



Impact of Ramadan Fasting in People with Type 1 Diabetes and Diabetic Kidney Disease: Insights from the DaR Global Survey

Bachar Afandi^{1,2} Samih Abed Odhaib³ Mohamed Habib⁴ Naji Aljohani⁵
Muhammad Yaqoob Ahmedani⁶ Nancy Elbarbary⁷ Eman Alfadhli⁸ Majd Aldeen Kallash⁹
Mohamed Hassanein^{10,11} 

¹Endocrine Division, Tawam Hospital, Al Ain, United Arab Emirates

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

³Thi Qar Specialized Diabetes Endocrine and Metabolism Center, College of Medicine, Sumer University, Thi Qar, Iraq

⁴Diabetes and Ramadan International Alliance, Alexandria, Egypt

⁵King Fahad Medical City, Riyadh, Saudi Arabia

⁶Baqai Institute of Diabetology and Endocrinology, Karachi, Pakistan

⁷Department of Pediatrics, Faculty of Medicine, Ain Shams University, Ain Shams, Egypt

⁸Taibah University, Madinah, Saudi Arabia

Address for correspondence Bachar Afandi, MD, Endocrine Division, Tawam Hospital, Al Ain, United Arab Emirates (e-mail: bafandi@seha.ae).

⁹Diabetic Center and Endocrinology, King Fahad Medical City, Riyadh, Saudi Arabia

¹⁰Department of Diabetes and Endocrinology, Dubai Hospital, Dubai, United Arab Emirates

¹¹Department of Medicine, Mohammed Bin Rashid University, Dubai, United Arab Emirates

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Abstract

Keywords

- Ramadan fasting
- type 1 diabetes mellitus
- diabetic kidney disease
- hypoglycemia
- hyperglycemia
- diabetes education
- self-monitoring of blood glucose
- risk stratification

Background Despite the scarcity of data, individuals with type 1 diabetes mellitus (T1D) and diabetic kidney disease (DKD) are considered at moderate to high risk for Ramadan fasting and are individually advised against fasting.

Objectives This subgroup analysis of the Diabetes and Ramadan (DaR) global survey was conducted to evaluate the outcomes and characteristics of patients with T1D complicated by DKD who observe fasting and to compare their outcomes with those of fasting people living with T1D uncomplicated by DKD.

Methods Using a specifically designed SurveyMonkey questionnaire, Muslim individuals with T1D and DKD were surveyed in several countries from different geographical regions and compared statistically to people with T1D without DKD or associated comorbidities.

Results Note that 53.8% ($N = 86$) of individuals with T1D and DKD fasted during Ramadan in comparison with 74% ($N = 1,523$) of the control group. Those with DKD experienced higher rates of hypoglycemia (65.1%) and hyperglycemia (69.6%) than the control group (56.5 and 42.5%, respectively). They also had more frequent emergency visits and hospitalizations. Additionally, among individuals with T1D and DKD, non-fasters exhibited significant differences in biochemical markers and demographics compared with those who fasted.

Conclusion Individuals with T1D and DKD are generally older, have multiple diabetes-related complications, and are less likely to fast during Ramadan. For those who do fast,

the risks are significant, including higher rates of hypoglycemia and hospital admissions compared with the control group. Ensuring safe fasting in this population requires interdisciplinary collaboration, patient education, and expert medical guidance.

Introduction

Diabetic kidney disease (DKD) represents a significant and often debilitating complication in patients with type 1 diabetes mellitus (T1D).¹ DKD remains a leading cause of morbidity and mortality in individuals with T1D.² The prevalence of DKD in T1D increases with diabetes duration, with approximately 33 and 25% of adults developing albuminuria and estimated glomerular filtration rate (eGFR) < 60 mL/min per 1.73 m², respectively, after > 40 years of diabetes,³ highlighting the urgent need for focused research and tailored interventions to improve long-term outcomes and quality of life in this vulnerable population.

