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Commentary

Religion, Culturally Structured Daily Routines, and Circadian Research Methodology: Considerations for Public Health

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Abstract
Circadian rhythm research is essential for understanding how daily biological processes influence health and disease. However, studying these rhythms in Muslim societies presents methodological challenges that are not fully addressed by existing circadian research tools and protocols. Daily religious practices, including the timing of five daily prayers and the fasting period during Ramadan, structure sleep and eating patterns in ways that may differ from the relatively fixed routines assumed in many circadian questionnaires and laboratory paradigms. These culturally structured behaviors can influence biological timing, yet they are often not captured in standard assessment instruments.
In addition, certain experimental designs that require strict control of light exposure, altered sleep schedules, or limited awareness of external time may present practical or ethical constraints in settings where religious practices follow defined temporal patterns. Current tools used to assess chronotype, social jetlag, and eating timing rarely incorporate variables related to religiously anchored behaviors, which may limit the interpretability of circadian data in these contexts. Although this commentary focuses on Muslim societies, similar considerations may arise in other religious and cultural environments where daily routines follow structured temporal practices. Developing and validating circadian assessment tools that account for culturally structured behaviors may improve measurement precision, strengthen ecological validity, and support more inclusive applications of circadian science and precision sleep medicine.
Keywords: Circadian rhythms, Religion, Muslim, Sleep, Methodology

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Introduction

The human circadian rhythm is a core biological system that regulates a wide range of physiological and behavioral processes. The sleep wake cycle coordinates metabolic activity and the production of key hormones that support daily functioning (1). Disruptions in circadian timing can lead to substantial health consequences, highlighting the importance of understanding these rhythms and their role in individual and population health (2). Disturbances such as irregular sleep patterns and circadian misalignment are linked to chronic conditions, including obesity (3), diabetes (4), and cardiovascular disease (5). Because of these associations, advancing research on circadian rhythms is essential for improving public health, guiding preventive strategies, and informing the development of precision based medical approaches.

The pivotal role of circadian rhythms in occupations that demand sustained alertness and optimal cognitive performance, including healthcare, aviation, and emergency services, is increasingly recognized (6). Shift workers in these fields frequently face daily challenges stemming from irregular work schedules and recurrent circadian disruption. Research on circadian rhythms provides opportunities to develop strategies that reduce the adverse effects of shift work and social jetlag, thereby enhancing performance, safety, and long term productivity (7). Social jetlag refers to the discrepancy between an individual's biological sleep timing and the sleep schedule imposed by social obligations, typically reflected in differences between workdays and free days

(8). In religiously observant populations, regularly timed practices such as early morning prayer may also influence daily sleep schedules and therefore interact with the interpretation of social jetlag.

A deeper understanding of circadian mechanisms supports workers in critical occupations as they strive to maintain optimal alertness decision making capacity(9) and job satisfaction (10). These insights also highlight the value of integrating circadian based principles into workplace policies, which aligns with emerging approaches in precision sleep medicine aimed at tailoring interventions to individual physiological and occupational demands.

Research on circadian rhythms plays a critical role in the field of mental health because accumulating evidence shows strong associations between circadian disruptions and conditions such as mood disorders (11), suicide risk (12), and substance use disorders (13). A more refined understanding of these relationships can provide insights into the underlying neurobiological mechanisms and may support the development of targeted therapeutic approaches. Advancing research in this area also highlights the importance of identifying individual differences in circadian vulnerability, which is increasingly relevant for precision-based strategies in sleep and mental health care (14). By addressing circadian disruptions more effectively, we may improve mental health outcomes and support the development of interventions that are more tailored and clinically meaningful (15).

One of the most promising applications of circadian rhythm research lies in the field of personalized and precision-based medicine. Aligning medical treatments and medication regimens with an individual's circadian timing can enhance therapeutic effectiveness and reduce unwanted side effects, offering a more patient centered approach to clinical care (16). This emerging perspective highlights the potential for circadian principles to guide individualized treatment strategies across diverse medical conditions. By synchronizing interventions with a patient's internal biological clock, healthcare strategies can become more efficient, more responsive, and better adapted to individual physiological needs (17). Within this context, the present perspective aims to highlight the cultural and religious determinants that shape circadian rhythms in Muslim societies and to emphasize why these factors should be integrated into future developments in precision sleep medicine. Although this commentary draws illustrative examples from Muslim societies, the broader methodological considerations discussed here are applicable to diverse religious and culturally structured temporal contexts. Importantly, the aim of this article is not to reject established circadian research protocols, but to emphasize their thoughtful adaptation, calibration, and context-sensitive validation in culturally structured environments.

