Original Article

Patterns of Sleep and Napping in Saudi Arabia: A Cross-sectional Evaluation

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Abstract

Objectives: Most people in Saudi Arabia reside in population-dense cities and may be predisposed to poor sleep quality. This study aimed to determine the self-reported sleep and napping patterns in a convenient cross-sectional sample of adults living in Saudi Arabia.

Materials and Methods: In this cross-sectional study, information related to sleep quantity and quality during workdays and weekends were collected from adults living in four major cities of Saudi Arabia: Makkah, Jeddah, Riyadh and Taif. Demographic, anthropometric, behavioral, socioeconomic, and comorbidity status were also collected. Standardized tools for screening common sleep complaints (i.e., the Epworth Sleepiness Scale, the Insomnia Severity Index, and the STOP-BANG questionnaire) were included.

Results: Participants ($N = 1200$; 40% males) had an average age of 35 ± 14 years. The most common sleep onset-time during workdays and weekends was 12 am. The most common wakeup times during workdays and weekends were 6 am and 12 pm, respectively. There was a significant difference between workdays and weekends in nighttime sleep duration (7.1 ± 2.3 hours vs. 8.5 ± 2.2 hours, $P < 0.001$) and total sleep duration over 24 hours (8.7 ± 2.2 hours vs. 9.7 ± 2.5 hours, $P < 0.001$). There was a greater proportion of participants who took regular daily naps during workdays compared with weekends (51% vs. 33%, respectively, Chi-square test $P < 0.001$). Nap duration during workdays and weekends was similar (2.1 ± 1.1 hours vs. 2.0 ± 1.0 hours, dependent t-test $P = 1.0$).

Conclusion: People living in Saudi Arabia tend to sleep late and have a short nighttime sleep duration and regular long daytime napping. On weekends, these variables change toward the recommended range (i.e., increased nighttime sleep duration and decreased napping count and duration).

Keywords: Arab world, Middle East, sleep deprivation, sleep habits, sleep hygiene, sleep quality

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INTRODUCTION

Sleep is an essential physiological process responsible for restoring physical and mental body functions.[1] Sufficient, consistent, and quality sleep is required to establish these gains. Adult humans require an average of 7–9 hours of sleep during nighttime to maximize sleep restorative effects.[2,3] Sleep restriction or poor sleep routine can lead to harmful health sequelae including cardiometabolic disease and cognitive impairment, increasing the incidence of road traffic accidents, and workplace errors.[4,5] These sequelae significantly reduces one's productivity and may burden financial and health systems.[6]

Short sleep duration and poor sleep habits are becoming increasingly common worldwide.[7-9] Residents of large, population-dense, industrialized cities are particularly affected. Noise and light pollution from prolonged trading hours in these busy cities hinder residents' ability to achieve a full nighttime sleep.[10-12] For example, 5% of the total population in a Korean study experienced significant sleep disturbances from high noise levels in residence areas close to major roads.[13] These effects extend further in areas of hot desert climate, in which people avoid activities during the afternoon, and nighttime social interaction becomes favorable.[14] Consequently, sleep onset is delayed, and nighttime sleep duration is shortened. Most of the population in Saudi Arabia lives in population-dense, hot-climate cities (such as Riyadh, Jeddah, and Makkah) and is, therefore, predisposed to poor sleep quality.

Daytime napping can be a countermeasure to compensate for short nighttime sleep duration.[15] Napping is especially tempting during the afternoon slump period, in which alertness is reduced, and sleep pressure and propensity are increased.[16] Indeed, many outdoor activities are not convenient during this period due to the extreme hot climate conditions in Saudi Arabia. The tradition of a daytime "siesta" is also common in the culture of Asian and Mediterranean countries. For example, power napping is frequently practiced in Japan to combat the pressures of long working hours, especially in urban areas.[17] Although napping has been associated with various cognitive and physical benefits,[18] findings remain inconsistent across studies.[19,20] No previous report has provided a systematic description of sleep and napping patterns in the general population of Saudi Arabia. To this end, the current study aimed to determine self-reported sleep and napping patterns of people living in Saudi Arabia.