The pathophysiology of DKD in T1D is multifactorial, driven by hyperglycemia-induced damage, hypertension, inflammation, and genetic predispositions.⁴ Persistent hyperglycemia is a key contributor to the development of diabetic nephropathy, a major precursor to DKD. It exerts its effects through mechanisms such as increased glomerular filtration rate, oxidative stress, and activation of the renin-angiotensin system, collectively promoting kidney damage.⁵ Hypertension further exacerbates renal injury by increasing glomerular pressure,⁶ while chronic inflammation accelerates fibrotic changes in renal tissues. If left untreated, DKD can progress to end-stage renal disease, a critical condition requiring dialysis or kidney transplantation for survival.

Fasting, whether observed for religious reasons like Ramadan or pursued for cultural or health-related purposes, has gained increasing attention as a critical consideration for individuals managing T1D. Fasting poses unique challenges, particularly in individuals with concurrent DKD, as it directly influences glycemic control and kidney function.⁷ Prolonged periods without food or water can lead to dehydration, significant fluctuations in blood glucose levels, and disturbances in electrolyte balance, all of which contribute to increased renal stress.⁸ Individualized management plans and close monitoring are crucial to mitigate the risks associated with fasting in this vulnerable population.

For individuals with T1D and compromised kidney function, fasting may accelerate the progression of DKD due to fluctuations in blood pressure, changes in insulin sensitivity, and an increased risk of acute kidney injury (AKI).⁹ The interplay between fasting, hyperglycemia, and preexisting kidney damage further heightens the vulnerability of these individuals to adverse renal outcomes. Despite these significant risks, many individuals with T1D choose to fast for many days,¹⁰ highlighting the need for tailored management strategies. Optimizing insulin regimens, hydration, and nutrition during nonfasting hours is essential to mitigate fasting's impact on kidney health. However, there remains a lack of

comprehensive guidelines specifically tailored to address the unique challenges faced by individuals with T1D complicated with DKD during fasting periods.

While previous studies have inspected the correlation between fasting in people with diabetes and chronic kidney disease (CKD),^{7,11,12} this article aims to examine the interplay between DKD and fasting in T1D patients in particular, focusing on the findings of the Diabetes and Ramadan (DaR) global surveys of 2020 and 2022 in hope of establishing significant correlations between fasting and baseline characteristics, incidence of hypoglycemia and hyperglycemia, hospitalizations, and structured diabetes education and self-monitoring of blood glucose (SMBG) practices among the Muslim-majority population in this particular cohort of patients.

Methods

A SurveyMonkey questionnaire was devised to collect data from consenting diabetic patients with a focus on three main domains. First, demographic characteristics and baseline biochemical markers such as age, duration of diabetes, hemoglobin A1c (HbA1c), body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), low-density lipoprotein (LDL), therapeutic regimens, diabetic complications, and comorbidities. Second, fasting intention, number of days fasted during the months of Ramadan and Shawwal, symptoms of hypoglycemia and hyperglycemia developed during fasting, attendance at an emergency department, or hospital admission. Third, Ramadan-specific diabetes education and SMBG.

The questionnaire was sent out to collaborating health care professionals in countries with significant Muslim populations, including Algeria, Bangladesh, Brunei, Egypt, India, Saudi Arabia, Malaysia, Morocco, Pakistan, Tunisia, Türkiye, the United Arab Emirates, and the United Kingdom. These participating countries spanned the Middle East, South Asia, North Africa, and parts of Europe, ensuring wide geographic representation. Approval was taken from local research and ethics authorities. These health care professionals came from endocrinology, general practice, and internal medicine backgrounds to reflect various levels of primary and specialist care clinical settings. For this analysis, DKD was defined according to physician-reported diagnosis within the survey. Participants with DKD were classified as cases, while those without DKD were classified as controls. Data collected from T1D cases of the survey was analyzed based on comparing DKD cases versus an age-matched control group whose individuals were without microalbuminuria, macrovascular disease (coronary artery

disease, heart failure, stroke or transient ischemic attack, peripheral vascular disease), and diabetic foot issues, as well as nephropathy/DKD (abnormal eGFR or serum creatinine). The aim was to compare T1D patients with DKD to a lower-risk T1D group, which necessitated the exclusion of those with macrovascular disease. The DKD group included patients with reduced eGFR or elevated serum creatinine, while the control group consisted of age-matched T1D patients without DKD or macrovascular complications. Out of 2,315 individuals with T1D included in the survey, 160 (6.9%) were identified as having DKD, while 2,058 served as the control group without DKD. Because the rate of urinary albumin to creatinine ratio (ACR) testing was low, patients with positive ACR but normal creatinine and eGFR were excluded.

