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Sleep Hygiene Practices and Sleep Quality Among Undergraduate Medical Students: A Cross-Sectional Study

Suhasini R Kanyadi[1*], Varsha M Shindhe[2], Ravikiran P Kamate[3], Shivalingappa B Javali[4]

[1]Department of Community Medicine, USM-KLE International Medical Programme, Belagavi, India
[2]Department of Physiology, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Deemed to be University, Belagavi, India
[3]Department of Community Medicine, BKL Walawalakar Rural Medical College Dervan, Chiplun, India
[4]Department of Bio-statistics, USM-KLE International Medical Programme, Belagavi, India

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ABSTRACT

Introduction: The role of sleep in supporting psychological, mental, and physical health is well documented. Sleep hygiene practices are effective modifiable behaviours that can be beneficial to improve sleep quality among medical students who are in short supply of sleep due to a demanding course. Aim and Objective: To estimate the magnitude and beliefs about of poor sleep hygiene among medical students. To identify specific changes to needed to Sleep Hygiene Index (SHI).

Methods: A cross-sectional study involving 293 undergraduate medical students using a pre-designed, self-administered questionnaire was conducted. Validated instruments the SHI and Pittsburgh Sleep Quality Index were used.

Results: Poor sleep hygiene practices (47.4%) and poor sleep quality (69.3%) were prevalent among substantial number of medical students. Bedtime technology use, sleep latency (AOR=2.276), sleep disturbance (AOR=2.459), use of sleeping medication (AOR=6.559) and daytime dysfunction (AOR=2.128) had a significant association with poor sleep hygiene practices ($p<0.05$). The area under the ROC curve for SHI as a tool for predicting good sleep quality was 0.663.

Conclusions: Regularization of sleep schedules by conducting time-management workshops among students and addition of items in SHI, on bedtime technology use along with dietary changes and daytime exposure to sunlight to improve sleep quality is recommended.

Keywords: Circadian Rhythm, Sleep Quality, Sleep Hygiene, Technology, Insomnia

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***Correspondence:** Dr. Suhasini R Kanyadi (Email: suha_kanyadi@ymail.com)

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INTRODUCTION

Sleep, like eating or drinking is an essential and habitual biological activity. We spend one-third of our lives sleeping and insufficient sleep is estimated to be prevalent among one-third of the global population.[1] Chronic insomnia is among the most common sleep disorders globally, affecting approximately 10% of the population.[2] Poor sleep which can be due to insufficient opportunity for sleep, shift work or the circadian rhythm disorders can adversely affect nearly all the body systems, contributing to a heightened risk of both morbidity and mortality.[3,4] To adapt to the geo-physical variability i.e. diurnal alteration between the light (day) and the darkness (night), all species including mammals have evolved a nearly 24-hour endogenous timing device known as the circadian clock.[5] During sleep, the brain recovers and processes information, supporting key cognitive functions like decision-making, focusing, and memory.[6]

Sleep hygiene has been defined as practicing a set of behaviours that facilitate sleep and avoiding behaviours that are disruptive to sleep. It is a collection of modifiable behaviours and environmental factors that helps to enhance sleep quality. The discovery of the terminology "Sleep hygiene", is credited to Peter Hauri, in his text "*The Sleep Disorders",* he outlines ten steps aimed at improving sleep.[7] While his recommendations have gained popularity, there is still no agreement on what precisely constitutes sleep hygiene

During the formative years of medical graduation, sleep itself in short supply because students are cramming in staying up late nights for examinations along with their demanding schedules compounded with digital addiction and stressful life conditions. Many students mistakenly believe they can compensate for weekdays sleep deprivation by sleeping long hours on the weekends, such irregular sleep habits make them vulnerable to insufficient and poor sleep quality.[8] Lack of awareness regarding sleep hygiene behaviours will contribute to practices which are disruptive to sleep, which in turn affects sleep quality thereby affecting the health of the individual.[9] *Technology* is no more a luxury but has become a necessity in today's modern era which includes smartphones, computers, laptops, smart home hubs (Amazon Echo/Google Home device), E-readers, smartwatches and video game consoles, all seamlessly connected to the internet. There is enough evidence to show that bedtime technology use can adversely impact sleep[10] but it is usually assessed in combination with other activities that may prolong falling asleep (for example: use the internet, cleaning or any other activities that keeps one awake). Also, if passive use (partners) of technology disrupts sleep is not clear.

