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Sleep Disturbances in Patients with Diabetes During Ramadan: Metabolic and Circadian Interactions

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Abstract **Original Research Article**

Ramadan fasting represents a distinctive model of daytime intermittent fasting that involves substantial lifestyle changes, including modifications in meal timing, sleep patterns, and circadian rhythms. For individuals with diabetes mellitus, these behavioral shifts may interact with metabolic regulation and potentially affect glycemic stability. Sleep plays a key role in glucose homeostasis, and disturbances in sleep duration or architecture have been associated with reduced insulin sensitivity and increased glycemic variability. This narrative review aims to synthesize current evidence on sleep alterations during Ramadan and to explore their metabolic implications in patients with diabetes. A structured literature search was conducted in PubMed/MEDLINE, Scopus, and Google Scholar, complemented by manual screening of relevant references and international guidelines such as the IDF–DAR recommendations. Studies examining sleep patterns, circadian rhythm changes, and glycemic outcomes during Ramadan fasting were analyzed narratively. Available evidence suggests that Ramadan fasting is commonly associated with delayed sleep timing and reduced total sleep duration, sometimes accompanied by alterations in sleep architecture. While these changes appear relatively well tolerated in healthy individuals, patients with diabetes may be more vulnerable to adverse effects. Sleep restriction, nocturnal hypoglycemia, glycemic variability, and comorbid sleep disorders such as obstructive sleep apnea may contribute to sleep fragmentation and metabolic instability. These findings highlight the importance of integrating sleep evaluation into diabetes management during Ramadan, alongside glycemic monitoring, individualized therapeutic adjustments, and culturally adapted patient education.

Keywords: amadan fasting; Sleep disturbances; Circadian rhythm; Glycemic variability; Hypoglycemia; Sleep restriction.

INTRODUCTION

Type 2 diabetes mellitus is a common chronic metabolic disease characterized by insulin resistance and a relative deficiency of insulin, leading to persistent hyperglycemia. Maintaining good glycemic control relies on appropriate lifestyle measures, including a balanced diet, regular meal timing, and continuous monitoring of blood glucose levels.

Ramadan fasting represents a particular model of daytime intermittent fasting, characterized by complete abstinence from food and beverages from dawn until sunset. This practice induces substantial changes in dietary habits and biological rhythms, which may lead to significant glycemic fluctuations. Despite the religious exemptions granted to individuals with chronic illnesses, a substantial proportion of patients with diabetes choose to fast every year. Globally, millions of individuals with type 1 and type 2 diabetes observe Ramadan, making the metabolic and physiological consequences of fasting an important public health concern.

Ramadan is also accompanied by notable lifestyle modifications, including delayed sleep onset, increased nighttime social activities, late evening meals (*iftar*), an early pre-dawn meal (*suhoor*), and adjustments in work schedules. These changes may disrupt circadian rhythms and reduce total sleep duration. Adequate sleep plays a crucial role in the regulation of glucose metabolism. Sleep restriction or fragmentation has been associated with reduced insulin sensitivity, increased glycemic variability, and a higher risk of hypo- or hyperglycemia.

While studies conducted in healthy individuals suggest that Ramadan fasting mainly induces circadian phase shifts without significantly increasing daytime sleepiness, patients with diabetes represent a metabolically vulnerable population in whom these disturbances may have amplified consequences. However, the interaction between Ramadan-induced sleep alterations and glycemic instability in patients with diabetes remains insufficiently synthesized in the literature.

This narrative review aims to synthesize current scientific evidence regarding sleep alterations during Ramadan and to analyze their metabolic implications in patients with diabetes. It seeks to explore the pathophysiological mechanisms linking circadian disruption, sleep restriction, hypoglycemia, and glycemic variability in order to better understand their impact on metabolic stability. The review also aims to propose a clinical framework integrating sleep assessment into the management of patients with diabetes who wish to fast, within a preventive and culturally adapted care perspective.

METHODS

Study Design

This manuscript was designed as a narrative review aimed at synthesizing current evidence regarding sleep changes during Ramadan and their metabolic and clinical implications in patients with diabetes mellitus. The objective was to provide a mechanistic and clinically oriented analysis integrating sleep physiology, circadian biology, and diabetes management during Ramadan fasting.

Search Strategy

A structured literature search was conducted in the electronic databases PubMed/MEDLINE, Scopus, and Google Scholar. Additional references were identified through manual screening of the bibliographies of relevant articles and international recommendations (for example, the IDF-DAR practical guidelines).