Differences in demographic characteristics and clinical outcomes between individuals with DKD and the control group were assessed using chi-squared analysis. All statistical tests applied were two-sided, with *p*-values of < 0.05 considered statistically significant. No adjustments or weights were applied for multiple comparisons. Statistical analyses were conducted using SPSS version 26.

Results

Demographic and Biochemical Characteristics

Out of the 2,315 individuals with T1D who participated in the survey, 160 (6.9%) were identified as having DKD and T1D, compared with 2,058 individuals with T1D without DKD (controls). There were significant differences in most baseline characteristics between cohorts, including age, duration of diabetes, HbA1c, BMI, SBP, DBP, and LDL. Moreover, several diabetes-related complications were of significantly higher occurrence in the T1D with DKD cohort (►Table 1).

A significant proportion of the T1D with DKD population (74 cases, or 46.3%) decided not to fast during Ramadan. We further analyzed this group to understand its characteristics better. When compared with the group that fasted (►Table 2), we noted a significantly higher incidence of diabetic complications in the nonfasting cohort (►Fig. 1).

Intentions and Abilities to Fast

The intention and ability to fast during Ramadan were significantly impacted by DKD. Only 53.8% of the T1D with DKD cohort intended to fast, compared with 74% in the T1D without DKD (controls) (*p* = 0.02). Conversely, 46.2% of the T1D with DKD group chose not to fast, highlighting the significant impact of DKD on fasting decisions. The average number of fasting days was also lower in the T1D with DKD group (23.5 ± 8.8 vs. 24.3 ± 7.2 days in controls). Post-Ramadan fasting rates were marginally higher in the controls (14.8% vs. 13.1%, *p* = 0.4), though this difference was not statistically significant.

Hypoglycemia/Hyperglycemia and Hospitalization during Ramadan

Among those who fasted, hypoglycemia incidence was higher at 65.1% in the T1D with DKD population versus 56.5% in the controls, and emergency visits/ hospital admissions were also higher at 4.7% versus 3.4%. Emergency visits/hospital admissions due to hyperglycemia were also higher at 3.6% in the T1D with DKD cohort versus 1.9% in the controls (*p* = 0.04). Frequent hypo- and hyperglycemia had a higher incidence in the T1D with DKD controls (►Fig. 2).

Self-Monitoring of Blood Glucose and Education

SMBG and Ramadan-specific patient education were performed at a more or less equal measure in both cohorts. However, education sessions ran significantly longer in the T1D with DKD cohort, with 62.2% of sessions running for over 15 minutes versus 39.1% in the controls (►Table 3).

Discussion

The DaR risk calculator, a widely utilized tool to assess the risk of fasting in individuals with diabetes, identifies individuals with T1D as moderate to high risk based on specific clinical parameters.¹³ This classification reflects the potential challenges associated with fasting, including blood glucose variability, hypoglycemia, hyperglycemia, and other

Table 1 Baseline characteristics and medication use in T1D with DKD vs. T1D without DKD (controls)

Characteristic	T1D with DKD (<i>n</i> = 160)	Controls (<i>n</i> = 2,058)	<i>p</i> -Value
Age (y), mean $\pm$ SD	41.2 $\pm$ 12.3	38.7 $\pm$ 11.9	0.06
Male sex, <i>n</i> (%)	79 (49.4)	1010 (49.1)	0.94
Duration of diabetes (y), mean $\pm$ SD	18.5 $\pm$ 7.2	16.9 $\pm$ 6.9	0.04^a
BMI (kg/m ²), mean $\pm$ SD	27.1 $\pm$ 4.2	26.3 $\pm$ 4.0	0.08
HbA1c (%), mean $\pm$ SD	8.7 $\pm$ 1.4	8.2 $\pm$ 1.3	< 0.001^a
Hypertension, <i>n</i> (%)	86 (53.8)	540 (26.2)	< 0.001^a
Dyslipidemia, <i>n</i> (%)	68 (42.5)	602 (29.2)	0.001^a
LDL < 100 mg/dL, <i>n</i> (%)	59 (36.9)	881 (42.8)	0.17
Insulin pump use, <i>n</i> (%)	24 (15.0)	466 (22.6)	0.02^a