In recent years the health concern over poor sleep quality has amplified the demand for designing an effective and affordable sleep promotion strategy that is easily adaptable and accessible. In attempting to define sleep hygiene behaviours, we need to consider whether the undergraduate medical students require tailored sleep hygiene advice as they are high risk groups for developing sleep related issues because of their demanding schedules which are often said to be necessary for learning and development of professionalism among doctors. Thus, this study was designed to estimate the magnitude of poor sleep hygiene practices using the Sleep Hygiene index and beliefs regarding it among undergraduate medical students during July-September 2022. Also, to identify specific changes needed to SHI to improve sleep quality

METHODOLOGY

Study design and setting: We conducted a descriptive cross-sectional study among 293 students pursuing graduation from a medical school in Belagavi, India following convenience sampling method. All the medical students (321) who attended Medical Institute were eligible to participate in the study. Absent students or students taking treatment for insomnia or the ones who were on long term medications (sedatives, opioids or anti-depressants) during the study period were excluded from the study to control the confounding factors. Ethical clearance was obtained from the institutional ethics committee (Ref no. USM-KLE/IEC/09/2022-01) and confidentiality was assured to each study participant. All the participants were given a brief description about the study and its objectives and a written informed consent was obtained from each study participant. The participation was on voluntary basis and the students were free to discontinue from the study at any point of time.

Data collection and tools: A self-administered predesigned, pre-tested questionnaire was used for data collection from the medical students. Classroom during self-study time was used for data collection and it was supervised by trained social workers. The questionnaire consisted of three sections, section one consisted of demographic details like age, gender, ethnicity, and phase in medical school, perceptions about sleep hygiene behaviors which were not a part of Sleep hygiene index scale and bedtime technology use. Section two had questions from Sleep Hygiene Index (SHI) instrument and section three had questions from Pittsburgh Sleep Quality Index (PSQI) instrument. Necessary instructions and directions were provided in the questionnaire for each section. The approximate time that was needed to complete the questionnaire was between 20-25 min after which the volunteers were instructed to collect the questionnaires**.**

Study variables: SHI tool is a validated 13-item self-report questionnaire developed based on the *International Classification of Sleep Disorders (ICSD)* to as-

sess the presence of sleep hygiene behaviors.[11] Participants were asked to indicate the frequency with which they engage in specific sleep-related behaviors, rating each item on a five-point scale: 0 (never), 1 (rarely), 2 (sometimes), 3 (frequently), and 4 (always). The individual item scores were summed to yield a global sleep hygiene score ranging from 13 to 65, with higher scores indicating more maladaptive sleep hygiene practices. The total score was then categorized as either "good practice" or "poor practice," using the mean SHI score as the cutoff point. For the purposes of this study, a mean score of 35 and above was considered as poor sleep hygiene practice.[12] The scale had a satisfactory internal consistency of Cronbach alpha of 0.68, and good test-retest reliability of (r (139) = 0.71, p <0.01) similar to the scale's developers report.

PSQI is a validated 19-item self-report questionnaire designed to measure subjective sleep quality and disturbances over a one-month period. It provides seven component scores and is applicable for use in both clinical and nonclinical populations. The seven components include sleep duration, sleep latency, habitual sleep efficiency, subjective sleep quality, sleep disturbances, use of sleep medication, and daytime dysfunction. The score for each component ranges from 0 to 3; with score 0 indicating no difficulty and 3 indicating severe difficulty. A total global PSQI score is derived by summing up the seven components, scores ranged from 0 to 21. According to the global PSQI, a score greater than five indicates poor sleep quality.[13,14] This scale had a satisfactory internal consistency, Cronbach alpha of 0.77. For the purpose of analysis of association between component scores and sleep hygiene practices score 0 (very good) and 1(fairly good) has been coded as good score and a score of 2 (fairly bad) and 3 (very bad) have been clubbed and coded as bad score.

The details of CGPA (Cumulative Grade Point Average) and attendance were obtained from the academic office of the institute for that particular study period semester and class attendance. A score of CGPA 2.67 (B $^{-}$) and attendance below 80% were coded as poor.

