Health Professional's Knowledge Practices in Morocco: The DTMAR Study

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Abstract

Background Ramadan holds profound spiritual and cultural significance for Muslims worldwide. In Morocco, where an estimated 2.88 million individuals live with diabetes, ensuring a safe and well-tolerated fast requires rigorous support and monitoring by health care professionals before and during this holy month. Despite the availability of international recommendations, no prior study has specifically investigated the Ramadan-related knowledge of Moroccan health care professionals involved in diabetes management.

Objective The primary objective of this study was to describe the practices, knowledge, and attitudes of health care professionals regarding therapeutic and dietary adaptations for patients with diabetes during Ramadan in Morocco. The secondary objective was to assess the sociodemographic profile of these professionals as well as the epidemiological and metabolic characteristics of their most recent patients.

Methods DTMAR study (DT: diabetes, MAR: Morocco), a descriptive cross-sectional study was conducted among a sample of 173 health care professionals across all regions of Morocco. Data collection was performed through an online questionnaire comprising 20 questions, covering sociodemographic characteristics, knowledge and practices related to diabetes care during Ramadan, and clinical data from their most recent patients.

Results General practitioners represented the majority of respondents (57.8%). Most participants practiced in urban areas (93.6%), mainly in public hospitals (36.4%). Regarding knowledge, 57.2% reported relying primarily on international recommendations. Almost all participants (95%) provided therapeutic education, and more than 80% adjusted antidiabetic regimens. Nutritional counseling by more than half of respondents was consistent with the International Diabetes Federation/Diabetes and Ramadan International Alliance guidelines. However, a considerable proportion continued to rely on personal experience rather than standardized recommendations.

Keywords
- diabetes mellitus
- fasting
- Ramadan
- health care professionals
- knowledge
- education
- Morocco

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Conclusion Most health care professionals are aware of the specificities of managing diabetes during Ramadan. Nevertheless, a substantial number continue to rely primarily on personal experience. These findings highlight the importance of strengthening continuous education and structured training to align theoretical knowledge with effective clinical practice.

Introduction

Diabetes is a major global public health challenge. According to the International Diabetes Federation (IDF), 589 million adults were living with diabetes in 2024, a figure projected to reach 853 million by 2050.[1]

The burden is not only medical but also social and economic, with an estimated 3.4 million deaths each year and health care expenditures exceeding 966 billion USD.[1] In Morocco, the prevalence of diabetes is estimated at 11.9%, corresponding to 2.88 million people, a figure likely underestimated given the large number of undiagnosed cases.[2] Type 2 diabetes predominates, driven by nutritional transition, urbanization, sedentary lifestyles, and the rise of obesity.

Ramadan, one of the five pillars of Islam, is observed by more than one billion Muslims worldwide. The duration of fasting may extend up to 20 hours, depending on latitude and season, significantly impacting biological rhythms and metabolic demands.[2,3] Ramadan fasting involves complete abstinence from food and drink from dawn until sunset. This results in profound changes in dietary patterns, with food intake concentrated in two main meals: *Suhoor* (pre-dawn) and *Iftar* (sunset). These meals are often high in simple sugars and saturated fats, with reduced intake of fiber, vitamins, and minerals. This change in diet can have varied effects on the metabolic health of those fasting.

The diversity of cultural practices, socioeconomic environments, and individual profiles necessitates a nuanced and personalized approach to understand the effects of Ramadan fasting better.

For patients with diabetes, fasting poses specific challenges requiring individualized management strategies. Since the EPIDIAR study[4] (2004), several international guidelines have been issued, notably by the IDF and the Diabetes and Ramadan International Alliance (DaR),[5,6] providing risk stratification and therapeutic adjustment protocols. However, a gap persists between recommendations and clinical practice, particularly in low- and middle-income countries where socioeconomic constraints and cultural factors strongly influence diabetes care.

To date, no study has specifically explored the knowledge and practices of Moroccan health care professionals regarding diabetes management during Ramadan.

Methods

This descriptive cross-sectional study was conducted among health care professionals in Morocco managing patients with diabetes during Ramadan. It aimed to describe the management practices of Moroccan physicians and to examine the sociodemographic, clinical, and paraclinical characteristics of patients with diabetes under their care.

Population

General practitioners, endocrinologists/diabetologists, internal medicine specialists, pharmacists, and nurses were eligible. Participation was voluntary through national professional networks and scientific societies of diabetology and endocrinology in Morocco.