This review was designed as a narrative review to provide a broad clinical and public health synthesis rather than to conduct a formal systematic review or meta-analysis.

The search included combinations of Medical Subject Headings (MeSH) and free-text keywords related to Ramadan fasting, sleep, and diabetes, including:
“Ramadan” OR “Ramadan fasting” OR “daytime intermittent fasting” AND “sleep” OR “sleep disorders” OR “sleep deprivation” OR “sleepiness” OR “rapid eye movement sleep (REM)” OR “circadian rhythm”AND “diabetes” OR “type 1 diabetes” OR “type 2 diabetes” OR “hypoglycemia” OR “glycemic variability” OR “continuous glucose monitoring” AND“risk stratification” OR “IDF-DAR” OR “fasting management” OR “obstructive sleep apnea”.

An example of a PubMed query was:
(“Ramadan” [Title/Abstract] AND “sleep” [Title/Abstract]) AND (“diabetes” [Title/Abstract] OR “hypoglycemia” [Title/Abstract])

Eligibility Criteria

Publications were considered eligible if they:

- addressed sleep habits, circadian rhythm alterations, or sleep architecture during Ramadan;
- evaluated metabolic consequences or glycemic control in patients with diabetes during Ramadan;
- included objective sleep assessment methods (e.g., actigraphy, validated sleep scales, polysomnography) or data derived from continuous glucose monitoring;
- were published in English.

We included original research articles, clinical studies, validation studies of risk stratification tools (e.g., IDF-DAR), systematic reviews, narrative reviews, and international clinical recommendations. Case reports and studies unrelated to Ramadan fasting or not addressing diabetes or sleep parameters were excluded.

Although a structured search and selection process was applied, this work was conducted as a narrative review; therefore, no formal risk-of-bias assessment or quantitative quality scoring system was used.

Study Selection

Titles and abstracts were screened for relevance. Full texts were reviewed when necessary. Studies meeting the eligibility criteria were retained for narrative synthesis. International guidelines and public health reports were also included to contextualize clinical recommendations and culturally adapted care approaches.

Data Extraction and Synthesis

Data were extracted according to a standardized framework including:

- study population (healthy subjects vs. patients with diabetes);
- type of diabetes (type 1 vs. type 2);
- sleep parameters (total sleep duration, REM sleep, sleep fragmentation, daytime sleepiness);
- circadian markers;
- glycemic parameters (hypoglycemia, hyperglycemia, glycemic variability);
- use of continuous glucose monitoring;
- presence of associated sleep disorders (e.g., obstructive sleep apnea);
- risk stratification tools and fasting management strategies.

The extracted data were then synthesized narratively and organized into key thematic domains:

1. Sleep and circadian rhythm changes associated with Ramadan in healthy individuals
2. Metabolic vulnerability of patients with diabetes during fasting
3. Hypoglycemia and nocturnal sleep disturbances
4. Glycemic variability and bidirectional sleep–glucose interactions
5. Clinical implications and risk stratification during Ramadan.

Given the heterogeneity of study designs, populations, sleep assessment tools, and metabolic outcomes, no meta-analysis was performed.

RESULTS

Objective sleep assessments in healthy fasting individuals demonstrate a consistent delay in bedtime and wake time during Ramadan, accompanied by a significant reduction in total sleep duration (3). Despite this reduction, studies using objective measures such as the John Drowsiness Scale and reaction time testing have not shown a significant increase in daytime sleepiness in healthy subjects (3). Similarly, when lifestyle factors such as light exposure and sleep duration are controlled, no significant alterations in biological circadian markers are observed (4). However, reductions in rapid eye movement (REM) sleep have been reported (4), a finding of potential metabolic relevance given the role of sleep architecture in glucose regulation.

In contrast, diabetic patients fasting during Ramadan are exposed to additional metabolic stressors. Risk stratification studies validating the IDF-DAR tool demonstrate that a substantial proportion of patients fall into moderate- to high-risk categories, with hypoglycemia being the leading cause of fasting interruption (5). The probability of adverse events increases significantly among high-risk individuals, particularly those with type 1 diabetes, prior hypoglycemic episodes, renal impairment, or negative prior Ramadan experiences (5). Comprehensive clinical reviews further highlight glycemic variability, dehydration, and medication adjustments as central challenges during Ramadan (2). Although direct objective sleep data in diabetic Ramadan cohorts remain limited, the convergence of sleep restriction, nocturnal glycemic fluctuations, and comorbid conditions such as obstructive sleep apnea suggests a heightened risk of sleep fragmentation and functional impairment compared with healthy fasting individuals.

