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Effect of smartphone screen time on sleep quality and daytime alertness: A cross-sectional observational study.

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Abstract
Background:
Smartphone use is pervasive in young adults and frequently extends into the pre-sleep period. Prolonged and late-night screen exposure can disrupt sleep initiation and continuity and contribute to next-day sleepiness.

Objectives:
To evaluate the association between daily smartphone screen time, sleep quality, and daytime alertness among young adults.

Methods:
This observational study was conducted among 100 adults at the Department of Physiology, Mamata Medical College, Khammam, Telangana, India, between January and December 2025. Daily screen time and bedtime phone-use behaviors were recorded. Sleep quality and daytime sleepiness were assessed using standardized questionnaires. Associations were examined across screen-time categories, along with correlation and multivariable analyses.

Results:
The mean age was 22.9 ± 3.8 years, and 54.0% were female. Mean smartphone screen time was 5.1 ± 2.0 hours/day; 76.0% used phones within 1 hour before sleep, and 41.0% frequently used them in bed. Mean PSQI rose from 4.6 ± 1.9 in those with <3 hours/day screen time to 8.3 ± 2.6 in those with >7 hours/day. Poor sleep increased from 30.0% to 100.0%, and short sleep from 35.0% to 82.4% [$p < 0.001$]. Mean ESS was 9.6 ± 3.8; screen time correlated with PSQI [$r = 0.49$] and ESS [$r = 0.36$], independently predicting poor sleep and daytime sleepiness significantly.

Conclusion:
Higher daily smartphone screen time and near-bedtime use were associated with poorer sleep quality and reduced daytime alertness in young adults. Targeted sleep-hygiene counselling focused on screen-time timing and duration is warranted in college and workplace health programs.

Recommendations:
Practical steps include keeping the phone away from the bed, stopping screen use at least 60 minutes before sleep, enabling night-mode settings, and replacing late-night scrolling with a low-stimulation wind-down routine.

Keywords: *Smartphone; Screen time; Sleep quality; Pittsburgh Sleep Quality Index; Epworth Sleepiness Scale; Daytime sleepiness; Young adults*
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Introduction
Smartphones have reshaped how young adults learn, communicate, and relax. A device that once served primarily as a calling tool now functions as a constant source of entertainment, academic content, social interaction, and work-related notifications [1]. This convenience has a hidden cost: screen exposure often extends into the pre-sleep

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period, a biologically sensitive window when the brain should transition to a low-arousal state. When this transition is disrupted, sleep initiation and sleep continuity suffer, and the next day begins with fatigue and reduced vigilance [2,3]. Several pathways link screen use to disturbed sleep. Bright, short-wavelength light from modern displays suppresses the evening rise of melatonin and delays circadian phase, while interactive content increases cognitive and emotional arousal [4-6]. Controlled experiments have shown that evening reading on light-emitting devices alters circadian timing and reduces next-morning alertness compared with print-based reading [5]. Beyond light effects, the behavioral habit of checking messages, social feeds, or videos after lights out can prolong sleep latency and increase night awakenings.

A second contributor is behavioral displacement. Time spent on the phone often replaces time that would otherwise be allocated to sleep, especially during late-night "catch-up" hours after academic or work commitments. Notifications, vibration alerts, and the habit of keeping the phone within arm's reach can fragment sleep even after sleep onset. Together, these influences produce a pattern of delayed bedtimes, shorter sleep duration, and greater daytime impairment—outcomes that are particularly relevant for students who need sustained attention and memory consolidation[6,7].

Sleep quality is commonly quantified using the Pittsburgh Sleep Quality Index (PSQI), which captures subjective sleep duration, latency, efficiency, disturbances, and daytime dysfunction [1]. Daytime alertness is frequently measured by the Epworth Sleepiness Scale (ESS), a simple tool for assessing the tendency to doze in everyday situations [2]. Together, these instruments offer a practical, clinic-friendly approach to characterize sleep health in student and workplace populations.

Observational studies in diverse settings have consistently linked bedtime phone use to poorer sleep outcomes. Adult surveys have associated texting or phone calls after lights out with higher PSQI scores and worse sleep efficiency [3]. Studies using directly measured screen time also support an inverse relationship between heavier smartphone use and sleep parameters [4]. In student cohorts, higher exposure has been associated with poor sleep quality and greater daytime sleepiness [8,10-13].