Data collection

The link to the online questionnaire was disseminated via email and professional social platforms (WhatsApp, SMS) to reach a diverse sample of practitioners working across different sectors (public/private) and regions.

This approach represents a nonprobability convenience sampling method, which is appropriate for descriptive studies such as nationwide surveys.

To minimize recall bias, participants were instructed to base their responses on the most recent patient consultation within 1 month prior to Ramadan. This strategy aimed to reduce memory-related inaccuracies and improve the reliability of reported practices.

After obtaining informed consent, participants completed an online questionnaire (20 questions) that covered sociodemographic characteristics, professional practices, and knowledge regarding diabetes care during Ramadan. Each professional also reported data from their most recent patient with diabetes.

Analysis

Data were analyzed using SPSS v13.0. Results are expressed in frequencies and percentages.

Results

Demographics of Participants

Among the 173 health care professionals included in the study, general practitioners constituted the majority with 100 participants (57.8%). Endocrinologists and diabetologists followed with 47 respondents (27.2%). The group also included 13 medical students in their sixth and seventh years of study, representing 7.5% of respondents. Other specialties were represented to a lesser extent: 3 occupational physicians (1.8%), 2 internists (1.2%), 2 endocrinology residents (1.2%), and 1 nephrologist (0.6%). Additionally, the

sample included one resident from a specialty other than endocrinology, one physician working in a dialysis center, and one pharmacist, each accounting for 0.6% of participants.

Regarding the practice setting, 63 participants (36.4%) worked in public hospitals, whereas 12 (6.9%) were employed in private hospitals. A total of 51 health care professionals (29.5%) practiced in the private nonhospital sector, and 6 participants (3.5%) were affiliated with the military sector.

The majority of participants (162; 93.6%) practiced in urban areas, whereas only 11 (6.4%) were based in rural settings.

Knowledge Status of Participants about Diabetes Care during Ramadan

A total of 99 health care professionals (57.2%) reported primarily relying on international guidelines for managing patients with diabetes during Ramadan. Fifty participants (28.9%) indicated adherence to local guidelines adapted to cultural, economic, and health contexts, whereas 24 respondents (13.9%) preferred to rely on their own clinical judgment and personal experience.

Therapeutic Education Practices

A large majority of 164 health care professionals (94.8%) reported regularly providing individual therapeutic education sessions lasting 20 to 30 minutes during consultations to their patients with diabetes therapeutic education to their patients with diabetes. Six participants (3.5%) acknowledged not offering therapeutic education, whereas 3 respondents (1.7%) considered therapeutic education not relevant in the management of patients with diabetes.

Recommendations Provided to Patients

Most respondents (167; 96.5%) recommended that their patients undergo an annual pre-Ramadan consultation to assess overall health and evaluate risks. Concerning blood glucose self-monitoring, 140 health care professionals (80.9%) encouraged daily testing during Ramadan, particularly during fasting hours, when glycemic imbalances are most likely, as well as after fasting to ensure stability, corresponding to at least five measurements per day (before and after the Suhoor meal, before and after the Iftar meal, and at bedtime). Furthermore, 96 health care professionals (55.5%) emphasized the importance of maintaining a structured meal plan consisting of Suhoor (predawn), Iftar (sunset), and an additional snack.

Clinical Circumstances Warranting Discontinuation of Fasting

There was a broad consensus among participants regarding the conditions requiring interruption of fasting. The majority of health care professionals (69.9%) recommended breaking the fast when blood glucose levels fall below 70 mg/dL (3.9 mmol/L) at any time during the day or exceed 300 mg/dL. Only a small number of participants recommended interrupting the fast solely in cases where blood glucose levels were >300 mg/dL, compared with those who advised against continuing the fast when glucose levels dropped below 70 mg/dL (►**Table 1**).

Table 1 Clinical circumstances warranting discontinuation of fasting

Blood glucose level	Frequency (%)
≤70 mg/dL[a] early in the fasting period	19 (11%)
≤70 mg/dL[a] later in the day	6 (3.5%)
≤70 mg/dL[a] any time during the day	11 (6.3%)
≥300 mg/dL[b]	16 (9.2%)
≤70 mg/dL[a] any time during the day or ≥300 mg/ dL[b]	121 (70%)

[a]Expressed in 3.9 mmol/L.
[b]Expressed in 16.7 mmol/L.

