non-DR cohort did not undertake SMBG. Education for diabetes management during Ramadan was comparable between groups (63.5 vs. 58.6%), as was the average duration of educational sessions (17.1 vs. 13.6 minutes).

Fasting during Ramadan

The prevalence of patients who fasted was lower in the DR compared with the non-DR cohorts (71.3 vs. 87.6%, $p = 0.05$). DR was independently associated with a 45% lower likelihood of fasting during Ramadan (AOR: 0.55, 95% confidence interval [CI]: 0.48–0.64, $p < 0.001$) after adjusting for confounders. The mean duration of fasting among those who fasted was similar between the groups: DR (26.6 ± 6.9 days) and non-DR (27.7 ± 5.4 days). The percentage of patients who intended to fast during the post-Ramadan period of Shawwal was comparable between the DR and non-DR cohorts (24.2 vs. 25.8%, $p = 0.7$).

Hypoglycemia

The prevalence of symptoms of daytime hypoglycemia was comparable between the DR (16.2%) and non-DR (14.6%) cohorts ($p = 0.5$, adjusted odds ratio [AOR]: 1.13, 95% confidence interval [CI]: 0.95–1.34, $p = 0.16$). However, DR was independently associated with breaking the fast due to hypoglycemia (AOR: 1.34, 95% CI: 1.10–1.63) and with severe hypoglycemia requiring medical attention (AOR: 1.76, 95% CI: 1.18–2.61; ►Fig. 1).

Hyperglycemia

Hyperglycemia was more common in the DR compared with non-DR cohort (24.1 vs. 13.8%, $p = 0.002$; AOR: 1.50, 95% CI: 1.27–1.77, $p < 0.001$) and those with DR experienced

hyperglycemia for more than 8 days more frequently than the non-DR group (32.5 vs. 21.6%, $p = 0.01$). However, DR was not associated with breaking the fast due to hyperglycemia (AOR: 1.28, 95% CI: 0.92–1.76, $p = 0.14$) or with severe hyperglycemia requiring medical attention (AOR: 1.14, 95% CI: 0.63–2.05, $p = 0.67$; ►Fig. 1).

Finally, the AORs for all hypoglycemia- and hyperglycemia-related outcomes are summarized in ►Fig. 1, which illustrates that participants with DR had significantly higher risks of adverse events compared with those without DR.

Discussion

This study is the first large-scale, international investigation to explore the association of Ramadan fasting on glycemic outcomes in individuals with and without DR. DR is, of course, more prevalent in those with a longer duration of diabetes¹⁵ and is also associated with a higher risk of nephropathy, neuropathy, and CVD.^{16,17} In the current study, patients with DR were older, had a longer duration of diabetes, and had a higher prevalence of insulin and GLP-1 use. However, their HbA1c was comparable, highlighting the legacy effect on complications, as opposed to current glycemic control. Hypertension, hyperlipidemia, and diabetic neuropathy were also more prevalent, indicating multiple comorbidities in those with DR.^{2,3,18}

Thus, patients with DR in our study were significantly less likely to observe fasting during Ramadan compared with those without DR, despite the absence of formal recommendations advising against fasting in those with DR. Indeed, DR was independently associated with a 45% lower likelihood of fasting (AOR: 0.55, 95% CI: 0.48–0.64, $p \leq 0.001$), after adjusting for age, insulin use, diabetes duration, diabetes-related complications, and HbA1c. However, it is important to recognize that the DR cohort represents a “sicker phenotype,” with more advanced and multisystem disease, and residual confounding cannot be excluded despite statistical adjustment.