Challenges of Circadian Rhythms Research in Muslim Societies

Cultural–Religious Time Anchors and Daily Rhythms

Daily life in many Muslim communities is structured around recurrent religious practices that occur at specific times across the 24-hour cycle (18). These practices shape sleep, activity, and eating patterns in ways that are not fully captured by existing circadian assessment tools. As illustrated in Figure 1, the fixed schedule of daily prayers and the distinctive changes in meal timing during Ramadan represent culturally anchored temporal cues that influence how individuals organize their day and night. Understanding these culturally specific time anchors is essential for accurately characterizing circadian rhythms in Muslim societies and for advancing precision sleep medicine in these populations (19).

Daily Prayer Times as Fixed Zeitgeber Like Social Cues

Islamic practice requires performing five daily prayers at defined intervals throughout the day: dawn, midday, afternoon, sunset, and night. These prayer times function as stable social time cues that structure the 24-hour cycle regardless of work schedules, weekends, or seasonal changes. For individuals who adhere to this routine, the temporal regularity of prayer can influence sleep timing, daytime alertness, and the interpretation of concepts

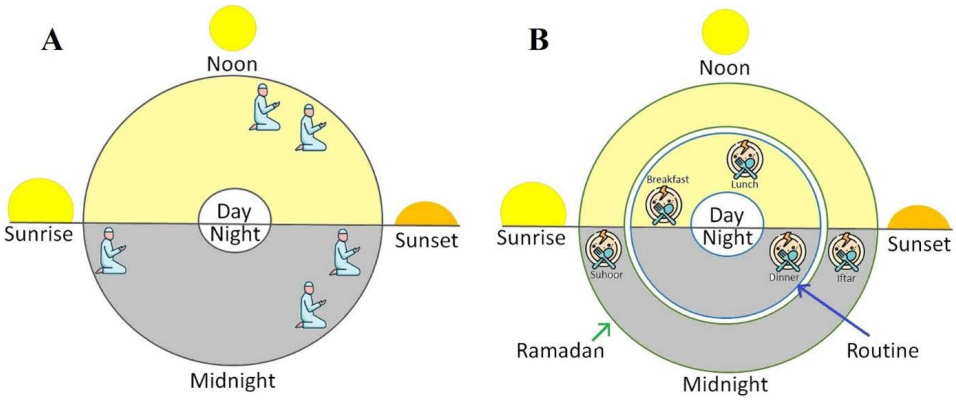

Figure 1. Cultural representation of daily religious practices in Muslim societies. (A) Daily obligatory prayers performed at five specific times across the 24-hour day (morning, noon, afternoon, sunset, and night). These time points are integral elements of daily life for many Muslims and create a culturally structured daily routine that may differ from conventional schedules assumed in standard circadian research tools. (B) Comparison of typical meal times during regular months and during Ramadan. The inner circle illustrates a common eating routine with meals distributed across daytime hours. The outer circle depicts the Ramadan pattern, in which food intake occurs only before sunrise and after sunset

such as social jetlag (20). Existing questionnaires and chronotype measures rarely incorporate these culturally specific anchors, which may limit their validity when applied to Muslim populations. For instance, consider an individual who wakes up for dawn prayer (Fajr) and subsequently returns to sleep. In standard chronotype questionnaires, this early interruption is often mistakenly recorded as the final wake time. Such systemic misclassification leads to biased estimates of sleep duration and timing, ultimately mischaracterizing an individual's true chronotype. Therefore, future circadian tools must be adapted to include items that distinguish between final awakening and transient awakenings triggered by culturally structured temporal practices.

Ramadan as a Month-long Shift in Eating and Activity Pattern

Ramadan introduces a predictable but profound shift in daily rhythms by altering both eating and sleep schedules for approximately one month each year (21). Fasting from dawn to sunset delays food intake to two main meals, one before sunrise and one after sunset, producing a distinct nocturnal pattern of eating (21). Many individuals also engage in nighttime prayers and extended wakefulness, which can temporarily alter sleep duration and timing, as well as daytime alertness (22). Meta-analyses and recent clinical studies show that Ramadan fasting can increase total sleep time, alter subjective sleepiness, and modify metabolic and circadian parameters (23). These changes resemble circadian adaptations observed in specific populations, such as athletes or during societal disruptions. Recognizing Ramadan as a culturally driven model of circadian phase shifting is important for designing accurate assessments of eating patterns, sleep-wake timing, and circadian alignment in Muslim societies (24).