Measurement: A digital scale and portable stadiometer were used to measure weight and height, respectively, with height recorded to the nearest 0.1 cm. BMI was calculated and classification was done as per the recommendations of the WHO[15] (South-East Asian classification).

Statistical Analysis: Data were verified for completeness, coded and entered into SPSS software version 20.0 and later analyzed. Descriptive statistics, including means and standard deviations, were used to summarize numerical variables. Categorical data were analysed and presented using frequencies and percentages. Bivariate binary logistic analysis was performed to test the association between various study variables with outcome variable (poor sleep hygiene practices) using Pearson's Chi-square. Statistical significance was set at p values <0.05. The variables which showed significant association during bivariate analysis were subjected to logistic regression analysis. Adjusted odds ratios with 95% confidence intervals were used to present the strength of association and p value of 0.05 was considered statistically significant.

RESULTS

Demographic details of study participants: 21.77 (±1.66) was the mean age (±SD) of undergraduate medical students and more than half of them 187 (63.8%) were females. Most of them belonged to Malay ethnicity 267 (91.1%) and the remaining 26 (8.9%) either belonged to Malaysian Chinese, Malaysian Indians or were Indians in origin. 129 (44%) were studying in Phase 1(academic year 1 and 2) and more than half of the students, 164 (56%) were studying in Phase 2 (academic year 3, 4 and 5). The frequency of good sleep hygiene practices was 154 (52.6%) and poor sleep hygiene practices were prevalent among 139 (47.4%) of medical students. A substantial proportion 203 (69.3%) of medical students had poor sleep quality. A bivariate analysis in the current study found that factors like students belonging to Malay ethnicity (p=0.026), Poor academic performance (0.0354), attendance shortage (0.0356), higher BMI (0.001) and poor sleep quality (0.001) showed a significant association with poor sleep hygiene practices (Table 1).

Among of the 13 items of the Sleep Hygiene Index; going to sleep at varying times each night (61%), doing something that wakes up before bedtime (47%) and varying wake-up times from day to day (43%) were the top three poor sleep hygiene practices among study participants. The SHI showed positive correlation (p < 0.05) with all the component scores of PQSI. The components of sleep quality which showed significant association during bivariate analysis in the current study were subjected to logistic regression analysis. Among the seven component scores of sleep quality, sleep latency (AOR=2.276, 95% CI: 1.342, 3.858), sleep disturbance (AOR=2.459, 95% CI: 1.002, 6.034), use of sleeping medication (AOR=6.559, 95% CI: 1.349, 31.898) and daytime dysfunction (AOR=2.128, 95% CI: 1.23 – 3.659) were significantly associated with poor sleep hygiene practices. (Table 2)

Regarding beliefs 151 (51.5%) of the students felt taking a hot shower an hour before going to bed, 126 (43.0%). exposure to sunlight during the day and 122 (41.6%) engaging in regular exercise were beneficial to improve sleep quality whereas, 200 (68.3%) of them felt that going to bed thirsty, 142 (48.5%) going to bed hungry and 128 (43.7%) having heavy meals close to bedtime were disruptive sleep behaviours. (Table 3)

Among bed time technology use, active-self smartphone use (I check e-mails, text messages or

watch/post on social media between going to bed and waking up (sleep time) with p=0.001, video games consoles (p=0.022) and us e of E-readers (p=0.013) were significantly associated with poor sleep quality. There was no significant association between passive self-use of smartphone (I sleep where my mobile makes lights, sound or vibrates), active partner use of smartphone (I sleep where my bed partner/roommate checks e-mails, texts or social media during sleep time) or passive partner use of smartphone (I sleep where my bed partner/ roommate's phone makes lights, sounds or vibrates during sleep time). (Table 4)

Table 1: Association of socio-demographic characteristics, sleep quality and other factors with sleep hygiene practices among undergraduate medical students