Abbreviations: BMI, body mass index; DKD, diabetic kidney disease; HbA1c, glycated hemoglobin; LDL, low-density lipoprotein; SD, standard deviation; T1D, type 1 diabetes mellitus.

^aBold values indicate statistically significant *p*-values (*p* < 0.05).

Table 2 Baseline characteristics and medication use in fasting versus nonfasting subgroups within T1D with DKD population

Characteristic	Fasting (n = 86)	Nonfasting (n = 74)	p-Value
Age (y), mean $\pm$ SD	39.9 $\pm$ 12.1	42.8 $\pm$ 12.4	0.17
Male sex, n (%)	36 (48.6)	43 (58.1)	0.25
Duration of diabetes (y), mean $\pm$ SD	17.6 $\pm$ 7.1	19.4 $\pm$ 7.2	0.18
BMI (kg/m ²), mean $\pm$ SD	26.4 $\pm$ 4.1	28.0 $\pm$ 4.3	0.04^a
HbA1c (%), mean $\pm$ SD	8.5 $\pm$ 1.3	8.9 $\pm$ 1.5	0.05
Hypertension, n (%)	42 (54.5)	44 (59.5)	0.55
Dyslipidemia, n (%)	32 (41.6)	36 (48.6)	0.42
LDL < 100 mg/dL, n (%)	37 (48.1)	22 (29.7)	0.016^a
Insulin pump use, n (%)	20 (26.0)	4 (5.4)	0.001^a

Abbreviations: BMI, body mass index; DKD, diabetic kidney disease; HbA1c, glycated hemoglobin; LDL, low-density lipoprotein; SD, standard deviation; T1D, type 1 diabetes mellitus.

^aBold values indicate statistically significant *p*-values (*p* < 0.05).

metabolic complications. The presence of any degree of DKD further amplifies these risks, as DKD exacerbates susceptibility to dehydration, electrolyte imbalances, and AKI during fasting periods. This subanalysis of the DAR global survey¹⁴ represents the first comprehensive effort to explore the unique characteristics, practices, and complications of individuals with both T1D and DKD who fast during Ramadan.

The progressive nature of CKD can explain the demographic characteristics attributed to the DKD cohort. The mean age of 32.7 $\pm$ 13.4 years in the DKD cohort compared with 25.3 $\pm$ 9.1 in the control is related to the potential cumulative damage inflicted by prolonged high blood glucose levels on the kidneys. This effect is even more pronounced when comparing the duration of diabetes in the two cohorts, with a mean duration of 16.8 years in the DKD population versus 10.6 years in the control. These findings

reinforce previous studies that identified older age and longer diabetes duration as significant risk factors in DKD progression.¹⁵ Poor glycemic control is another critical factor, with nearly half of all DKD patients (46.3%) having an HbA1c level of more than 9% compared with just 30.2% in the control (*p* = 0.005). This aligns with earlier studies that observed a strong independent association between elevated HbA1c and incident CKD.¹⁶

The high-risk trajectory of different cardiovascular morbidities associated with DKD among individuals with diabetes mellitus is well established.¹⁷ As evident from our analysis, all major cardiovascular morbidities occurred at a significantly higher rate in the DKD cohort (**Table 1**). The underlying molecular and cellular mechanisms of T1D include inappropriate activation of the renin angiotensin–aldosterone system, mitochondrial dysfunction, excessive oxidative stress, inflammation, dyslipidemia, and thrombosis. These abnormalities

Occurrence of diabetes-related complications and comorbidities
in fasting vs non-fasting patient