Dietary Intake of Dates

Among respondents, 103 health care professionals (59.5%) advised restricting date consumption to a single fruit. Sixty-eight (39.3%) allowed up to three dates, whereas only two (1.2%) considered up to five dates acceptable. None recommended breaking the fast with seven dates.

Knowledge of Suhoor Practices

Most participants (138; 79.8%) advised against skipping Suhoor in patients treated with sulfonylureas and/or insulin. Furthermore, 160 health care professionals (92.5%) recommended delaying Suhoor as close as possible to the start of fasting. Only one participant (0.6%) suggested an early Suhoor.

Therapeutic Adaptations in Well-Controlled Diabetes

Over 80% of participating physicians reported adjusting both the dosage and timing of sulfonylurea and insulin therapies. In contrast, changes to metformin or DPP-4 inhibitor regimens were relatively rare among respondents (►**Table 2**).

At the conclusion of this assessment of knowledge regarding diabetes management during Ramadan, the majority of endocrinologists answered correctly, in accordance with international guidelines, as did other health care professionals. The observed difference was statistically significant for recommendations provided to patients (pre-Ramadan consultation, blood glucose self-monitoring, and number of daily meals), as well as for situations warranting discontinuation of fasting (►**Table 3**).

Table 2 Therapeutic adaptations in well-controlled diabetes

Treatment	Frequency (%)
Metformin	24 (13.9%)
Sulfonylureas	155 (89.6%)
DPP-4 inhibitors	15 (7.5%)
Insulin	141 (81.5%)

Table 3 Comparison between endocrinologists and other health care professionals regarding knowledge of diabetes care during Ramadan

Knowledge items (correct answer)	Endocrinologists	Others HCPs	*p*
Adherence to international guidelines	32 (63.8)	67 (53.1)	0.21
Therapeutic education practice	46 (97.8)	118 (93.6)	0.46
Fast-breaking situations	41 (78.2)	80 (63.4)	0.03
Recommendations provided to patients	30 (63.8)	47 (37.3)	0.01
Knowledge of Suhoor practices	39 (82.9)	87 (69.0)	0.13
Dietary intake of dates	30 (63.8)	73 (57.9)	0.50
Therapeutic adaptation	37 (78.7)	85 (67.4)	0.56
Total (*N*)	47	128	173

Abbreviation: HCPs, health care professionals.

Self-reported Professional Practices

The Number of Patients with Type 2 diabetes is Likely to Fast

Among the 173 respondents, 119 health care professionals (68.8%) reported managing between 0 and 50 patients with type 2 diabetes who were likely to fast during Ramadan. Thirty-seven health care professionals (21.4%) cared for 50 to 100 such patients, 9 (5.2%) managed 100 to 150 patients, and 8 (4.6%) reported caring for more than 150 fasting patients (►**Fig. 1**).

Characteristics of the Most Recent Managed Case

Patient Profile

Women accounted for 59.5% (103/173) of the most recent patients, while men represented 40.5% (70/173). Type 2 diabetes predominated (157 patients; 90.8%), followed by type 1 diabetes (13; 7.5%) and gestational diabetes (3; 1.7%).

Regarding glycemic control, 81 patients (46.8%) had HbA1c between 6.5 and 7.5%, 31 (17.9%) between 7.5 and 8%, and 48 (27.7%) between 8 and 9%.

With respect to complications, 104 patients (60.1%) had concomitant hypertension, 16 (9.2%) had coronary artery disease, and 14 (8.3%) presented with other cardiovascular complications. Renal complications included nephropathy (microalbuminuria, proteinuria, or glomerular hyperfiltration with preserved glomerular filtration rate) in 29 patients (16.8%) and renal insufficiency (glomerular filtration rate < 60 mL/min/1.73 m^2, regardless of the stage) in 29 patients (16.8%) and renal insufficiency in 10 (5.8%). No renal complications were reported in 131 patients (75.7%) (►**Figs. 2**, **3**).