Despite the growing body of evidence, sleep-health counselling in many college environments remains limited, and routine assessment of screen habits is uncommon. Local data from physiology departments can help tailor educational strategies to the realities of young adults' daily routines. The objectives of this study were to (i) describe smartphone screen-time patterns and near-bedtime phone-use behaviors, (ii) examine differences in sleep quality across screen-time categories, and (iii) evaluate the association of screen time with daytime alertness and excessive daytime sleepiness among young adults.

Methodology

Study design and setting

This cross-sectional observational study was conducted in the Department of Physiology, Mamata Medical College, Khammam, Telangana, India, from January to December 2025. Mamata Medical College is a tertiary-care teaching institution attached to Mamata General and Super Specialty Hospital, which provides outpatient, inpatient, operating theatre, emergency, intensive care, and diagnostic services. The institution caters to patients from Khammam and surrounding districts and supports a broad range of specialties, including general medicine, general surgery, orthopaedics, obstetrics and gynaecology, paediatrics, ENT, ophthalmology, dermatology, psychiatry, respiratory medicine, radiodiagnosis, and selected super-specialty services such as cardiology, urology, and neurosurgery. This academic and clinical environment provided access to a young-adult population suitable for evaluating smartphone use, sleep quality, and daytime alertness.

Study participants

Adults aged 18–35 years who reported regular smartphone use were approached through classroom and workplace notices. Participants were included if they owned a smartphone for at least one year and provided informed consent. Individuals with diagnosed sleep disorders, current use of sedative-hypnotics, rotating night-shift duty, major psychiatric illness, or chronic medical conditions that substantially affect sleep were excluded to reduce confounding.

Sample size

A sample size of 100 participants was included, based on feasibility within the study period and the intent to obtain stable estimates of sleep-quality proportions across screen-time categories.

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Sampling

Participants were selected by non-probability convenience sampling. Eligible young adults who were available during the study period and consented to participate were enrolled until the target sample size of 100 was reached. Recruitment was carried out within the academic setting of Mamata Medical College and its affiliated teaching environment. All participants were screened using predefined inclusion and exclusion criteria before enrolment.

Study variables and instruments

Sociodemographic details (age, sex, occupation) and health-related behaviors (caffeine intake and physical activity) were recorded using a structured proforma. Daily smartphone screen time (hours/day) was collected from device-reported usage logs wherever available, and otherwise from the participant's standardized recall. Screen time was categorized as <3, 3–5, 5–7, and >7 hours/day. Near-bedtime use was captured as phone use within one hour before intended sleep time, and habitual phone use in bed (often/always). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) [1], with PSQI >5 classified as poor sleep. Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS) [2], with ESS ≥11 classified as excessive daytime sleepiness.

Data collection procedure

After consent, participants completed the questionnaires in a supervised setting to limit missing responses. Screen-time category and bedtime phone-use behaviors were verified through brief probing questions. All responses were anonymized using unique study identifiers.

Bias

Several steps were undertaken to reduce potential sources of bias. Selection bias was addressed by applying uniform eligibility criteria to all prospective participants during the study period. Information bias was minimized by using a structured data-collection proforma and validated instruments, namely the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale, for all participants. To reduce measurement variability, the same study protocol and questionnaire format were used throughout data collection. Because smartphone use and sleep-related variables were self-reported, recall bias and social-desirability bias were possible; these were addressed by collecting responses consistently, assuring confidentiality, and avoiding leading questions. In the analysis, multivariable regression was performed to reduce the influence of measured confounders on the association between screen time and sleep outcomes.

Ethical considerations

The study followed ethical principles for research involving human participants. Confidentiality was maintained, and participants were allowed to withdraw at any time without academic or workplace consequences.

Statistical analysis

Data were entered and cleaned with range and logic checks. Continuous variables were summarized as mean ± standard deviation, and categorical variables as number (%). Differences in PSQI scores and proportions of poor sleep across screen-time categories were evaluated using appropriate parametric or non-parametric tests. Associations between continuous screen time and PSQI/ESS were examined using Pearson correlation. Multivariable logistic regression models were fitted to estimate adjusted odds ratios for poor sleep and excessive daytime sleepiness for higher screen time (>5 hours/day) while controlling for age, sex, BMI, caffeine intake, physical inactivity, and near-bedtime phone use. Statistical significance was set at $p < 0.05$.