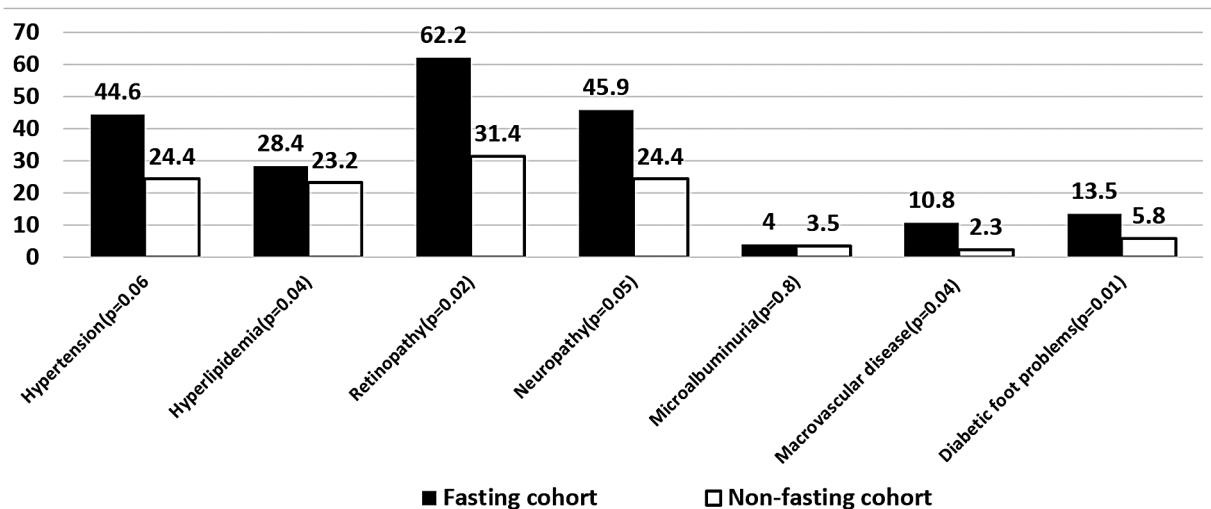


Fig. 1 Rates of occurrence of diabetes-related complications and comorbidities in fasting versus nonfasting cohorts (%).