DISCUSSION

The present synthesis highlights that while Ramadan fasting in healthy individuals induces circadian shifts and reduced total sleep time without clear objective increases in daytime sleepiness (3,4), the extrapolation of these findings to patients with diabetes requires caution. Diabetes mellitus is characterized by altered glucose homeostasis, impaired counterregulatory responses, autonomic dysfunction, and frequently coexisting sleep disorders. The metabolic vulnerability of this population may transform what is a benign behavioral circadian shift in healthy individuals into a clinically significant disturbance in patients with diabetes.

Experimental sleep restriction studies have demonstrated that even short-term sleep deprivation reduces insulin sensitivity and impairs glucose tolerance (7,8). Decreased slow-wave sleep is associated with reduced insulin sensitivity and increased sympathetic activity (9). Moreover, REM sleep alterations have been linked to dysregulated glucose metabolism and autonomic imbalance (10). Ramadan-associated reductions in REM sleep proportion (4) may therefore have metabolic implications in diabetic individuals, particularly those already experiencing insulin resistance.

Hypoglycemia represents a central mechanism linking Ramadan fasting to sleep disruption in diabetic patients. The EPIDIAR study demonstrated a significant increase in severe hypoglycemia during Ramadan in patients with type 1 and type 2 diabetes (11). Subsequent observational data confirmed that hypoglycemia remains one of the most frequent complications during fasting (12,13). Hypoglycemic episodes trigger catecholamine release, sympathetic activation, and cortical arousal, leading to micro-awakenings and sleep fragmentation (14). Recurrent nocturnal hypoglycemia may therefore reduce restorative sleep and exacerbate daytime fatigue. Additionally, the fear of hypoglycemia may itself disrupt sleep continuity through anticipatory awakenings for glucose monitoring.

Glycemic variability further contributes to sleep instability. Emerging evidence suggests bidirectional interactions between nocturnal glucose fluctuations and sleep architecture (15,16). Continuous glucose monitoring studies have demonstrated that glucose excursions can precede sleep fragmentation, while sleep restriction increases glycemic variability (17). During Ramadan, prolonged fasting intervals, altered medication timing, and post-iftar glycemic spikes may intensify this instability.

Obstructive sleep apnea (OSA) is highly prevalent among individuals with type 2 diabetes, with reported prevalence rates exceeding 50% in some cohorts (18,19). OSA is independently associated with insulin resistance, systemic inflammation, and cardiovascular risk (20). Ramadan-related sleep restriction superimposed on untreated OSA may significantly increase daytime somnolence and cardiometabolic burden. Despite this, OSA screening is rarely included in pre-Ramadan assessments, representing a missed opportunity for risk mitigation.

Risk stratification tools such as the IDF-DAR calculator provide structured pre-Ramadan assessment of metabolic risk (5,21). However, current algorithms primarily focus on glycemic history, medication use, renal function, and previous fasting experiences. Sleep quality, sleep duration, and presence of sleep disorders are not systematically integrated into these tools. Given the physiological interaction between sleep and glucose regulation, incorporating sleep assessment—such as validated sleep questionnaires or OSA screening—could enhance risk prediction accuracy.

From a public health perspective, Ramadan represents a unique window for structured health engagement. The EPIDIAR study estimated that approximately 79% of patients with type 2 diabetes fast for at least 15 days during Ramadan (11). This high participation rate underscores the need for culturally sensitive interventions. Healthcare professionals may underestimate the strength of religious motivation influencing patient decision-making (2). Community-based, religio-culturally conscious care models have demonstrated promise in addressing sleep health disparities (6). Integrating mosque-based education, collaboration with religious leaders, and targeted Ramadan workshops could improve awareness of hypoglycemia recognition, sleep hygiene, and safe fasting practices.

Practical medical and hygieno-dietary recommendations are essential. For diabetic patients intending to fast, pre-Ramadan consultation should include individualized medication adjustment, particularly for insulin and sulfonylureas, to reduce nocturnal hypoglycemia risk (2,22). The use of continuous glucose monitoring is strongly encouraged in high-risk individuals (23). Patients should be advised to maintain adequate total sleep duration by scheduling consistent sleep periods, minimizing late-night social activities, and incorporating short daytime naps when appropriate.