MATERIALS AND METHODS

Study design, setting, and participants

A convenient cross-sectional sample of adults from different demographic, socioeconomic, and ethnic groups living in Saudi Arabia were invited to participate in this study. We targeted invitees from four major cities of Saudi Arabia: Makkah, Jeddah, Riyadh and Taif.

Invitations to potential participants were distributed through two methods. First, a standardized electronic invitation message with a link to an electronic-based study questionnaire was shared via groups or communities of expected potential participants on common social media platforms. Second, individuals passing by public places (e.g., shopping malls, university halls, and healthcare facilities) were directly approached by a member of our research team for a face-to-face conversation to complete the electronic-based study questionnaire. Invitees were asked to read a brief and informative description of the study and, if willing, to complete the data-collection questionnaire. To reduce response bias, no reimbursement was offered to potential participants for their participation. Data acquisition continued from August 2022 to July 2023 to minimize the seasonal effect on sleep.[21]

The Institutional Review Board granted the authors an exemption from obtaining participants' written consent. Willingness to complete the study questionnaire was considered implicit consent for participation. No identifiable information was collected from the participants.

Study tool

The study questionnaire was designed to collect self-reported information on sleep quantity and quality during workdays and weekends. The primary variables were regular sleep onset time, wake-up time, and daytime napping habits (count per day, onset time, and offset time). Participants were asked to provide sleep and napping onset and offset times in hour format (hh:mm). The allocated response boxes for these questions were left free of any restrictions (i.e., no response categories were provided to the participants). Sleep duration during nighttime (i.e., 8 pm–8 am) and during the 24-hour period (i.e., nighttime plus napping time) were calculated accordingly.

The questionnaire included validated Arabic translations of three standardized tools for screening of common sleep complaints: The Epworth Sleepiness Scale (assesses excessive daytime sleepiness),[22,23] the Insomnia Severity Index (assesses inability to initiate or maintain sleep despite sufficient opportunity),[24,25] and the STOP-BANG (assesses the risk of obstructive sleep apnea).[26,27] The questionnaire also collected self-reported demographics, anthropometrics, behavioral factors (exercise, smoking, and caffeine intake), socio-economic factors (work sector and routine, education level, and city of residence), and common comorbidity (e.g., hypertension, diabetes, and mood disorders).

Data management and statistical analysis

All hour-format times (hh: mm) were converted into the 24-hour system with 30-minute approximation (1–30 minutes were approximated-down and 31–59 minutes were approximated-up to the nearest hour). After cleaning, preparation, and quality assurance, data were analyzed using the SPSS software. Data were reported as frequency, percentages, median (95% confidence interval [CI]), or mean (95% CI), as indicated by the level of measurement and normality distribution. Subgroups of participants were compared via performing independent *t*-test or one-way ANOVA for parametric variables, Mann–Whitney test, or Kruskal–Wallis test for non-parametric variables, or Chi-square of independence test for categorical variables. Dependent *t*-test or Mann–Whitney test were performed to compare workdays and weekends. A *P* value <0.05 was considered statistically significant.

RESULTS

Demographic, anthropometric and socioeconomic characteristics

A total of 1200 participants completed the questionnaire. Of these, 40% were males, and the mean age was 35 ± 14 years and the mean body mass index was 27 ± 7 kg/m^2. Participants from Makkah, Taif, Riyadh, and Jeddah accounted for 34%, 28%, 16%, and 10% of the total sample, respectively; the remaining 12% were from >15 cities of Saudi Arabia, with no statistical difference in the general characteristics compared to participants from the densely populated cities. Most participants were students (26%) and housewives/retires (22%), or were working in the education (16%) and health (10%) sectors. The majority (53%) of working participants spent 8–10 hours daily in their jobs. Nightshifts were reported by 25% of the employed participants. Smoking was reported by 21%, regular exercise (≥1/week) by 45% and regular caffeine intake (≥1/daily) by 49% of the participants [Table 1].