Occurrence, frequency, and EHR/hospitalization in CKD vs controls

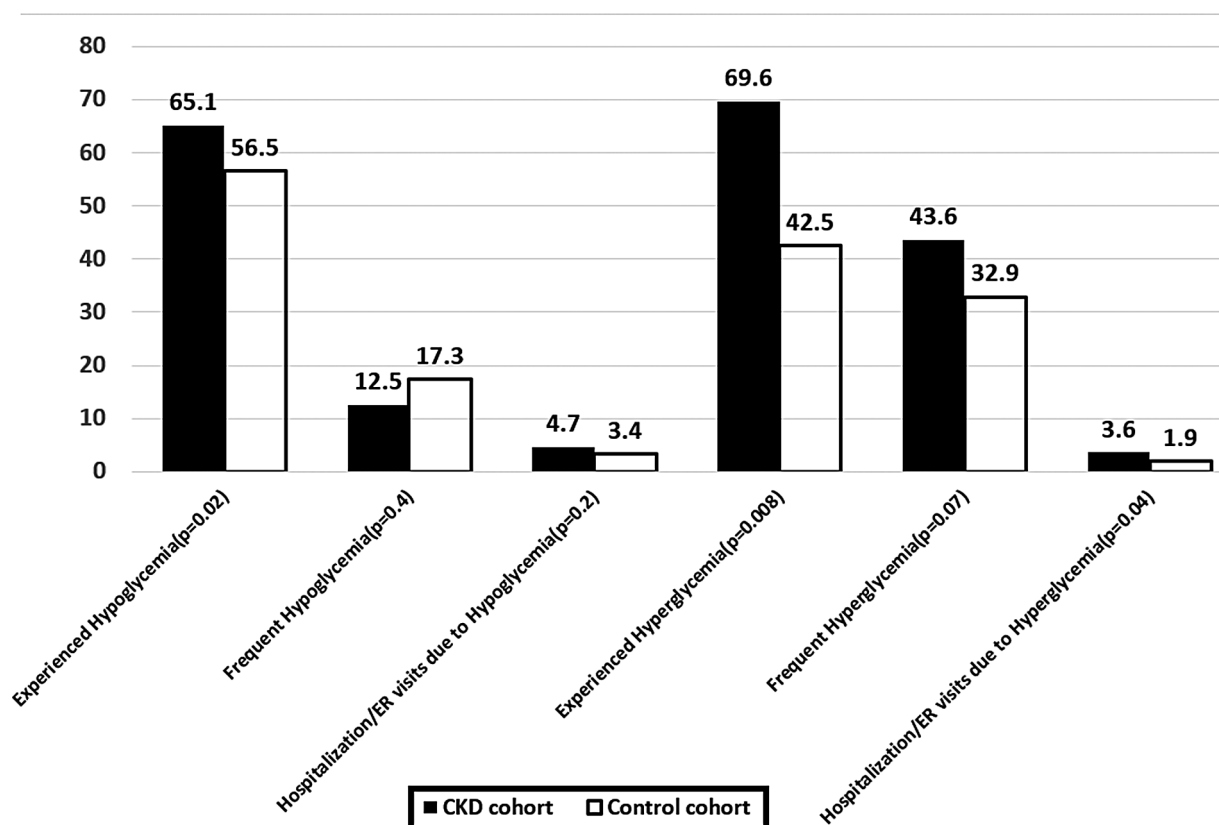


Fig. 2 Rates of occurrence, frequency, and hospitalizations due to hypo- and hyperglycemia in chronic kidney disease (CKD) versus control cohorts (%).

collectively promote metabolic disorders and further promote diabetic vasculopathy,¹⁸ particularly in type 1 patients.

The aforementioned classification of T1D patients with DKD as high risk for fasting, based on the DaR risk calculator and its specific criteria, is demonstrated by the fact that nearly half (46.3%) of DKD patients chose not to fast during Ramadan. This is in contrast to only 15% of patients in the general survey population who made the same decision. The combined burden of older age, longer duration of diabetes, poorer glycemic control, and a significantly higher proportion of people with other complications (►Fig. 1) contributes to the fact that this has one of the lowest fasting rates among Muslim individuals with diabetes.

Hypoglycemia can be considered a serious patient safety event with severe health complications, including dizziness, disorientation, slurred speech, convulsions, and death. DKD is an additional risk factor for hypoglycemia and augments the risk of hypoglycemic events already present in people with diabetes.¹⁹ Since in general the frequency of hypoglycemia is lower in people with type 2 diabetes than in those with T1D,²⁰ it is no wonder our analysis shows a majority of 65% of patients in the DKD cohort reporting hypoglycemic episodes during Ramadan with more patients requiring hospital

visits/admissions compared with the control (►Fig. 2). Hyperglycemic episode frequency and severity is also demonstrated to be higher in the DKD cohort and is possibly precipitated by the limitations imposed by fasting on fluid consumption²¹ and the administration of treatment, particularly insulin.

It is worth noting that there was very little difference between the two cohorts in the frequency at which SMBG was performed, and that the majority of patients performed SMBG at the same or even more frequently than before Ramadan (►Table 3). This may be associated with the concerted efforts made in the last few years in providing Ramadan-focused structured education, which was shown to decrease the incidence of hypoglycemia and HbA1c levels when compared with controls.²² The fact that education sessions were considerably longer in the DKD cohort (62.2% of sessions running for over 15 minutes vs. 39.1% in the control, $p = 0.003$) might be simply due to the added burden of CKD and associated complications.