Results

A total of 100 eligible adults who consented to participate were enrolled and included in the final analysis. Detailed records of the numbers approached, screened, excluded before enrolment, or declining participation were not maintained. Among the analysed participants, the mean age was 22.9 ± 3.8 years, with a slight female predominance. Most participants were students, and nearly half reported regular caffeine intake [Table 1].
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Table 1. Baseline Demographic and Clinical Characteristics (n = 100)

Variable	Value
Age (years), mean ± SD	22.9 ± 3.8
Age group, n (%)	18–24: 62 (62.0); 25–35: 38 (38.0)
Sex, n (%)	Male: 46 (46.0); Female: 54 (54.0)
Occupation, n (%)	Students: 72 (72.0); Employed: 28 (28.0)
BMI (kg/m²), mean ± SD	23.6 ± 3.9
Regular caffeine intake, n (%)	48 (48.0)
Physically inactive, n (%)	44 (44.0)

Average daily smartphone screen time was 5.1 ± 2.0 hours/day. Screen-time distribution showed that 45% of participants reported more than 5 hours/day. Night-time phone use within one hour before sleep was common, and 41% reported frequent phone use in bed (Table 2).

Table 2. Smartphone Screen Time Pattern and Night-Time Usage (n = 100)

Screen time variable	n (%) / Mean ± SD
Daily screen time (hours), mean ± SD	5.1 ± 2.0
Screen time category, n (%)	<3 h/day: 20 (20.0); 3–5 h/day: 35 (35.0); 5–7 h/day: 28 (28.0); >7 h/day: 17 (17.0)
Night-time phone use (<1 h before sleep), n (%)	76 (76.0)
Phone use in bed (often/always), n (%)	41 (41.0)

Sleep quality demonstrated a clear exposure–response pattern across screen-time categories. Mean PSQI scores increased from 4.6 ± 1.9 in the <3 h/day group to 8.3 ± 2.6 in the >7 h/day group. The prevalence of poor sleep (PSQI >5) rose progressively and reached 100% among those with >7 h/day screen time (Table 3). Short sleep duration (<7 hours) also increased across categories (Table 3 & **Figure 1).**

Table 3. Sleep Quality Parameters by Screen Time Category (PSQI)

Screen time category	PSQI score (mean ± SD)	Poor sleep (PSQI > 5), n (%)	Sleep duration < 7 h, n (%)
<3 h/day (n=20)	4.6 ± 1.9	6 (30.0)	7 (35.0)
3–5 h/day (n=35)	5.8 ± 2.1	18 (51.4)	18 (51.4)
5–7 h/day (n=28)	7.1 ± 2.4	21 (75.0)	19 (67.9)

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>7 h/day (n=17)	8.3 ± 2.6	17 (100.0)	14 (82.4)
p-value	<0.001	<0.001	<0.001

The mean ESS score was 9.6 ± 3.8, and 38% of participants had excessive daytime sleepiness (ESS ≥11). Participants with poor sleep quality had higher ESS scores than those with good sleep quality (Table 4). Daily screen time correlated positively with PSQI (r = 0.49) and ESS (r = 0.36). In adjusted models, screen time >5 h/day was associated with higher odds of poor sleep and excessive daytime sleepiness (Table 4, Figure 2,3,4).

Table 4. Daytime Alertness and Association With Screen Time

Parameter	Value
ESS score, mean ± SD	9.6 ± 3.8
Excessive daytime sleepiness (ESS ≥ 11), n (%)	38 (38.0)
ESS score by sleep quality	
Good sleep (PSQI ≤ 5)	7.9 ± 3.2
Poor sleep (PSQI > 5)	11.3 ± 3.6
Correlation: screen time vs PSQI (r, p)	0.49, <0.001
Correlation: screen time vs ESS (r, p)	0.36, <0.001
Adjusted OR for poor sleep (>5 h/day)	2.6 (95% CI: 1.2–5.7)
Adjusted OR for ESS ≥ 11 (>5 h/day)	2.1 (95% CI: 1.0–4.6)