Table 1: Demographic and socioeconomic characteristics of the participants

Variables	Percentage
Gender	
Male	40
Female	60
Location of residence	
Makkah	34
Taif	28
Riyadh	16
Jeddah	10
Others	12
Exercise routine	
Do not exercise	23
Occasionally	32
1–5 days/week	38
Daily	7
Caffeine intake	
Do not drink caffeine	3
Occasionally	48
1–2 cups/day	33
>2 cups/day	16
Work sector	
Students	26
Housewives and retirees	22
Education	16
Health	10
Sales and administration	10
Other professions	12
Unemployed	4
Nightshifts (per week)	
None	75
1–2	9
3–5	7
>5	8
Work hours/day	
<8	36
8–10	53
>10	9
Smoking	
Nonsmokers	79
<10 cigarettes/day	13
10–20 cigarettes/day	5
>20 cigarettes/day	2

General and sleep health characteristics

Most participants (62%) had no comorbidity, while 24% had single comorbidity and 12% had multiple comorbidities. Diabetes (9%), mood disorders (9%), and hypertension (8%) were the most reported comorbidities. Physician-diagnosed sleep disorder was reported by 8% of participants. More than 70% of participants reported morning tiredness, 23% reported snoring, and 9% reported being witnessed gasping air during sleep. Increased risk of obstructive sleep apnea, clinically significant insomnia, and excessive daytime sleepiness were reported by 36%, 29% and 20% of the participants, respectively.

Sleep and napping patterns during workdays

During workdays, the most commonly reported sleep-onset time was 12 am (26%) (median = 10 pm, 95% CI = 9 pm–10 pm, IQR = 12 am–2 am) and wakeup time was 6 am (median = 7 am, 95% CI = 7 am–7 am, IQR = 6 am–10 am), with the average duration of nighttime sleep being 7.3 ± 2.3 (95% CI = 7.1–7.4) hours/night. Approximately 74% of the participants reported waking up at dawn time (4 am–5 am) to perform early morning (Fajr) prayer, and 62% of these continued to sleep after that.

About 44% of participants reported taking one daytime nap per day, while 7% took two or more daytime naps per day; the remaining 49% did not report taking daily naps. The most common times for nap onset and wakeup were 2 pm (median = 2 pm, 95% CI = 2 pm–3 pm, IQR = 2 pm–4 pm) and 4 pm (median = 5 pm, 95% CI = 4 pm–5 pm, IQR = 3 pm–6 pm), respectively. The average duration of daily naps was 2.1 ± 1.1 (95% CI = 2.1–2.3) hours, and the average total sleep time per 24-hour was 8.7 ± 2.2 (95% CI = 8.5–8.9) hours. The proportion of participants who slept <7 hours at night (i.e., 8 pm–8 am) and within 24-hour was 44% and 12%, respectively. Nappers (≥1 nap per day) had significantly shorter duration of nighttime sleep compared with non-nappers (6.6 ± 2.3 hours vs. 7.9 ± 3.0 hours, $P < 0.001$).

Sleep and napping patterns during weekends

During weekends, the most commonly reported sleep onset time was 12 am (20%) (median = 5 am, 95% CI = 5 am–5 am, IQR = 10 pm–3 am) and wakeup time was 12 pm (median = 12 pm, 95% CI = 11 am–12 pm, IQR = 9 am–2 pm). The average duration of nighttime sleep during weekends was 8.5 ± 2.2 (95% CI = 8.4–8.6) hours/night. Approximately 72% of participants reported waking up for early morning (Fajr) prayer, and 79% of these continued to sleep after that.

About 25% and 8% of the participants reported taking one and two or more daytime naps, respectively, while 67% did not take naps. The most common times for napping onset and wakeup were 2 pm (median = 2 pm, 95% CI = 2 pm–2 pm, IQR = 1 pm–4 pm) and 4 pm (median = 4 pm, 95% CI = 4 pm–4 pm, IQR = 3 pm–6 pm), respectively. The average duration of daily naps was 2.0 ± 1.0 (95% CI = 1.9–2.2) hours, and the average total sleep time within 24 hours was 9.7 ± 2.5 (95% CI = 9.5–10.0) hours. The proportion of participants who slept less than 7 hours at night and within 24 hours was 18% and 11%, respectively. Nappers (≥1 nap per day) show significantly shorter duration of nighttime sleep compared with non-nappers (7.8 ± 2.4 hours vs. 8.9 ± 2.0 hours, P <0.001).