A major strength of this study lies in its large sample size, wide geographic distribution, and granular data encompassing fasting behavior, metabolic complications, insulin regimens, and self-care practices. This is the largest real-world, multicountry analysis specifically addressing

Table 3 Characteristics of fasting, SMBG, and Ramadan-focused diabetes education in T1D with DKD versus T1D without DKD (controls)

	DKD cohort, <i>N</i> = 160	Control, <i>N</i> = 2,058	<i>p</i> -Value
Fasted the month of Ramadan	86 (53.8%)	1,523 (74%)	0.02
Duration of Ramadan fasting			
Mean duration (d) ± SD	23.5 ± 8.8	24.3 ± 7.2	0.07
1–7 d	9 (10.5%)	81 (5.3%)	0.06
30 d	31 (36%)	480 (31.4%)	0.5
Intention for Shawwal fasting	21 (13.1%)	305 (14.8%)	0.4
SMBG during Ramadan			
More frequent than before Ramadan	33 (23.4%)	428 (22.6%)	0.8
Less frequent than before Ramadan	10 (7.1%)	156 (8.2%)	0.6
Same frequency as before Ramadan	94 (66.7%)	1,178 (62.3%)	0.6
None	4 (2.8%)	130 (6.9%)	0.07
Received education	85 (60.3%)	1,143 (60.5%)	0.9
Method of education			
In clinic (routine consultation)	76 (62.8%)	849 (58.1%)	0.6
Group session	23 (19%)	150 (10.3%)	0.01
Online / app	10 (8.3%)	239 (16.3%)	0.04
Leaflet	12 (9.9%)	224 (15.3%)	0.03
Duration of education session			
0–15 min	31 (37.8%)	651 (60.9%)	0.02
> 15–30 min	34 (41.5%)	291 (27.2%)	0.05
> 30 min	17 (20.7%)	127 (11.9%)	0.05

Abbreviations: DKD, diabetic kidney disease; SD, standard deviation; SMBG, self-monitoring of blood glucose; T1D, type 1 diabetes mellitus.
 Note: Bold values indicate statistically significant *p*-values (*p* < 0.05).

Ramadan fasting among individuals with T1D complicated by DKD. The study's detailed stratification by DKD status, fasting status, and insulin modality allows for a nuanced understanding of clinical and behavioral differences in this high-risk group.

Nonetheless, several limitations should be acknowledged. First, the absence of DKD staging precluded deeper analysis of fasting tolerance by renal impairment severity. Second, reliance on self-reported hypoglycemia and hyperglycemia introduces potential recall and reporting bias. Lastly, the heterogeneity of health care systems and Ramadan education delivery across countries introduces potential variability in participant support and outcomes. Finally, the relatively small number of participants with T1D and DKD within individual countries limited the ability to explore geographical differences in fasting outcomes.

Conclusion

Individuals with T1D complicated with DKD are typically older, have various other diabetes-related conditions, and are less likely to observe Ramadan fasting. Ramadan fasting in this group of people presents notable risks, such as higher rates of hypoglycemia and hospital admissions

when compared with a control group. To ensure safe management during Ramadan fasting, interdisciplinary collaboration, patient education, and expert guidance are crucial. Several strategic recommendations can be drawn from these conclusions: (1) ensure comprehensive pre-Ramadan clinical assessment, (2) implement individualized risk stratification, (3) deliver structured Ramadan-specific education, (4) promote blood glucose monitoring protocols and expand access to diabetes technologies, (5) integrate multidisciplinary care models, and (6) prioritize future research using continuous glucose monitoring (CGM) and DKD-stage data.

Authors' Contributions

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

Compliance with Ethical Principles

Ethical approval was not required for this subanalysis. Original studies were approved by the ethical committees of the participating sites.

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None.

Conflict of Interest

None declared.