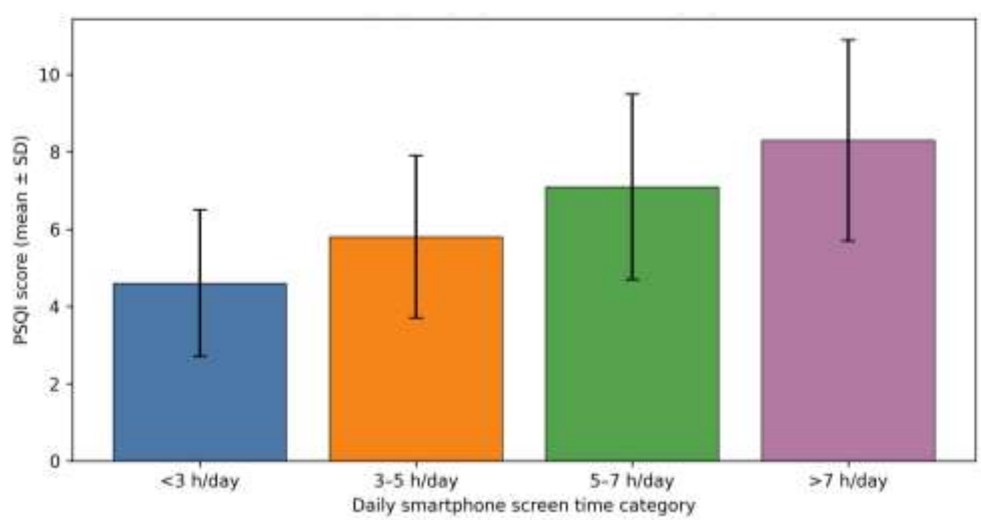

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Figure 1. Mean PSQI score (mean ± SD) across daily screen-time categories.

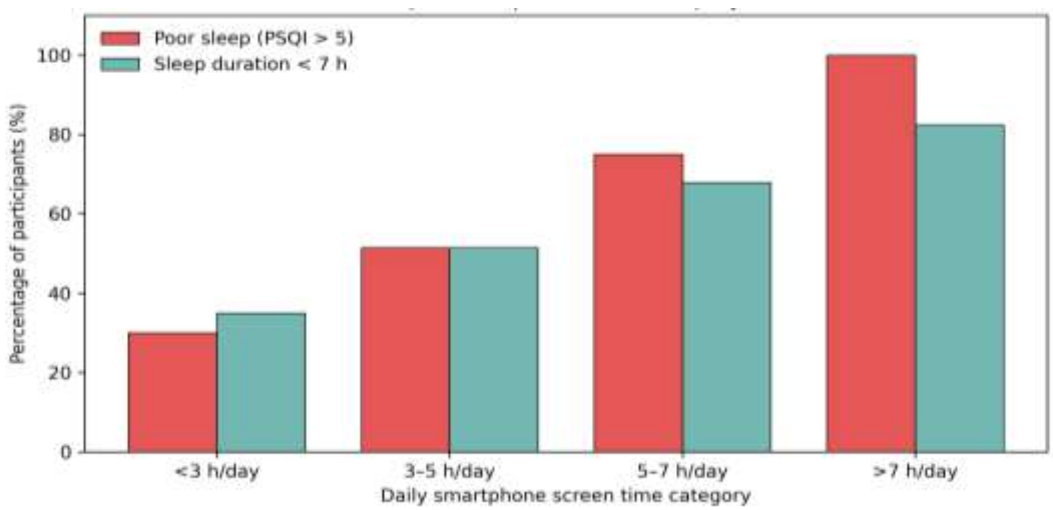

Figure 2. Prevalence of poor sleep (PSQI >5) and short sleep duration (<7 hours) by screen-time category.