Differences between workdays and weekends

Table 2 compares participants' sleep and napping characteristics during workdays and weekends. There was a significant difference in nighttime sleep duration between workdays and weekends (7.3 ± 2.3 hours vs. 8.5 ± 2.2 hours, $P < 0.001$). There was also a significant difference in the total sleep time over 24 hours between groups (8.7 ± 2.2 hours vs. 9.7 ± 2.5 hours, $P < 0.001$). The proportion of participants who reported taking regular naps were greater during workdays compared with weekends (51% vs. 33%, $P < 0.001$). There was no significant difference in nap duration between workdays and weekends (2.1 ± 1.1 hours vs. 2.0 ± 1.0 hours, $P = 1.0$).

Table 2: Sleep and napping characteristics during workdays and weekends

Characteristic	Workdays	Weekends
Epworth sleepiness scale score[a]	6.8±4.6	
Excessive daytime sleepiness, *n* (%)[b]	20.0	
Insomnia severity index score[a]	10.2±7.0	
Clinically significant insomnia, *n* (%)[b]	29.0	
STOP-BANG Questionnaire score[a]	2.1±1.3	
High risk of obstructive sleep apnea, *n* (%)[b]	35.9	
Sleep onset time[c]	10 pm (12–2 am)	5 am (10 pm–3 am)
Wakeup time[c]	7 am (6–10 am)	12 pm (9 am–2 pm)
Waking-up for dawn prayer, *n* (%)[b]	74	72
Sleeping after dawn wakeup, *n* (%)[b]	62	78
Napping count, *n* (%)[b,*]		
None	49.5	67.0
1 per day	43.8	25.5
≥2 per day	6.7	7.5
Nap onset time[c]	2 pm (2–4 pm)	2 pm (1–4 pm)
Nap wakeup time[c]	5 pm (3–6 pm)	5 pm (3–6 pm)
Nighttime sleep duration (h)[a,*]	7.1±2.3	8.5±2.2
Napping sleep duration (h)[a,*]	2.1±1.1	2.0±1.0
Total sleep duration/24 h (h)[a,*]	8.7±2.2	9.7±2.5
Sleep duration <7 h/night, *n* (%)[b]	43.6	18.2
Sleep duration <7 h/24 h, *n* (%)[b]	11.6	10.9

*Dependent *t*-tests P value for nighttime sleep duration <0.001, 24-h sleep duration <0.001, and nap sleep duration=0.1; [a]Mean±SD; [b]Frequency; [c]Median (1st–3rd quartiles). Values were reported as indicated by the level of measurement and normality distribution. Chi-square of independence test P value for napping count P<0.001. SD – Standard deviation

Effects of participant's characteristics and sleep-related complaints on sleep and napping pattern

There was no relationship between gender and sleep or napping durations during workdays or weekends. No correlation between age or body mass index and any sleep or napping durations was observed. There was no relationship between work sectors, work hours, or frequency of nightshifts per week and any sleep or napping duration. No relationship between the frequency of exercise, smoking, or caffeine intake and any sleep or napping durations was seen.

During workdays, the proportion of participants who took regular naps was higher in those with hypertension (68% vs. 49%, P >0.001), diabetes (64% vs. 49%, P >0.005), and daytime tiredness (53% vs. 45%, $P = 0.001$). During weekends, the proportion of participants who took regular naps was greater in those with hypertension (50% vs. 31%, P >0.001), diabetes (50% vs. 31%, $P < 0.001$), and regular snorers (40% vs. 31%, $P = 0.022$).

Nighttime sleep duration during workdays was less in participants who reported previous diagnosis of sleep disorders compared with those who did not (6.6 ± 2.3 [95% CI = 6.1–7.1] vs. 7.3 ± 2.8 [95% CI = 7.2–7.5] hours, *P* = 0.016), and those showing high risk of obstructive sleep apnea development in the STOP-Bang questionnaire (7.0 ± 2.6 [95% CI = 6.8–7.3] vs. 7.4 ± 2.8 [95% CI = 7.2–7.6] hours, *P* = 0.022). Nighttime sleep duration during weekends was less in participants with comorbidities (8.2 ± 2.3 [95% CI = 8.0–8.5] vs. 8.7 ± 2.2 [95% CI = 8.5–8.8] hours, *P* = 0.002), and specifically with hypertension (7.9 ± 2.5 [95% CI = 7.4–8.4] vs. 8.6 ± 2.2 [95% CI = 8.4–8.7] hours, *P* = 0.005), diabetes (7.8 ± 2.5 [95%CI = 7.3-8.2] vs. 8.6 ± 2.2 [95%CI = 8.4-8.7] hours, *P* = 0.001).