References

- 1 GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392(10159):1789–1858 Erratum in: *The Lancet*. 2019;393(10190):e44
- 2 Rossing P, Hougaard P, Borch-Johnsen K, Parving HH. Predictors of mortality in insulin dependent diabetes: 10 year observational follow up study. *BMJ* 1996;313(7060):779–784
- 3 Dena M, Svensson AM, Olofsson KE, et al. Renal complications and duration of diabetes: an international comparison in persons with type 1 diabetes. *Diabetes Ther* 2021;12(12):3093–3105
- 4 Ricciardi CA, Gnudi L. Kidney disease in diabetes: from mechanisms to clinical presentation and treatment strategies. *Metabolism* 2021;124:154890
- 5 Wu T, Ding L, Andoh V, Zhang J, Chen L. The mechanism of hyperglycemia-induced renal cell injury in diabetic nephropathy: an update. *Life (Basel)* 2023;13(02):539
- 6 Salem MM. Pathophysiology of hypertension in renal failure. *Semin Nephrol* 2002;22(01):17–26
- 7 Ahmad S, Chowdhury TA. Fasting during Ramadan in people with chronic kidney disease: a review of the literature. *Ther Adv Endocrinol Metab* 2019;10:2042018819889019
- 8 AlSahow A. The impact of hot ambient temperature and prolonged fasting duration during Ramadan on patients with chronic kidney disease: a literature review. *Int J Nephrol* 2023; 2023:2636507
- 9 NasrAllah MM, Osman NA. Fasting during the month of Ramadan among patients with chronic kidney disease: renal and cardiovascular outcomes. *Clin Kidney J* 2014;7(04):348–353
- 10 Bentaleb M, Sersar I, Bencharif M, et al. Type 1 diabetes mellitus and Ramadan fasting: a case of adolescents and adults from Algeria. *Nutr Clin Metab* 2023;37(04):214–220
- 11 Hassanein M, Yousuf S, Ahmedani MY, et al. Ramadan fasting in people with diabetes and chronic kidney disease (CKD) during the COVID-19 pandemic: the DaR global survey. *Diabetes Metab Syndr* 2023;17(07):102799
- 12 Chowdhury A, Khan H, Lasker SS, Chowdhury TA. Fasting outcomes in people with diabetes and chronic kidney disease in East London during Ramadan 2018: the East London diabetes in Ramadan survey. *Diabetes Res Clin Pract* 2019;152:166–170
- 13 Hassanein M, Afandi B, Yakoob Ahmedani M, et al. Diabetes and Ramadan: practical guidelines 2021. *Diabetes Res Clin Pract* 2022; 185:109185
- 14 Hassanein M, Binte Zainudin S, Shaikh S, et al. An update on the current characteristics and status of care for Muslims with type 2 diabetes fasting during Ramadan: the DAR global survey 2022. *Curr Med Res Opin* 2024;40(09):1515–1523
- 15 Radcliffe NJ, Seah JM, Clarke M, MacIsaac RJ, Jerums G, Ekinci EI. Clinical predictive factors in diabetic kidney disease progression. *J Diabetes Investig* 2017;8(01):6–18
- 16 Bash LD, Selvin E, Steffes M, Coresh J, Astor BC. Poor glycemic control in diabetes and the risk of incident chronic kidney disease even in the absence of albuminuria and retinopathy: Atherosclerosis Risk in Communities (ARIC) study. *Arch Intern Med* 2008; 168(22):2440–2447
- 17 Roy S, Schweiker-Kahn O, Jafry B, et al. Risk factors and comorbidities associated with diabetic kidney disease. *J Prim Care Community Health* 2021;12:21501327211048556
- 18 Jia G, Bai H, Mather B, Hill MA, Jia G, Sowers JR. Diabetic vasculopathy: molecular mechanisms and clinical insights. *Int J Mol Sci* 2024;25(02):804
- 19 Moen MF, Zhan M, Hsu VD, et al. Frequency of hypoglycemia and its significance in chronic kidney disease. *Clin J Am Soc Nephrol* 2009;4(06):1121–1127
- 20 Akram K, Pedersen-Bjergaard U, Borch-Johnsen K, Thorsteinsson B. Frequency and risk factors of severe hypoglycemia in insulin-treated type 2 diabetes: a literature survey. *J Diabetes Complications* 2006;20(06):402–408
- 21 Ahmed SH, Chowdhury TA, Hussain S, et al. Ramadan and diabetes: a narrative review and practice update. *Diabetes Ther* 2020; 11(11):2477–2520
- 22 El Toony LF, Hamad DA, Omar OM. Outcome of focused pre-Ramadan education on metabolic and glycaemic parameters in patients with type 2 diabetes mellitus. *Diabetes Metab Syndr* 2018;12(05):761–767