Variables	Sleep Hygiene Practices		Total	Pearsons' χ2 Value	P value
	Poor (%)	Good (%)			
Gender					
Male	46 (33.09)	60 (38.96)	106 (36.2)	1.0	0.297
Female	93 (66.91)	94 (61.04)	187 (63.8)		
Age group					
19-21	66 (47.48)	84 (54.55)	150 (51.2)	1.654	0.437
22-24	64 (46.04)	63 (40.91)	127 (43.3)		
>24	9 (6.47)	7 (4.55)	16 (5.5)		
Ethnicity					
Malaya	132 (94.96)	135 (87.66)	267 (91.1)	4.81	0.028*
Others	7 (5.04)	19 (12.34)	26 (8.9)		
Phase					
Phase 1 (year 1&2)	60 (43.17)	69 (44.81)	129 (44)	0.080	0.778
Phase 2 (year 3,4&5)	79 (56.83)	85 (55.19)	164 (56)		
Attendance					
Poor	29 (20.86)	20 (12.99)	244 (83.3)	3.254	0.0356*
Good	110 (79.14)	134 (87.01)	49 (16.7)		
Academic Performance					
Poor	85 (61.15)	78 (50.65)	163 (55.6)	3.264	0.0354*
Good	54 (38.85)	76 (49.35)	130 (44.4)		
Body Mass Index (BMI)					
=<18.50	13 (9.35)	13 (8.44)	26 (8.9)	20.090	0.001*
=18.5-23.0	55 (39.57)	102 (66.23)	157 (53.5)		
23.1-27.50	48 (34.53)	30 (19.48)	78 (26.6)		
>27.50	23 (16.55)	9 (5.84)	32 (10.9)		
Sleep Quality					
Poor	114 (82.01)	89 (57.79)	203 (69.3)	4.817	0.001*
Good	25 (17.99)	65 (42.21)	80 (27.3)		

Note: *p value less than 0.05

Table 2: Logistic regression showing association between component scores and sleep hygiene practices among undergraduate medical students

Components scores (PQSI))	Sleep Hygiene Practices		Unadjusted	Adjusted	P value
	Poor (%)	Good (%)	Odds ratio (95% CI)	Odds ratio (95% CI)	
Subjective sleep quality					
Good score	114 (82.1)	145 (94.2)	1	1	0.191
Bad score	25 (17.99)	9 (5.8)	1.808 (0.749 - 4.392)	1.171 (0.496-1.224)	
Sleep latency					
Good score	52 (37.7)	100 (65)	1	1	0.002*
Bad score	86 (62.3)	54 (35)	2.276 (1.343 – 3.856)	6.629 (0.570-0.927	
Sleep duration					
Good score	72 (52.2)	99 (64.3)	1	1	0.696
Bad score	66 (47.8)	55 (35.7)	1.112 (0.653-1.895)	0.241 (0.686-1.253)	
Habitual sleep efficiency					
Good score	8 (5.8)	3 (1.9)	1	1	0.405
Bad score	131 (94.2)	151 (98.1)	1.879 (0.426 - 8.277)	0.047 (1.070-0.578)	
Sleep disturbance					
Good score	110 (79.1)	146 (94.8)	1	1	0.049*
Bad score	29 (20.9)	8 (5.2)	2.459 (1.002 - 6.034)	7.524 (0.756-0.954)	
Use of sleeping medication					
Good score	126 (90.6)	152 (98.7)	1	1	0.020*
Bad score	13 (9.4)	2 (1.3)	6.559 (1.349 31.898)	1.969 (0.410-1.159)	
Daytime dysfunction					
Good score	75 (53.9)	117 (75.9)	1	1	0.006*
Bad score	64 (46.1)	37 (24.1)	2.128 (1.23 – 3.659)	3.463 (0.593-1.014)	

Note: 1.00 Reference, *p value less than 0.05

Table 3: Perceptions regarding sleep behaviours among undergraduate medical students

Perceptions	Beneficial (%)	No effect (%)	Disruptive to sleep (%)	Total
Going to bed hungry	12 (4.1)	139 (4.4)	142 (48.5)	293 (100)
Going to bed thirsty	6 (2)	8 (29.7)	200 (68.3)	293 (100)
Having heavy meals close to bedtime	89 (30.4)	76 (30.4)	128 (43.7)	293 (100)
Taking a hot shower just before going to bed	73 (24.9)	126 (43.0)	94 (32.1)	293 (100)
Taking hot shower an hour before going to bed	151 (51.5)	132 (45.1)	10 (3.4)	293 (100)
Exposure to sunlight during the day	126 (43.0)	154 (52.6)	13 (4.4)	293 (100)
Engaging in regular exercise	122 (41.6)	157 (53.6)	14 (4.8)	293 (100)