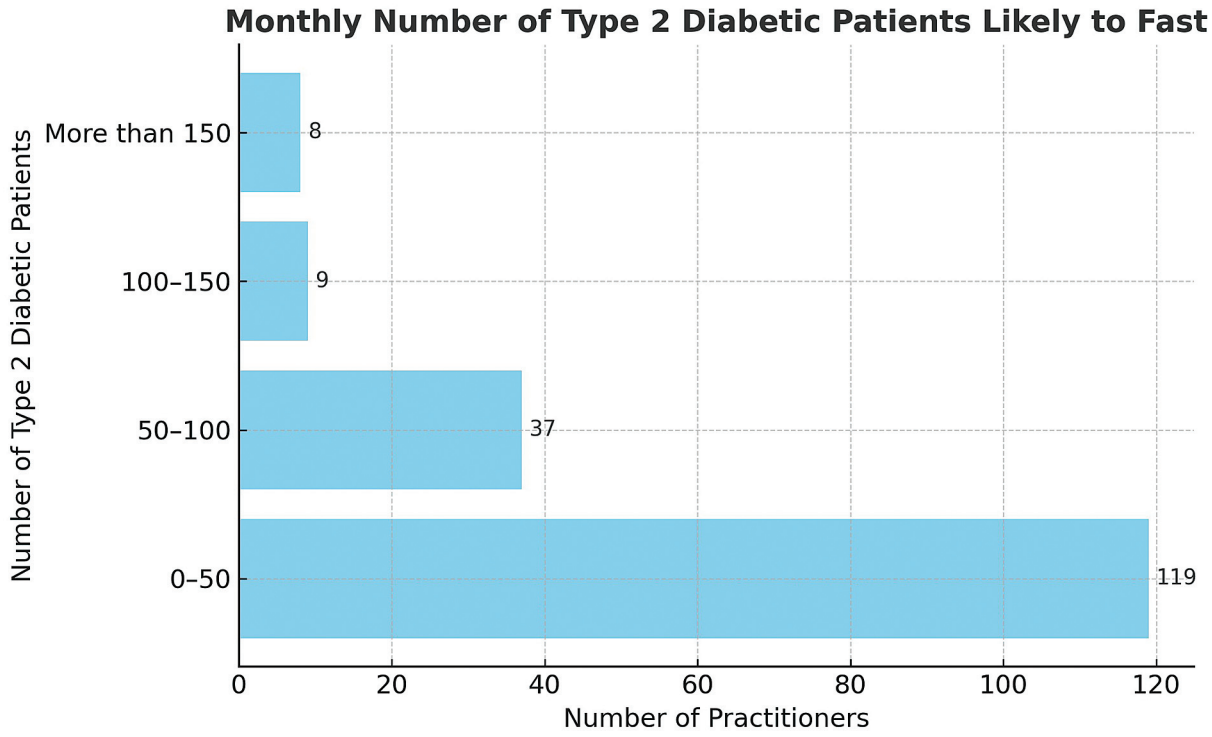

Fig. 1 The monthly number of type 2 patients with diabetes likely to fast.