Of course, individuals with DR may be attending specialist clinics and have a heightened awareness of their health status, which may be influenced by having experienced

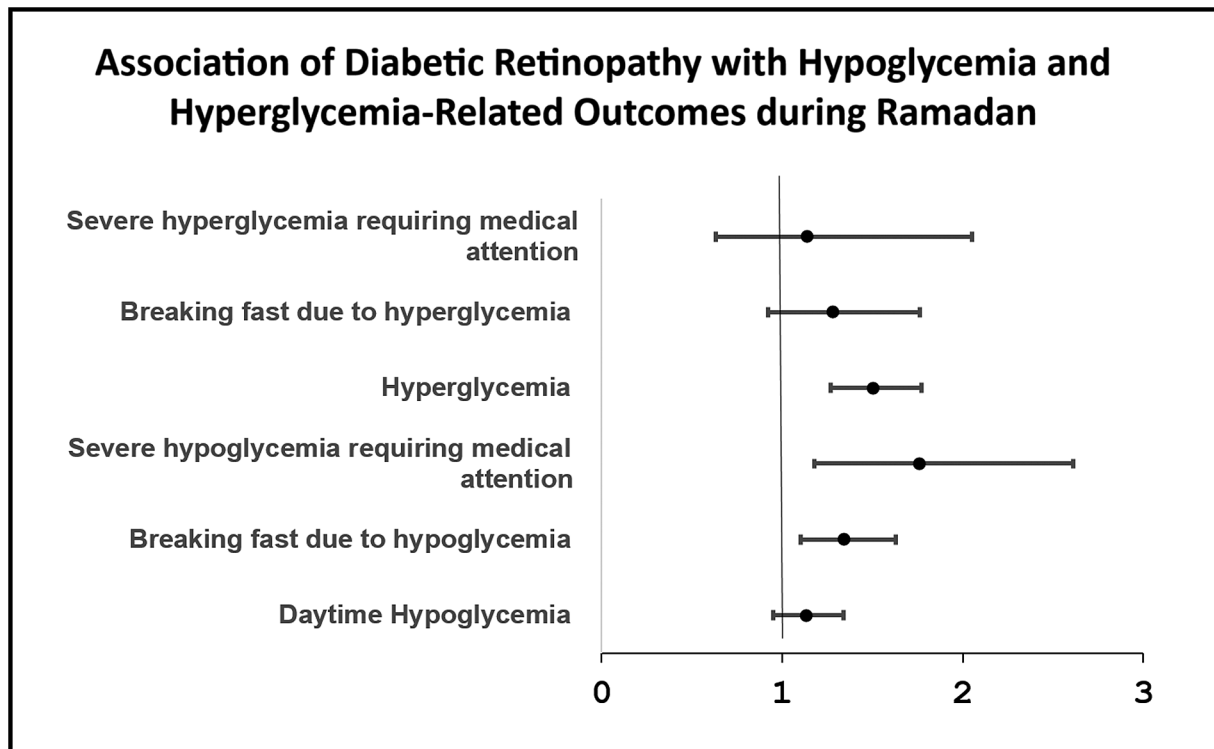


Fig. 1 Forest plot showing adjusted odds ratios for adverse glycemic outcomes during Ramadan fasting in participants with diabetic retinopathy (DR) versus those without DR. DR was associated with significantly higher risks of both hypoglycemia- and hyperglycemia-related events. Odds ratios were adjusted for age, HbA1c, complications, and insulin use. Error bars indicate 95% confidence intervals.

impaired vision, an increased medication burden, and episodes of dysglycemia during fasting. This could lead to a greater fear of complications or a reduced sense of physical well-being, prompting a more cautious approach to fasting. Alternatively, DR may represent a broader perception of disease severity among patients, even if their current level of glycemic control is not markedly worse. This suggests that patient self-selection played a major role in our findings. As a result, the observed risks in this study may underestimate the true risks for DR patients in an unselected population. This highlights the importance of patient-centered dialogue in pre-Ramadan care planning.

Furthermore, in multivariate analysis, DR significantly increased the odds of hypoglycemia requiring medical attention (AOR: 1.76) and hyperglycemia (AOR: 1.50), even after adjusting for confounders. While DR was significantly associated with breaking the fast due to hypoglycemia, there was no significant difference in the incidence of daytime hypoglycemia or severe hyperglycemia requiring hospitalization between patients with and without DR. These findings suggest that the presence of DR identifies a subgroup of patients with greater fasting vulnerability, but this should be interpreted cautiously, given the high probability of residual confounding. Rather than being a causal independent risk factor, DR may serve as a clinical marker of advanced disease and overall fragility in patients with diabetes who attempt to fast.^{17,18}