Nutritional counseling plays a critical role. The suhoor meal should include low-glycemic index carbohydrates, adequate protein, and healthy fats to reduce rapid glucose excursions (24). Excessive intake of refined carbohydrates during iftar may provoke postprandial hyperglycemia and reactive hypoglycemia later in the night. Adequate hydration during non-fasting hours is crucial to prevent dehydration-related fatigue. Caffeine consumption in the late evening should be minimized to protect sleep continuity.

Light exposure management also deserves attention. Evening exposure to intense artificial light may delay circadian phase and suppress melatonin secretion (25). Encouraging reduced screen exposure before bedtime may improve sleep quality during Ramadan. **[Table1]**

In summary, while Ramadan fasting alone does not appear to induce pathological sleepiness in healthy individuals, diabetic patients constitute a distinct clinical population in whom circadian disruption, hypoglycemia, glycemic variability, OSA, and behavioral sleep restriction may converge to produce clinically significant sleep disturbances. Integrating sleep evaluation into diabetes care during Ramadan represents an opportunity to enhance both metabolic safety and functional well-being.

Table 1: Mechanisms linking Ramadan fasting to sleep disturbances in patients with diabetes.
(Conceptual synthesis adapted from references 2–5, 7–11, 18, 21.)

Domain	Mechanism	Sleep Consequence	Metabolic Consequence	Clinical Implication
Circadian shift	Delayed bedtime and wake time	Reduced total sleep time	Altered cortisol rhythm	Fatigue, impaired glycemic control
REM reduction	Ramadan-associated sleep architecture change	Reduced restorative sleep	Autonomic imbalance	Increased insulin resistance
Nocturnal hypoglycemia	Counterregulatory hormone activation	Micro-arousals, sleep fragmentation	Glycemic instability	Daytime somnolence
Post-iftar hyperglycemia	Rapid glucose excursions	Sleep instability	Oxidative stress	Poor HbA1c control
Medication adjustment	Insulin/sulfonylurea timing changes	Night awakenings for monitoring	Hypoglycemia risk	Interrupted sleep
Dehydration	Fluid restriction	Fatigue, poor sleep quality	Hemoconcentration	Functional impairment
Behavioral factors	Late social activities, screen exposure	Circadian delay	Hormonal dysregulation	Reduced daytime alertness

CONCLUSION

Ramadan fasting represents a complex behavioral and metabolic intervention. In patients with diabetes, the interaction between sleep restriction, circadian misalignment, nocturnal hypoglycemia, and glycemic variability may increase vulnerability to sleep disturbances and daytime functional impairment. Medical management during Ramadan should therefore extend beyond glycemic control to include structured assessment of sleep quality, screening for obstructive sleep apnea, culturally sensitive education, and appropriate hygieno-dietary guidance.

Importantly, current risk stratification tools such as the IDF-DAR score primarily focus on metabolic and clinical parameters but do not systematically incorporate sleep-related factors. Given the growing evidence linking sleep disturbances with glycemic instability and metabolic risk, integrating sleep parameters—such as sleep duration, sleep quality, and the presence of sleep disorders—into pre-Ramadan risk assessment frameworks could improve the accuracy of patient stratification and enhance clinical decision-making regarding the safety of fasting.

Future prospective studies combining objective sleep monitoring and continuous glucose assessment are needed to better characterize the bidirectional relationship between sleep architecture and metabolic stability during Ramadan and to support the development of more comprehensive and culturally adapted risk assessment tools for patients with diabetes who wish to fast.

11. DECLARATIONS

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Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

This narrative review did not involve human participants, animal experimentation, or the collection of personal data. Therefore, ethical approval was not required. The work was conducted in accordance with the principles of the Declaration of Helsinki.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this manuscript, the authors used generative AI–assisted tools to support language editing, clarity, and organization of the text. All AI-assisted content was carefully reviewed, verified, and edited by the authors. The authors take full responsibility for the accuracy, integrity, originality, and scientific content of the manuscript

Author contributions

- Conceptualization: N.B.
- Literature search and synthesis: N.B., M.E.K., C.B., F.E.…
- Writing—original draft: N.B.
- Writing—review and editing: all authors
- Final approval: all authors

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