Compared with those without comorbidities, napping duration during workdays was less in participants with comorbidities in general (2.0 ± 1.0 [95% CI = 1.9–2.1] vs. 2.2 ± 1.3 hours [95% CI = 2.1–2.4], *P* = 0.024), and specifically with hypertension (1.8 ± 1.0 [95% CI = 1.5–2.1] vs. 2.2 ± 1.2 [95% CI = 2.1–2.3] hours, *P* = 0.014) and snoring (1.9 ± 1.0 [95% CI = 1.7–2.1] vs. 2.2 ± 1.2 [95% CI = 2.1–2.3] hours, *P* = 0.003). Napping duration was increased in participants reporting daytime tiredness during workdays (2.2 ± 1.2 [95% CI = 2.1–2.3] vs. 1.9 ± 1.0 [95% CI = 1.7–2.1] hours, *P* = 0.008) and during weekends (2.1 ± 1.1 [95% CI = 2.0–2.3] vs. 1.8 ± 1.0 [95% CI = 1.6–2.0] hours, *P* = 0.023). There was no interaction effect of long napping duration (≥2 hours) and long nighttime sleep duration (≥6 hours) during workdays on participants' health conditions such as diabetes mellitus (logistic regression OR [95% CI] =0.24 [0.05–1.19], *P* = 0.077) and hypertension (logistic regression OR [95% CI] =0.33 [0.01–1.05], *P* = 0.059). There was also no interaction effect of long napping duration (≥2 hours) and long nighttime sleep duration (≥6 hours) during workdays on participants' health conditions such as diabetes mellitus (logistic regression OR [95% CI] =0.24 [0.05–1.19], *P* = 0.077) and hypertension (logistic regression OD [95% CI] =0.33 [0.01–1.05], *P* = 0.059). Other sleep and napping patterns were not significantly different between subgroups of participant characteristics or sleep-related complaints.

DISCUSSION

The findings from this cross-sectional survey are novel in providing a basis for epidemiological understanding of sleep and napping patterns in the general population of Saudi Arabia. Four key findings can be drawn from this study. The median nighttime sleep onset of people living in large, population-dense cities of Saudi Arabia ranges between 10 pm during workdays and 5 am during weekends, with the most reported time being 12 am during both workdays and weekends. The average duration of nighttime sleep ranges between 7 hours during workdays and 8.5 hours during weekends. The proportion of participants who take regular daytime naps ranges between 51% during workdays and 33% during weekends. Napping most commonly occurs between 2 pm and 4 pm and lasts for an average of 2 hours.

The American Academy of Sleep Medicine and the Sleep Research Society have recently issued a consensus statement on the recommended amount of sleep for healthy well-being in adult individuals.[2] A sleep duration of 7–9 hours per night, with consistent sleep onset and wake-up times is essential to promote overall well-being. Similar recommendations have been issued by the Saudi Public Health Authority.[28] These recommendations were based on several studies that demonstrate the beneficial effects of maintaining sleep amount and quality on general health. In fact, a U-shape association between total sleep duration per 24-hour and common causes of mortality has been suggested. Short sleep duration (≤4 hours) and long sleep duration (≥10 hours) have been linked to detrimental health sequelae including cardiometabolic disease.[29-31] However, the actual sleep durations fall short of these recommendations in different regions of the world.[32,33]

Although the average nighttime sleep duration of participants in this study was 7.1 hours during workdays (aligning well with national and international recommendations), a major proportion of participants (44%) get less than 7 hours of daily nighttime sleep. Several factors can contribute to inadequate nighttime sleep duration in participants of this study. Most cities in Saudi Arabia are characterized by extreme meteorological condition, and people living there often delay their social interaction to late hours during the night. This may be carried over to later sleep onset time as well. The current study demonstrates a 2–4 hour delay in nighttime sleep onset compared to societal norms in most cold-climate countries. The influence of climate on sleep onset and duration has also been documented by studies in regional and international countries with comparable weather conditions including Kuwait, Qatar, and Brazil.[34-36] Whether these effects extend to influence the quality and outcome of sleep in hot-weathered countries requires further studying.