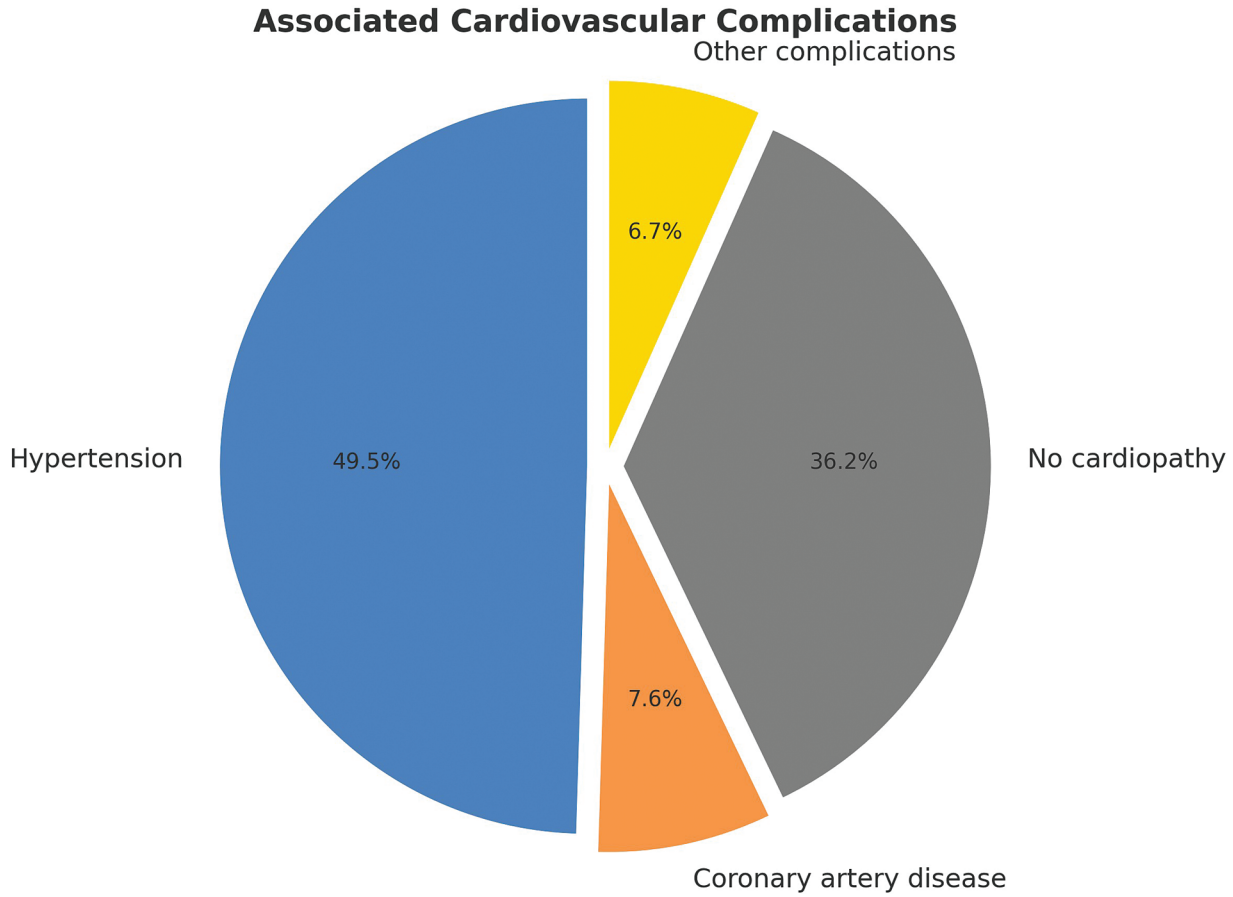

Fig. 2 Cardiovascular complications.

Regarding therapy, metformin was the most commonly prescribed treatment (149 patients; 86.1%), followed by sulfonylureas (68; 39.3%), insulin (47; 27.2%), SGLT2 inhibitors (26; 15.0%), and incretins (GLP-1 receptor agonists/IDPP4) (13; 7.5%).

Fasting Practice

In 2024, 109 patients (63%) observed fasting throughout Ramadan, whereas 49 (28.3%) did not fast. Fourteen (8.1%) fasted for fewer than 15 days, and only one patient (0.6%) reported fasting for more than 15 days.

In 2025, 56 patients (32.4%) were permitted to fast due to well-controlled diabetes, 85 (49.1%) were advised against fasting to avoid metabolic decompensation, and 32 (18.5%) were authorized to fast after individualized therapeutic adjustments were made.

Discussion

Among the 173 health care professionals surveyed, more than half were general practitioners, underscoring their pivotal role in Morocco's health care system, particularly in patient follow-up within resource-limited settings.[7] Endocrinologists and diabetologists accounted for only 27.2%, as their involvement is primarily focused on specialized care and advanced therapeutic education. Other professional categories represented less than 10% of participants, reflecting the gradual engagement of practitioners, especially younger ones, in diabetes management.

Regarding practice settings, the vast majority of respondents work in public institutions, including public hospitals and community health centers. Geographically, 93.6% of professionals were based in urban areas, compared with only 6.4% in rural zones, highlighting the persistent imbalance in health care resource distribution. This disparity emphasizes the need to strengthen primary care in rural areas through the implementation of health maps and territorial health groupings, a project currently underway by the Moroccan Ministry of Health. Alternative strategies, such as telemedicine, may also be proposed to address these gaps.[8,9]

Our findings indicate that general practitioners constitute the primary point of care in Morocco and are therefore more frequently confronted with patients who choose to fast during Ramadan. This observation highlights the critical need to strengthen their competencies in diabetes management and to promote multidisciplinary collaboration with specialists. Such collaboration is particularly essential during high-risk periods, including Ramadan, to ensure optimal patient outcomes and minimize complications associated with fasting.