Methodological, Ethical, and Feasibility Constraints in Time-Restricted Protocols

Laboratory-based circadian protocols, such as constant routine and forced desynchrony, aim to isolate endogenous rhythms by minimizing external time cues and imposing controlled sleep and meal schedules (25). Although these methods are central to circadian research, their feasibility in Muslim societies is constrained by cultural and religious practices that require awareness of time throughout the day. Performing daily prayers depends on recognizing solar-based intervals, which makes protocols that restrict exposure to daylight or external time difficult to implement. In addition, Ramadan introduces substantial shifts in sleep and eating patterns because individuals abstain from food and drink from dawn to sunset and consume meals only before sunrise and after sunset. This nocturnal eating schedule and the extended night activities challenge the regularity that classic laboratory protocols require. Together, these religiously anchored patterns influence recruitment, adherence, and retention, and raise ethical concerns about altering or masking practices central to daily life. These factors limit the applicability of standard circadian protocols and underscore the need for culturally sensitive methodological adaptations that maintain scientific rigor while respecting religious obligations.

Need for Culturally Adapted Research Tools

Widely used scales and protocols in circadian rhythm research, including the Munich Chronotype Questionnaire and fixed routine laboratory methods, have contributed substantially to our understanding of sleep and circadian biology (26). However, these instruments were developed for populations whose daily routines generally follow stable patterns and do not incorporate religiously structured behaviors. As a result, their applicability in Muslim societies, where five daily prayers, Ramadan fasting, and seasonal shifts in meal timing play central roles in shaping daily life, is limited. Current chronotype questionnaires focus primarily on sleep while giving less attention to biological, psychological, environmental, and social dimensions that interact with cultural and religious practices. These omissions can reduce the accuracy of chronotype classification and make it difficult to interpret concepts such as social jetlag and eating jetlag in populations whose daily timing cues differ from those assumed by conventional tools. Eating jetlag refers to the discrepancy in the timing of food intake between workdays and free days, representing a misalignment between an individual's dietary rhythms and their biological circadian system (27). In contexts such as Ramadan fasting, where meal timing shifts toward evening and nighttime hours, these patterns may substantially modify eating rhythms and complicate the interpretation of eating jetlag.

Existing questionnaires also include behavioral variables such as caffeine, alcohol, and nicotine intake, but do not assess the influence of obligatory religious practices that occur at multiple time points across the 24-hour cycle. Furthermore, studying circadian constructs in Muslim societies is complicated by the difficulty of implementing protocols that require participants to remain unaware of external time or to follow highly irregular sleep and meal schedules. In settings where religious laws or community norms prioritize awareness of prayer times or daylight cues, such protocols may be impractical or ethically inappropriate. These methodological limitations highlight the need for instruments that respect cultural obligations while maintaining the precision required for rigorous circadian research.

Developing culturally adapted questionnaires and methodological approaches can improve the quality of circadian assessments in Muslim societies. These tools should explicitly measure the timing, frequency, and behavioral consequences of daily religious practices and examine how they interact with sleep patterns, eating rhythms, and metabolic cues. Incorporating these dimensions can provide a clearer understanding of chronotype, social jetlag, and eating jetlag in culturally diverse populations and enhance the validity of data used for precision sleep medicine. Redefining and adapting

research tools in this way is essential for ensuring that circadian rhythm research remains inclusive, accurate, and applicable to the lived experiences of Muslim communities.

Religious Temporal Practices and Circadian Rhythms

While this commentary highlights methodological considerations relevant to Muslim societies, the importance of culturally sensitive circadian assessment extends to a broader range of religious and spiritual traditions. Many religious frameworks incorporate structured temporal practices that can shape daily rhythms, including sleep–wake timing, eating patterns, and social synchronization. For example, in Christianity, regular worship schedules and fasting traditions such as Lent may influence patterns of activity and food intake during specific periods of the year (28). In Judaism, daily prayer practices and the weekly observance of the Sabbath introduce predictable, religion-specific temporal structures (29) that may act as social time cues. Similarly, in some Hindu and Buddhist traditions, practices such as early morning meditation, temple rituals, and periodic fasting (30, 31) may contribute to culturally structured behavioral rhythms.

These diverse temporal practices, much like those observed in Islamic contexts, highlight an important methodological consideration for circadian research. Standardized questionnaires and laboratory protocols are typically developed within relatively secular or culturally homogeneous settings and may not always capture the full range of temporally structured behaviors present in religiously observant populations. Rather than replacing existing approaches, future work should focus on adapting and validating established circadian assessment tools to better account for culturally structured routines. Such efforts may enhance measurement precision and ecological validity while supporting more inclusive and globally applicable chronobiological research.

Discussion

The primary aim of this commentary was to highlight how culturally structured behaviors in Muslim societies interact with sleep and circadian rhythms and to clarify why existing approaches may not capture these dynamics with sufficient accuracy. By examining prayer schedules, fasting routines, and seasonally shifting time cues, we sought to identify methodological constraints that can limit the precision of circadian assessments in these populations. This culturally focused analysis provides a foundation for redefining the assumptions that shape current sleep and circadian measurement tools.