Table 4: Association of bed-time technology use with sleep quality among undergraduate medical students

Bed-time technology use	Sleep Quality		Total (%)	Pearson's $\chi 2$ Tests	P value
	Poor (%)	Good (%)			
Smart phone use					
Self					
Active use					
Yes	191 (94.1)	70 (77.8)	261(89)	17.052	0.001*
No	12 (5.9)	20 (22.2)	32 (11)		
Passive use					
Yes	130 (64)	60 (66.7)	190 (64.8)	0.189	0.664
No	73 (36)	30 (33.3)	103 (35.2)		
Partner					
Active use					
Yes	107 (52.7)	39 (43.3)	146 (49.8)		
No	57 (28.1)	30 (33.4)	87 (29.7)	2.197	0.333
NA	39 (19.2)	21 (23.3)	60 (20.5)		
Passive use					
Yes	93 (45.8)	37 (41.1)	130 (44.3)	χ^2 =1.327	0.515
No	72 (35.5)	31 (34.4)	103 (35.2)		
NA	38 (18.7)	22 (24.5)	60 (20.5)		
Tablets					
Rarely	54 (26.6)	23 (25.6)	77 (26.3)	0.355	0.851
Frequently	149 (73.4)	67 (74.4)	216 (73.7)		
Desktop and laptop computers					
Rarely	85 (41.9)	32 (35.6)	117 (39.9)	1.037	0.308
Frequently	118(58.1)	58 (64.4)	176 (60.1)		
Video game consoles					
Rarely	179 (94.1)	70 (77.8)	249 (85)	5.284	0.022*
Frequently	24 (5.9)	20 (22.2)	44 (15)		
E-readers					
Rarely	141 (69.5)	75 (83.3)	216 (73.7)	6.196	0.013*
Frequently	62 (30.5)	15 (16.7)	77 (39.9)		
Smart-watch					
Rarely	186 (91.6)	80 (88.9)	266 (90.8)	0.558	0.455
Frequently	17 (8.4)	10 (11.1)	27(9.2)		
Smart home hubs (Amazon echo/Google home device)					
Rarely	188 (92.6)	85 (94.4)	273 (93.2)	0.330	0.566
Frequently	15 (7.4)	5 (5.6)	20 (6.8)		

A ROC curve plotted for SHI at a cut-off of 35 against PSQI showed the area under curve was 0.663 with 95% confidence interval = 0.599–0.726 and a standard error = 0.032. (Figure 1) it implies that, 66% of the time, a student who is randomly selected from those categorized as having poor sleep quality will have a total SHI score greater than 35 when compared to a student randomly selected from those with good sleep quality.

DISCUSSION

In this study 47.4% medical students had poor sleep hygiene practices which is line with the studies conducted in Ethiopia (48.1%)[16] and lesser in comparison with studies conducted in India 72.9% [17] and Iran (57.5%)[18]. The possible reasons for the variations in results across the countries could be due the differences sampling method, study population, socio-cultural environment and also the period of data collection (having exams/completed exams). It is practically difficult for the students to control a set of behaviours each day to enhance sleep. The top two poor sleep hygiene practices in our study were going to bed at different times from day to day (61%) and doing something that wakes up before bedtime (47%) which is similar to studies conducted in Qatar[19] which highlights the meaning role of proving

time management training which in turn would help them prioritize their tasks and reduce the need to tasks before bedtime.