People in Saudi Arabia, like other regions of the Islamic world, strictly follow religious obligations such as prayer and Ramadan fasting. This may play a role in shaping the pattern of sleep of people living in these areas. Approximately 75% of participants in the current study report waking up between 4 am–6 am to perform the dawn (Fajr) prayer. Two-thirds of these continue to sleep after performing the dawn prayer, indicating a high prevalence of biphasic pattern of sleep in our population. The effect of cultural norms is also evident by the observed change of the median sleep onset time in participants of the current study from 10 pm during workdays to 5 am (time of Fajr prayer) during weekends. This may highlight the importance of considering the timing of religious practices when planning the rules and regulations of trading hours and work commitments in Islamic countries. Participant preference to go to work directly after Fajr prayer instead of getting a second phase of sleep is interesting to explore but beyond our scope.

Several lifestyle factors can also contribute to delayed nighttime sleep onset seen in our sample. Continuous availability of internet services and excessive browsing of social media are replacing nighttime sleep of many people.[37] Teenagers and young adults are especially affected due to the physiological tendency of their bodies for delayed sleep phase.[38,39] High prevalence of caffeine intake among our population is also observed. Coffee, with its aromatic and stimulatory effects, is deeply rooted in the tradition of Saudi Arabia. Caffeine can entrain the body in a cycle of delayed sleep onset, short sleep duration, daytime tiredness, and further demand of the stimulatory effects of caffeine.[40] Nonetheless, individuals in Saudi Arabia are increasingly embracing healthy lifestyle habits, including regular exercise and a balanced diet, which will likely contribute to improved sleep quality. Promoting sleep hygiene in the general population via educational campaigns and long-term follow-up research can enhance these efforts.

Another interesting finding in our study is that half of the participants take regular daytime naps, with an average duration of 2 hours. Regular napping is an expected compensatory measure to overcome the effects of sleep deficits from long-term delay in sleep onset and/or short nighttime sleep duration. Short 30-minute naps around noon can be beneficial especially for those waking up early in the morning.[28,29] Although the onset hour of napping among our participants is not far from recommended (2 pm vs. 12 pm, respectively), the average duration is longer than that (2 hours vs. 30 minutes, respectively). Whether this is a manifestation of a severe sleep deficit among participants, or a pure culture-related phenomenon requires further studying. On a similar note, daytime napping in the workplace or during office hours has been recognized for its potential to enhance productivity and well-being in Western societies.[41] However, we believe that workplace napping in Saudi Arabia, and the Middle East in general, faces cultural, social, and organizational barriers, where it can be perceived as a sign of inaction. Daytime napping remains a culturally driven behavior in Saudi Arabia, similar to many Mediterranean countries, which is greatly influenced and encouraged by climatic and religious factors.[42]

Napping may not always be a favorable compensatory mechanism for insufficient nighttime sleep. A U-shaped relationship between napping duration and cognitive function has been reported.[43,44] Moderate duration of napping improves cognitive functions, whereas prolonged napping or short nighttime sleep without daytime naps reduces cognitive performance. One possible explanation is that long napping provides a chance for the brain to delve into deeper sleep stages, requiring more time to restore cognitive abilities after waking-up.[45] However, long napping duration shows association with increased risks of mortality and major cardiovascular events in individuals who get ≥6 hours of nighttime sleep.[29] Long regular napping is also associated with increased risk of hypertension, diabetes, stroke, and atrial fibrillation.[46-48] People with comorbidities may experience shorter interrupted nighttime sleep due to pain or difficulties from their chronic conditions, and thus may have contributed to naps among those with comorbidities in the current study. Further elucidation of the relationship between napping and health is needed.