Despite substantial advances in circadian science, an important gap remains in understanding how religiously anchored behaviors function as social and behavioral time cues. Existing models tend to classify zeitgebers into biological, environmental, or social domains, yet religiously structured timing in Muslim societies does not fit neatly into any of these categories. The lack of conceptual integration of these cues has resulted in measurement tools that do not fully capture the lived temporal structure of daily life in these communities. Addressing this gap is essential for the equitable extension of precision sleep medicine to culturally diverse populations.

While our discussion focuses on the methodological implications within Muslim societies, it is important to recognize that the need for culturally sensitive circadian assessment extends to diverse religious and spiritual traditions. Limited research has explicitly explored how varied religious temporal practices, such as specific prayer schedules in Judaism, liturgical fasting periods in Christianity, or ritualized daily routines in Buddhist and Hindu traditions (19, 28-31), might influence circadian rhythm measurements. Despite the diversity of these practices, the existing literature on the intersection of religious temporal structures and chronobiology remains sparse, representing a significant gap in our current understanding. Standardized circadian assessment tools often assume a secular, stable daily routine, which may not adequately capture the behavioral complexity found in religiously observant populations.

New approaches are needed to improve the accuracy and cultural relevance of circadian assessments. One potential direction is the development of hybrid instruments that measure prayer timing, meal pattern variability, and associated psychological or behavioral constraints while preserving the core structure of validated circadian tools. Such instruments can provide multidimensional profiles of chronotype and eating timing that reflect both biological and culturally embedded temporal behaviors. Another promising avenue is the co-production of research tools through collaboration between scientists and Muslim communities in different countries. This cooperative process can increase cultural sensitivity, enhance participant engagement, and improve the ecological validity of data.

Future methodological solutions may also include the use of adaptive study designs that accommodate religious practices without compromising scientific rigor. For instance, protocols can be scheduled around obligatory prayer times or adjusted during Ramadan to reflect the temporary shift in sleep and meal timing. Digital tools such as wearable technologies and ecological momentary assessment platforms also provide opportunities for minimally intrusive monitoring that respects religious obligations while enabling high resolution circadian data collection.

Taken together, these strategies may support the long-term goal of integrating cultural and religious variables into precision sleep medicine. Incorporating these dimensions can lead to more accurate assessments, more inclusive research frameworks, and ultimately more effective health recommendations. By addressing underexplored cultural determinants, future work can help reduce disparities in circadian research and contribute to improved health and well-being in Muslim societies and globally.

As actionable recommendations, we propose several

practical steps to enhance the cultural validity of circadian research in religiously structured settings. Researchers should adapt commonly used chronotype, sleep, and meal timing instruments to distinguish between final awakenings and temporary awakenings related to prayer practices, and to account for fasting-related shifts in eating schedules. Incorporating structured items that capture daily prayer timing, segmented sleep, and context-dependent behavioral shifts can reduce systematic misclassification and improve the accuracy of chronobiological assessments. Furthermore, validation studies should be conducted in culturally diverse populations to ensure that established protocols maintain both methodological rigor and ecological relevance across different social and religious contexts.

Conclusion

Research on circadian rhythms is essential for understanding how daily biological processes interact with health across diverse populations. As discussed in this commentary, culturally structured behaviors such as prayer timing, religious fasting, and ritualized daily routines can shape sleep and eating patterns in ways that are not fully captured by commonly used circadian assessment tools. Although this article focuses on Muslim societies, similar considerations may arise in other religious and cultural contexts where daily activities follow structured temporal practices. Existing research addressing these methodological implications remains limited.

Recognizing culturally structured temporal behaviors can improve the accuracy and interpretability of circadian assessments. Adapting and validating established research tools to account for such factors may enhance measurement precision and support more inclusive approaches in circadian science and precision sleep medicine. Integrating cultural context into circadian research can therefore contribute to a more comprehensive understanding of biological rhythms and strengthen the field's relevance to global public health.

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Competing Interests

The authors declare that they have no conflicts of interest.

Data Availability Statement

Not applicable.

Declaration of generative AI and AI-assisted technologies in the writing process

We confirm that the conception, design of the review framework, literature search, selection, interpretations, and drafting of the manuscript were entirely performed by the authors. During the writing process, an artificial intelligence language model (OpenAI) was used solely to enhance academic tone, clarity, style, and grammar and punctuation. Following this assistance, all authors critically reviewed and refined the text and take full responsibility for the accuracy, originality, and integrity of the scientific interpretations presented in this review.

Ethical Approval

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