Fasting during Ramadan alters metabolic homeostasis through hormonal and circadian shifts.^{19,20} Cortisol secretion and insulin sensitivity may be disrupted due to changes

in the sleep pattern and altered mealtimes, leading to post-prandial spikes and pre-Iftar drops in glucose levels.²¹ These fluctuations may be particularly concerning in patients with DR, who may already have impaired vascular autoregulation²² and reduced counterregulatory responses due to concomitant autonomic neuropathy, which is common in this population. Indeed, hypoglycemia often occurs in the late afternoon before Iftar, when insulin action peaks and glycogen stores are depleted,²³ and post-Iftar hyperglycemia is commonly observed, due to large meals and delayed medication.²⁴ Such instability may place additional stress on the retinal microvasculature, further contributing to disease vulnerability.

Increased glycemic instability in individuals with DR may place additional stress on the retinal microvasculature and contribute to disease progression.²⁵ This aligns with the American Diabetes Association's (ADA) 2025 emphasis on individualized, culturally sensitive diabetes care that includes consideration of religious beliefs.²⁶ Rather than being considered an independent causal factor, DR should be viewed as a clinical marker that identifies patients with advanced disease who require closer monitoring. Incorporating DR into pre-Ramadan assessments helps clinicians recognize higher-risk patients, guide therapy adjustments, and provide personalized education to support safer fasting. In addition, structured use of continuous glucose monitoring (CGM) and tailored fasting regimens should be explored as strategies to mitigate risk in this vulnerable group.^{27,28}

While our study focused on short-term outcomes, there is a theoretical concern that recurrent glycemic variability, recurrent hypoglycemia, and oxidative stress during fasting

may also influence long-term DR progression.^{29,30} Thus, structured and supervised fasting may confer metabolic benefits if well-managed, although this remains underexplored.³¹

While this study provides valuable insights into the implications of Ramadan fasting in patients with DR, several limitations should be acknowledged. First, the reliance on self-reported episodes of hypoglycemia and hyperglycemia may introduce recall bias and lead to underreporting of mild events. Second, the classification of DR was based on physician reports and not standardized grading, which may introduce inaccuracies and heterogeneity. Third, residual confounding is highly likely given the profound baseline differences between DR and non-DR cohorts. Although we adjusted for age, sex, HbA1c, diabetes duration, and insulin use, other important factors such as severity of nephropathy, presence of autonomic neuropathy, and overall comorbidity burden were not fully captured. Fourth, the absence of CGM data limits our understanding of intra-day glycemic fluctuations. Fifth, patient self-selection (the “healthy faster effect”) may have led to underestimation of true risks, as those with DR who were more unwell may have opted not to fast. Sixth, propensity score methods were not applied, and this may have limited our ability to balance the baseline differences between groups fully.

Factors such as dietary intake, hydration, and medication adherence during Ramadan were not systematically captured, although they may have influenced glycemic outcomes. Selection bias is also possible, as individuals who were unfit to fast or chose not to fast may have been underrepresented, leading to an underestimation of fasting-related risks in the broader DR population. Residual confounding remains a possibility, as physical activity and socioeconomic factors were not fully accounted for. Moreover, the retrospective design and reliance on cross-sectional survey data mean that causality cannot be established, and our findings should be interpreted as associations rather than causal effects. Finally, while multivariate adjustments were applied, the absence of more advanced techniques such as propensity score matching further limits the ability to balance baseline differences fully, and unmeasured variables may still have influenced results.

Conclusion

This study underscores the increased risk of hypoglycemia, hyperglycemia, and associated medical interventions in patients with DR who fast during Ramadan. While DR was associated with key adverse glycemic outcomes even after adjustment for age, glycemic control, diabetes-related complications, and insulin use, these associations should be interpreted cautiously, given residual confounding and selection bias. Rather than being viewed as an independent causal factor, DR should be considered a clinical marker that identifies patients at higher risk and who warrant more detailed pre-Ramadan assessment and counseling. Future research should explore the long-term effects of fasting on DR progression and assess the impact of structured fasting

protocols, CGM, and tailored medication regimens in this high-risk population.

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 DAR Global Survey from Dubai Health Authority.

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None.

Conflict of Interest

None declared.

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