Historically, the first specific recommendations for diabetes management during Ramadan were issued by the

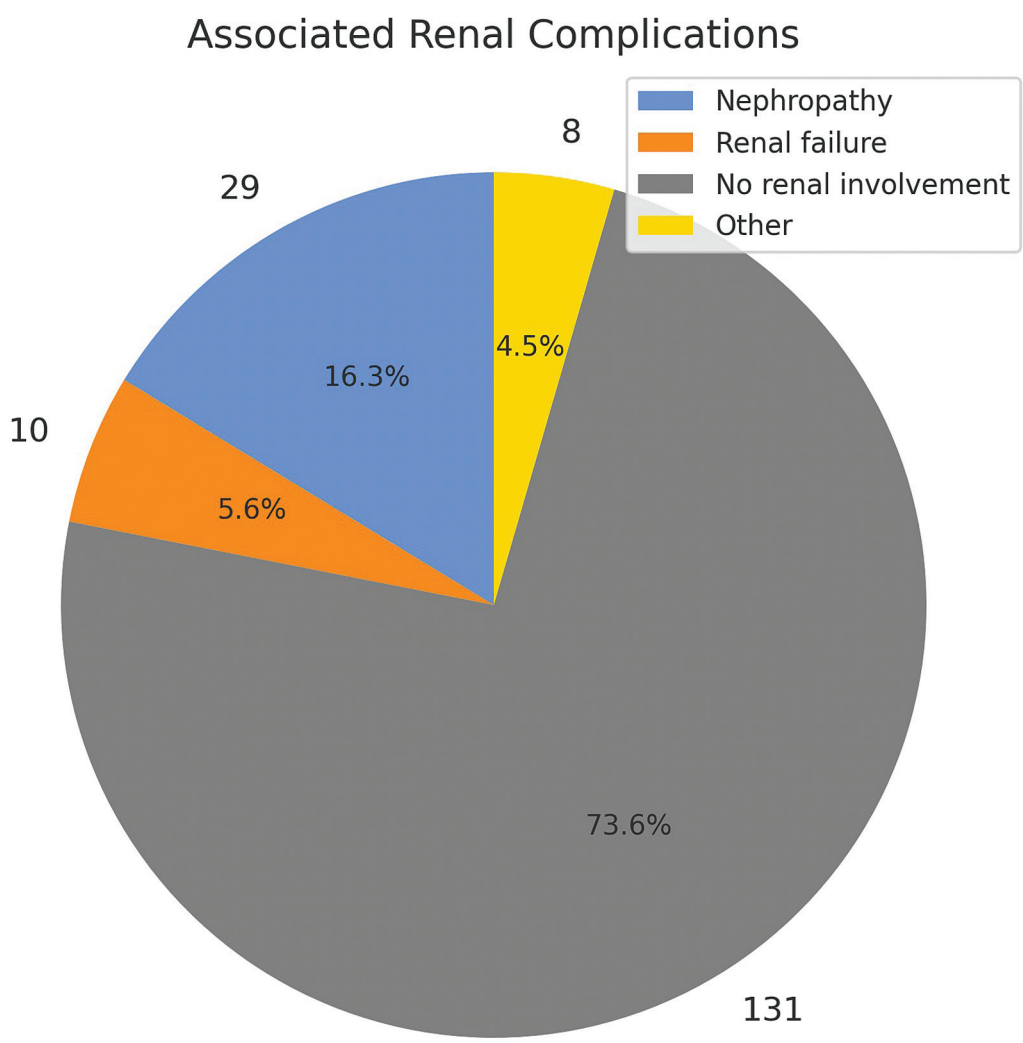

Fig. 3 Renal complications.

American Diabetes Association in 2005, partly informed by the EPIDIAR study conducted across Asia and the Middle East. Later, the CREED study[10] provided additional data on management strategies and outcomes in patients with type 2 diabetes who were fasting. The joint American Diabetes Association/European Association for the Study of Diabetes (ADA/EASD) recommendations also represented a milestone in the history of diabetes management during Ramadan.[11]

In our survey, more than half of the respondents (57.2%) reported primarily relying on international guidelines, reflecting a strong commitment to aligning clinical practice with globally recognized standards. However, nearly one-third (28.9%) favored locally developed recommendations[12] that take into account cultural, economic, and health care-specific factors, underscoring the importance of adapting guidelines to contextual realities. Finally, a noteworthy minority, representing 13.9% of participants, indicated that their decisions were based mainly on personal clinical judgment and experience. Our findings align with those reported by Zainudin and Yeoh,[13] and appear more favorable than those of Catic and colleagues in Bosnia in 2020, who noted that over 63% of participants relied predominantly on personal clinical experience, with only 18.5% adhering to the ADA/EASD guidelines for diabetes management during Ramadan. In contrast, Moroccan hospitals and polyclinics have implemented internal protocols and conducted regular training sessions to enhance adherence to evidence-based practice.