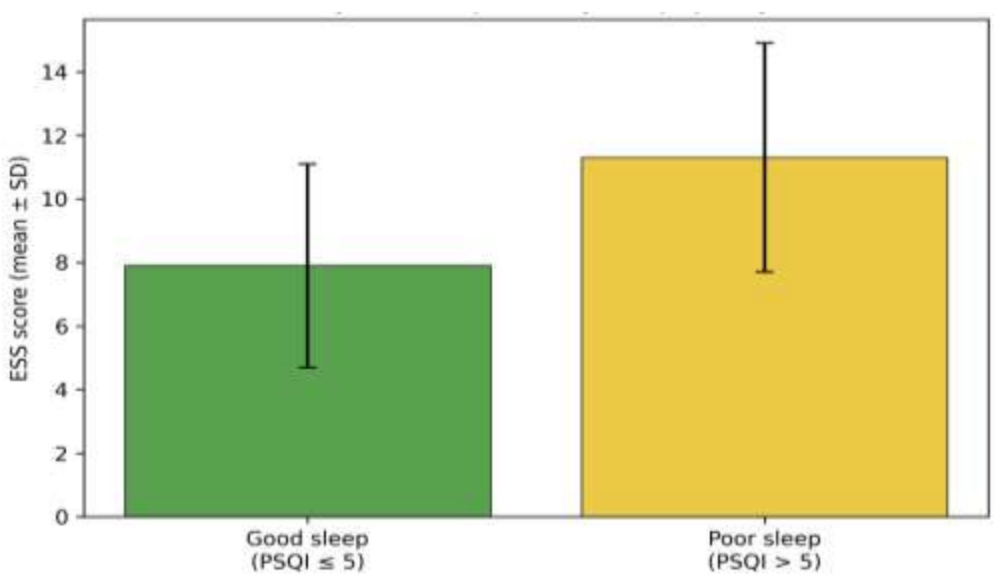

Figure 3. Mean ESS score (mean ± SD) among participants with good versus poor sleep quality.

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Table 5. Multivariable logistic regression analysis for factors associated with poor sleep and excessive daytime sleepiness

Outcome variable	Main predictor	Adjusted OR	95% CI	p-value	Covariates included in the model
Poor sleep [PSQI >5]	Screen time >5 hours/day	2.6	1.2–5.7	0.015*	Age, sex, BMI, caffeine intake, physical inactivity, near-bedtime phone use
Excessive daytime sleepiness [ESS >10]	Screen time >5 hours/day	2.1	1.0–4.6	0.048*	Age, sex, BMI, caffeine intake, physical inactivity, near-bedtime phone use

**Statistically significant at p < 0.05.*
Footnote: OR = odds ratio; CI = confidence interval; PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale.

Multivariable logistic regression analysis showed that smartphone screen time >5 hours/day was independently associated with poor sleep and excessive daytime sleepiness after adjustment for age, sex, BMI, caffeine intake, physical inactivity, and near-bedtime phone use [Table 5].

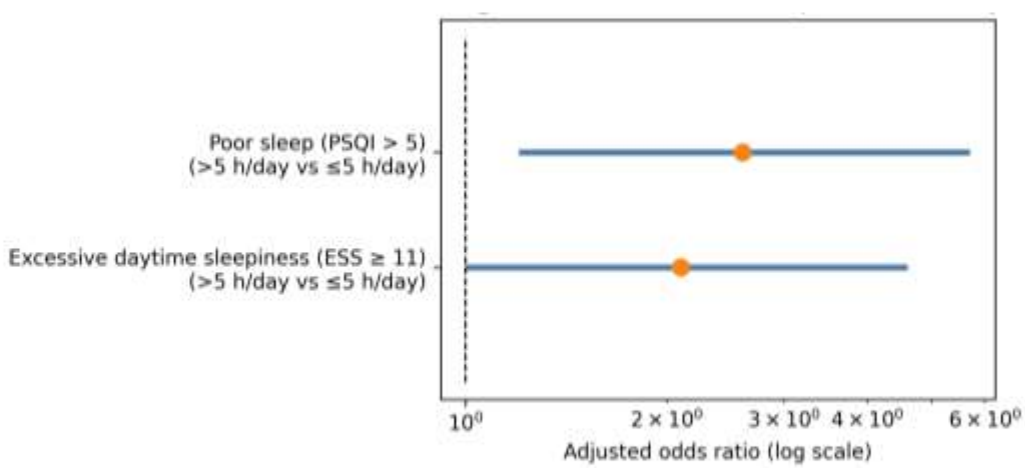

Figure 4. Adjusted odds ratios (95% CI) for sleep outcomes comparing >5 h/day versus ≤5 h/day screen time.

Discussion

This study observed a consistent association between higher smartphone screen time and poorer sleep quality, accompanied by reduced daytime alertness. The exposure–response pattern across screen-time categories suggests that both the duration and timing of smartphone use are relevant to sleep health. A large proportion of participants reported phone use within one hour of bedtime, highlighting that problematic exposure is not limited to total daily use but also to pre-sleep habits.