The observations from this study are also consistent with similar population-based studies showing longer sleep duration during weekends compared to workdays.[49] In contrast, napping is less prevalent during weekends compared to workdays. This may be caused by longer nighttime sleep duration on weekends, which enables restful deep sleep of the brain and complete physiological recovery processes of the body.[50] The observation of no differences in sleep patterns across demographic groups may contradict findings from other epidemiological studies. One possible explanation for this observation is that the populations in the targeted cities share the same environmental, cultural, religious, habitual, and traditional approaches to sleep.

Strengths and limitations

Using systematic methodology, this study provides insights into the epidemiology of sleep and napping in a large, diverse sample of the Saudi Arabian population. However, a few methodological improvements can provide a stronger basis for practical recommendations. Objective measurement techniques of sleep such as actigraphy, wearable devices, and sleep logs can provide a more precise estimation of sleep pattern and quality.[51] Implementation of these techniques is desired, but not feasible for collecting information from large numbers of participants due to costs and logistics. Nonetheless, the authors of this study aim to perform an additional analysis in a subgroup of participants from this sample using actigraphy devices to enhance the validity and reliability of our findings.

Another possible limitation of the current study is the methodology used for standardization of sleep and napping onset and offset times. Approximation of the hh:mm format to the nearest hour may cause skewness of data into inflation or deflation. However, this study is the first to report the epidemiological patterns of sleep and napping in the general population of Saudi Arabia. Therefore, the authors elected to analyze and report data in a simple, easy to understand, and feasible to replicate system. A more detailed (minute-based) analysis can certainly be insightful and more precise, but is also beyond the overarching aim of the current study. Nonetheless, we emphasize that the current study has succeeded in establishing grounds from which future research in this area can excel.

Data was collected from large population-dense cities in Saudi Arabia including a cold-weather city (i.e. Taif). However, we noted no difference in sleep patterns between participants from this city and the remaining participants. We also noted no effect of sociodemographic characteristics or behavioral patterns on sleep and napping patterns of our participants. Inclusion of a stratified samples of key sub-populations from all regions of Saudi Arabia can provide further insight into the effects of these variables on sleep and napping patterns in the country.

Finally, responding to an electronic-based study questionnaire may be easier for younger, tech-savvy individuals, which can introduce response bias to the current findings. Nonetheless, the proportions of retirees and housewives in our sample is 9.5% and 12.5%, respectively, indicating a reasonable presentation of middle-aged, presumed tech-naïve individuals in our sample, which supports the generalizability of the findings to the general population.

CONCLUSION

Nighttime sleep onset is delayed by a large proportion of the people in Saudi Arabia. Nighttime sleep duration is also at the lower border of normal range, with a considerable proportion of participants sleeping less than 7 hours during the night. Participants adopt two mechanisms for compensation: taking regular daytime naps during workdays and sleeping-in during weekends. These patterns seem homogenous and not influenced by sociodemographic or health characteristics. Future research with stratified sampling from multiple groups of interest of the Saudi population can provide further enlightenment on the effects of culture and weather on the epidemiology of sleep and napping patterns in the country. Epidemiological studies, such as the current study, provide bases for practical recommendations to promote health among the general population, particularly in relation to regional populations living in similar climate conditions.

Ethical considerations

The study was approved by the Institutional Review Board of King Abdullah Medical City, Makkah, Saudi Arabia (approval number: 22-975; date: 28 August 28, 2022). An exemption from collecting participants' written consent has been granted. Willingness to complete the study questionnaire was considered implicit consent for participation. The study adhered to the principles of the Declaration of Helsinki, 2013.

Peer review

This article was peer-reviewed by three independent and anonymous reviewers.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author contributions

Conceptualization: A.A.B., S.O.W., and S.A.A.; Methodology: A.A.B., A.A.A., H.F.R., S.S.A., M.A.B., and S.A.A.; Data analysis: A.A.B., A.A.A., H.F.R., and S.S.A.; Writing–original draft preparation: A.A.B. and S.O.W.; Writing – review and editing: A.A.A., H.F.R., S.S.A., M.A.B., and S.A.A.; Supervision: S.O.W. and A.A.B.

All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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