Therapeutic education emerged as a key component of practice.[14–16] Nearly 95% of respondents reported providing regular educational sessions to their patients, reflecting a strong commitment to patient empowerment. Evidence from international literature confirms that structured pre-Ramadan education helps patients adjust their lifestyle, reduce hypoglycemic episodes, prevent weight gain, and improve metabolic control. However, these beneficial effects tend to diminish over time, highlighting the importance of regularly scheduled sessions before Ramadan rather than relying solely on patients' previous knowledge.

A recent Saudi study among insulin-treated patients demonstrated that participation in a structured Ramadan-focused education program significantly improved metabolic outcomes and reduced complications compared with patients who did not receive such training.[17] This supports

the systematic integration of Ramadan-focused education into clinical practice. Nonetheless, a minority of physicians (3.5%) did not provide therapeutic education, and 1.7% considered it irrelevant. Although marginal, this finding highlights disparities in the perception and integration of patient education, which may be attributed to time constraints, inadequate training, or insufficient resources for structured programs.

Our study also showed that 96.5% of respondents recommended pre-Ramadan consultations, confirming their alignment with international recommendations. Such proactive assessment is crucial, particularly for high-risk groups such as elderly patients or those with multiple comorbidities.[18]

These observations are consistent with the broader perspective supported by international consensus statements, which systematically recommend pre-Ramadan assessment and tailored education. Both globally and locally, health care professionals have developed multidimensional approaches to prepare patients with diabetes for fasting. Numerous studies have confirmed that pre-Ramadan counseling significantly reduces the incidence of fasting- and diabetes-related complications in these patients.[13]

These findings underscore the need to enhance the organization of pre-Ramadan educational programs and to incorporate practical and repetitive modules into the ongoing education of health care professionals. Such measures would not only contribute to harmonizing medical practices but also significantly reduce the risk of severe complications and ensure greater safety for patients with diabetes during the fasting period.

With regard to glycemic monitoring, the majority of health care professionals advocated for daily self-monitoring of fasting blood glucose, particularly during critical periods—up to five times per day and in the presence of hypoglycemic symptoms. These findings are consistent with those of Ahmedani et al. in Pakistan[19] and Catic and Jusufovic in Bosnia,[20] where all respondents recommended strict monitoring practices. Nevertheless, some health care providers did not endorse this approach, citing either time constraints or concerns about patients' willingness to comply. Patient adherence may be further limited by financial or cultural barriers, as misconceptions persist—such as the belief that capillary blood glucose testing breaks the fast. Awareness campaigns led by religious leaders and media outlets, similar to those implemented in Singapore, have proven effective in enhancing the acceptability of diabetes self-management during Ramadan.[8]

Despite the identified gaps, Morocco remains one of the North African countries where self-monitoring of blood glucose is more frequently performed compared with other Muslim-majority countries, according to the conclusions of the DaR study.[21]

Nutritional education was another central element. In our survey, 55.5% of physicians recommended structuring meals into three intakes: Suhoor, Iftar, and a snack. This organization helps reduce glycemic variability and the risk of hypoglycemia and hyperglycemia. The IDF-DaR Practical Guidelines propose a similar Ramadan Nutrition Plan, with an adjusted caloric distribution to prevent metabolic imbalance.[22] This is particularly important since studies such as Alsunni et al. in Saudi Arabia[17] revealed that 19% of patients skip Suhoor and 52% do not consume a regular dinner, increasing the risk of glycemic instability.

Despite strong involvement, physicians still reported difficulties managing glycemic control in fasting patients. Ali et al[18] reported similar challenges, with over 50% of professionals facing difficulties. Furthermore, only a minority systematically addressed nutritional aspects (25%) or medical risks associated with fasting (22.7%), highlighting the need for additional training and practical tools adapted to the cultural and religious context.

Our study also found that most physicians agreed on the criteria for interrupting fasting: 93.1% considered hypoglycemia below 70 mg/dL and 86.7% considered hyperglycemia above 300 mg/dL as clear indications for breaking the fast. These rates are higher than those reported in previous studies, suggesting that targeted training on Ramadan-specific diabetes management is effective in improving outcomes.