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Study findings align with adult data showing that bedtime mobile phone activities after lights out are linked to higher PSQI scores and greater daytime dysfunction [3,9]. The current results are also consistent with studies using direct screen-time measurements, which have reported that heavier smartphone use is associated with poorer sleep outcomes [4]. In young adult and student samples, similar patterns of poor sleep quality among higher exposure groups have been described [8,10-13]. Broader evidence, including meta-analytic findings on portable screen devices, also supports an adverse association with sleep outcomes [7].

Mechanistically, evening light exposure from screens can suppress melatonin and delay circadian phase, thereby prolonging sleep latency and shifting sleep timing [5,6]. In addition, interactive content can heighten arousal through emotional engagement, reward-based scrolling, and rapid switching of attention. This behavioral activation extends wakefulness and increases the likelihood of fragmented sleep due to nocturnal notifications or habitual checking. These pathways provide biological plausibility for the observed increases in PSQI scores and the higher frequency of short sleep duration among participants with longer screen time.

Daytime sleepiness in this cohort was meaningfully higher among those with poor sleep. This relationship is expected because reduced sleep duration and increased sleep fragmentation impair homeostatic sleep drive and cognitive alertness. Prior studies in health science students have reported that higher device-use exposure is linked to poor sleep quality and daytime sleepiness [10-13]. In the present analysis, the positive correlation between screen time and ESS and the elevated adjusted odds of excessive daytime sleepiness support a clinically relevant impact, as sleepiness can affect learning efficiency, reaction time, and risk-taking behavior[14].

From a public health perspective, the findings emphasize that screen-time counselling can be positioned as a modifiable, low-cost intervention within college health services and workplace wellness programs. Simple behavioral targets, such as a consistent screen-free period before bedtime and reducing phone use in bed, are practical and culturally adaptable. Where feasible, device-based usage tracking can support individualized feedback and goal setting.

Generalizability

The study reflects young adults from a single medical college environment with a predominance of students. The exposure–response relationship aligns with published observational evidence, supporting applicability to similar Indian college and early-career settings with high smartphone access across urban and semi-urban regions, where device habits resemble those observed here. External validity is limited for older adults, night-shift workers, and individuals with clinically diagnosed sleep disorders, where sleep determinants and comorbidities differ.

Conclusion

In this observational study among young adults, higher daily smartphone screen time and near-bedtime phone use were associated with poorer sleep quality and greater daytime sleepiness. PSQI scores and the prevalence of poor sleep increased progressively across screen-time categories, and participants with poor sleep demonstrated higher ESS scores. Screen time correlated positively with both sleep disturbance and sleepiness, and higher exposure remained associated with adverse sleep outcomes after covariate adjustment. Integrating screen-time assessment into routine counselling, promoting a consistent pre-sleep digital curfew, and reducing phone use in bed can support better sleep health, improved concentration, and safer daytime functioning in campus settings. Incorporating digital well-being modules into routine orientation programs can strengthen adoption of these practices.

Limitations

The cross-sectional design limits causal inference. Several measures relied on self-report, including bedtime behaviors and, in some participants, screen-time recall. The sample was drawn from a single institution with a predominance of students, which restricts external validity for other age groups and occupational profiles. Unmeasured factors such as psychological stress, detailed content type, and ambient light exposure were not captured, which influence sleep quality and sleepiness.

Recommendations

Institutions should integrate brief sleep-screening questions into routine student and employee health assessments. Health education programs should promote a fixed digital curfew of at least 60 minutes before bedtime, discourage phone use in bed, and encourage enabling night-mode features to reduce blue-light exposure. Students and young employees should be counselled to silence non-urgent notifications overnight, use an alarm clock instead of the phone, and adopt calming pre-sleep routines such as reading

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print material or breathing exercises. Where possible, device-based screen-time reports should be used for personalized feedback, peer support, and goal tracking. Reinforcement through posters, peer-led reminders, and periodic follow-up improves adherence.

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Abbreviations
BMI: Body mass index;
ESS: Epworth Sleepiness Scale;
EDS: Excessive daytime sleepiness;
PSQI: Pittsburgh Sleep Quality Index;
SD: Standard deviation;
OR: Odds ratio;
CI: Confidence interval.

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The study had no funding.

Conflict of interest
The authors declare no conflict of interest.

Author contributions
Amrutha Kanagala-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.**Ankur**-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.

Data availability
Data available on request

Author Biography
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