In the current study, ethnicity (Malay), academic performance, attendance, Body Mass Index and sleep quality were factors which were significantly associated with sleep hygiene practices. Similarly, among Ethiopia university students it was observed that students with good sleep quality tended to achieve a higher average CGPA. i.e. better academic performance as compared to than poor sleepers[20] which is line with our study which showed good sleep hygiene which in turns leads to better sleep quality helps get better grades. Also, the finding of our study coincided with another study which showed an association between, poor sleep quality and reduced academic performance among non-depressed undergraduate students.[21] A systematic review on sleep and obesity revealed that sleep dysregulation disrupts the metabolic environment through changes in eating behaviours, hormonal imbalances involving leptin and ghrelin, and disturbances in the neuroendocrine and autonomic nervous systems. Therefore, promoting good sleep hygiene practices may offer a novel approach for the prevention and management of obesity in the future.[22,23] Study conducted in Qatar found that, sleep hygiene was the only significant predictor of sleep quality among university students such that those students who practiced healthy sleep hygiene behaviours were more likely to have better sleep quality.[19] Sleep latency is the technical term used for the length of time it takes to fall asleep with two items in PQSI with a healthy range of 10–20 minutes according. In our study students with poor sleep hygiene practices where twice more likely of having longer sleep latency as compared to students with good sleep hygiene scores. Similarly, the Odds of having Sleep disturbance and daytime dysfunction increased to two times among students with poor sleep hygiene practices. The frequency at with which various situations have troubled one's sleep measures the *Sleep disturbance,* and it consists of nine items representing different situations (e.g., inability to breathe well, bad dreams and pain) whereas, Daytime dysfunction reflects the impact of sleep disturbances on daily life, such as difficulty remaining alert or decreased drive to accomplish tasks.[24] Also, Odds of *using sleep medications* which consists of one item inquiring how frequently one has taken medicine to aid sleep was 6 times more among students with poor sleep hygiene practices.

Daytime exposure to sunlight which by regulating melatonin production helps entrain the circadian rhythm and taking hot shower an hour before going to bed which temporarily raises core body temperature which drops rapidly post shower signalling sleep time were beneficial to sleep. Going to bed thirsty/hungry which are the survival instincts and going to bed after heavy meals were disruptive sleep hygiene behaviours according to students' perception in this study which is in line with other studies which demonstrated having consuming large meals shortly before sleeping can lead to hormone disruption and poor sleep.[25] An American study demonstrated, the negative influence of eating close to bedtime on sleep duration.[26]

Among bedtime technology use; active-self smartphone use, video gaming and using E-readers were found to have poor sleep quality which is line with the study among adults where screen use for ≥2 h before bed increased the odds of having poor sleep quality.[27] The brightness of the short blue wavelengths emitted from the smartphone devices causes cognitive stimulation and sleep disturbances by disrupting the circadian rhythm which explains the use of active-self bedtime technology users having poor sleep quality.[28]

Our study found the Sleep Hygiene Index (SHI) to be of moderate use as a screening tool to predict poor sleep quality among undergraduate medical students. The AUC (Area Under Curve) of 0.663 found in our study is in line with a study undertaken among Nigerian undergraduate students (AUC of 0.655)[29] and lower than a study which showed AUC of 0.800[30] is the recommended value for instruments with good screening potential. Addition of items like technology use before bedtime, dietary habits and daytime sunlight exposure may help in increasing the predictability of sleep quality.

Strength and Limitations

The current study considered variables like bedtime technology use (both self and partner use) and BMI which is a unique feature of this study. Evidence has been garnered for few additional sleep hygiene behaviours considered for inclusion for future sleep hygiene scale development for students.

Limitations of the present research were that this study used cross-sectional design, thus we were only able to establish associations and not temporal relationship between the study outcome and the independent variables. Though the sample size was good enough it was conducted only in one medical school which may limit the generalizability of the findings to other regions with different socio-cultural environment. Since the responses were collected using a self-administered questionnaire, there may be an information bias. Lastly the use of subjective assessment instrument for sleep quality outcomes as there can be differences between subjective and objective measurements. Actigraphy can be used in future study for validation.

Conclusion

In the present study, a significant proportion of undergraduate medical students exhibited poor sleep hygiene practices, which was associated with poor sleep quality. Thus, it becomes necessary to address

the well-being of students before they proceed to internship where their schedules are much more demanding. Regularization of sleep schedules by conducting campus workshops on fixed sleep times among students, time management and implementing a 30-min technology free period before bedtime needs to be emphasized. Sleep hygiene index (SHI) as a tool for predicting good sleep quality needs modifications to tailor fit the undergraduate medical students. Sleep hygiene education intervention is a relatively inexpensive, efficient and effective lifestyle intervention to improve sleep quality and needs to be included in the undergraduate medical curriculum. Addition of items in sleep hygiene practices, focussing on technology use along with dietary changes and exposure to daytime sunlight which are potential factors that could implicate sleep quality is recommended.

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

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