Regarding traditional practices, 59.5% of physicians recommended limiting date consumption to one, and 39.3% allowed up to three dates, reflecting preventive approaches consistent with individualized dietary counseling. Similarly, 92.5% recommended delaying Suhoor to minimize the risks of prolonged fasting and maintain better metabolic stability.

Therapeutic adaptation was also widely practiced, with 89.6% of patients adjusting sulfonylureas and 81.5% adjusting insulin regimens, consistent with international recommendations. However, 13.9% still adjusted metformin monotherapy unnecessarily, indicating persistent gaps between theoretical knowledge and clinical application.

Finally, methodological limitations must be acknowledged. First, reliance on self-reported data from health care professionals introduces potential biases, such as recall bias and social desirability bias. These factors may lead to an overestimation of adherence to guidelines or an underreporting of challenges encountered in clinical practice. Incorporating multiple data sources, such as structured observations or electronic health records, would have strengthened internal validity. Second, the sample's representativeness is limited. The predominance of urban general practitioners restricts the generalizability of the results to rural settings, where access to care, resource availability, and cultural practices may significantly influence diabetes management during Ramadan. Third, the absence of longitudinal patient follow-up represents a major gap. Without post-Ramadan data on glycemic control, acute complications, and hospitalization rates, it is impossible to assess the long-term impact of the strategies implemented. A prospective design incorporating clinical and behavioral indicators would have provided a more comprehensive understanding of outcomes and risk factors.

These limitations highlight opportunities for more rigorous research and organizational improvements:

Future Studies

- Longitudinal and Multicenter Designs: Future research should include patient cohorts monitored before, during, and after Ramadan to assess short- and long-term effects on glycemic parameters, acute complications (hypoglycemia, hyperglycemia), and quality of life.
- Mixed-Methods Approach: Combining quantitative data (biological measures, medical records) with qualitative insights (interviews with patients and health care providers) would provide a comprehensive understanding of practice determinants.
- Geographic and Disciplinary Diversity: Including rural areas and professionals from various specialties—such as endocrinology, nutrition, and pharmacy—will ensure findings are representative of national practices.

Practical Recommendations

- National Standardized Protocol: Develop guidelines based on international recommendations (IDF-DaR, ADA) tailored to the Moroccan context. This protocol should define risk stratification criteria, therapeutic adjustments, and nutritional counseling.
- Continuous Professional Education: Implement targeted training programs for health care providers, including practical workshops and online modules, to harmonize clinical practices.
- Patient Education: Launch pre-Ramadan awareness campaigns using accessible educational tools (brochures, videos, mobile applications) to empower patients in self-management.
- Digital Innovation: Leverage telemedicine and glucose-monitoring applications to enhance continuity of care, particularly in underserved rural areas.

These initiatives could reduce fasting-related complications, improve patient autonomy, and optimize coordination among health care stakeholders. Ultimately, they would contribute to better quality of care and lower costs associated with preventable hospitalizations.

Conclusion

This study highlights the strong commitment of Moroccan health care professionals to supporting patients with diabetes who choose to fast during Ramadan. While most respondents demonstrated awareness of international recommendations and integrated therapeutic education into their practice, a considerable proportion continued to rely on personal clinical judgment rather than standardized guidelines. This reliance may contribute to variability in care and expose patients to preventable risks.

The results highlight the pivotal role of general practitioners in managing type 2 diabetes, particularly in primary care settings, where they are often the initial point of contact for patients. Strengthening their training in Ramadan-specific diabetes management, while fostering multidisciplinary collaboration with specialists, is essential to ensure safe and effective care.

To move toward harmonized and evidence-based practice, it is necessary to develop and disseminate a national protocol adapted to the Moroccan context, supported by continuous professional development, structured educational programs, and pre-Ramadan counseling strategies. These initiatives would help bridge the gap between theoretical knowledge and clinical practice, reduce complications, and optimize therapeutic outcomes.

Ultimately, such measures will contribute to improving the quality of care for people living with diabetes in Morocco, ensuring safer fasting practices during this month of profound spiritual significance.

Authors' Contributions

Z.H.: drafting of the study protocol, data collection and manuscript writing. H.I.: formulation of the research question, development of the study protocol, and critical revision of the manuscript. R.B. data collection and contribution to manuscript drafting. K.R.: critical revision of the manuscript. G.S. and F.T.: contributed to the review of the manuscript. M.E.G.: authorized the study and approved the final version of the manuscript for publication. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Conflict of Interest

None declared.

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