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Effect of a Sleep Hygiene–Focused Health Education Intervention on Screen-Time Behaviours and Pittsburgh Sleep Quality Index Outcomes

Dr Harthy Preetha R[1*], Dr Rajam Krishna Subramanian[2], Dr Dinesh Kumar[3]

[1]Postgraduate, Department of Physiology, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Chengalpattu District, Tamil Nadu, India (Corresponding author)

[2]Professor, Department of Physiology, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Chengalpattu District, Tamil Nadu, India

[3]Deputy Medical Superintendent, Sayee Speciality Hospital, Kancheepuram, Tamil Nadu

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KEYWORDS

Screen time, Sleep quality, Pittsburgh Sleep Quality Index, Sleep hygiene, Health education, Young adults

ABSTRACT:

Background: Excessive screen time – particularly during the evening and at bedtime – has been increasingly implicated in poor sleep quality, shorter sleep duration, and daytime sleepiness among young adults, making it a modifiable target for health education interventions.

Objective: To evaluate the effect of a structured health education session on screen-time behaviours and sleep outcomes.

Methods: A pre–post interventional study was conducted over six months in the Department of Physiology, Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India, among 100 participants who underwent baseline assessment of screen-time behaviours and sleep outcomes. A structured health education session on healthy digital habits and sleep hygiene was delivered, after which the same measures were reassessed and analysed using paired statistical tests ($p<0.05$).

Results: Among 100 participants (mean age 23.3 ± 5.4 years; 47% male), most were students (85%) and 59% lived at home. Baseline lifestyle risks included 49% overweight/obesity, 60% caffeine use (mean 1.9 ± 0.7 cups/day among users), and 59% late-evening meals. After the health education session, screen exposure reduced significantly: weekday screen time fell from 6.28 ± 1.64 to 5.17 ± 1.85 h/day and evening exposure after 8 pm from 2.57 ± 1.12 to 1.82 ± 1.23 h/day (all $p<0.001$). Bedtime screen use decreased (68% → 49%) and the screen-free interval before sleep increased (11 → 37 minutes, $p<0.001$). Sleep improved with lower PSQI (9.56 → 5.64, $p<0.001$), fewer poor sleepers (65% → 43%), longer sleep duration (5.43 → 5.97 h/night), and better SHI (29.1 → 24.3, $p<0.001$).

Conclusion: A brief health education intervention was associated with significant reductions in bedtime screen exposure and improved sleep hygiene, translating into better PSQI-defined sleep quality, longer sleep duration, and reduced daytime sleepiness.

Introduction

Sleep is a fundamental biological process that supports neurocognitive performance, emotional regulation, metabolic homeostasis, and immune function, and insufficient or poor-quality sleep has become increasingly common in modern populations.(1) The rapid proliferation of smartphones and other portable screens has normalised device use in the evening and in bed, raising concern that screen exposure may contribute to delayed bedtimes, shortened sleep duration, and impaired sleep quality.(2) Literature has consistently reported adverse associations between screen media use and sleep outcomes, with Al-Garni et al. (2024), Alshoaibi et al. (2023) and Merdad et al. (2014) linking screen exposure to later sleep timing and/or reduced total sleep time.(3-5) The Bedtime Electronic Devices study by Brosnan et al. (2024) using objective measures has further supported this relationship, demonstrating that screen use at bedtime is associated with shorter sleep duration and poorer sleep quality among youths.(2)

Several biological and behavioural mechanisms have been proposed to explain how screen time disrupts sleep. First, screen use may displace time that would otherwise be allocated to sleep, especially when entertainment or social media engagement extends beyond intended bedtime.(6) Second, stimulating content and interactive features may increase cognitive and emotional arousal, delaying sleep initiation and increasing bedtime resistance.(7, 8) Third, light emitted from LED screens – particularly short-wavelength ('blue') light – may suppress melatonin secretion and shift circadian timing, thereby delaying sleepiness and altering sleep physiology.(9) Heo et al. (2017), Höhn et al. (2024) and Sharf et al. (2024) have shown that evening smartphone or tablet exposure can reduce melatonin and worsen subjective sleepiness and subsequent sleep parameters compared with non–blue-light exposure or non-screen activities.(10-12) Given these pathways, the American Academy of Sleep Medicine has promoted practical measures such as disconnecting from electronic devices 30–60 minutes before bedtime to reduce 'digital distractions' that interfere with sleep. In younger children,(13) the World Health Organization has issued guidance to minimise sedentary screen time and emphasise healthy sleep routines as part of 24-hour movement behaviours.(14)

In this context, the present study was conducted to evaluate whether a structured health education session could modify screen-time behaviours and improve sleep-related outcomes. Education-based interventions are attractive in school/college and community settings because they are low-cost, scalable, and can target modifiable habits (e.g., bedtime device use, screen curfews, and sleep hygiene). By comparing outcomes before and after the educational intervention, this study aimed to generate locally relevant evidence on the effectiveness of health education as a practical strategy to mitigate screen-related sleep disruption.

Materials and Methods

This study was conducted as a single-centre, prospective, interventional pre–post (before-and-after) assessment study in the Department of Physiology, Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India, over a period of six months. Prior to initiation, approval was obtained from the Institutional Human Ethics Committee (IHEC) of the institution (approval number IHEC-I/072/03/2026 dated 23/03/2026). All eligible participants were provided a Participant Information Sheet (PIS) in a language they could understand, and the study purpose, procedures, potential risks/benefits, confidentiality safeguards, and voluntary nature of participation were explained verbally to ensure comprehension; thereafter, written informed consent was obtained before enrolment. Participants were enrolled based on predefined eligibility criteria. Inclusion criteria comprised individuals aged 18 years and above who reported regular use of screen-based devices (e.g., smartphone/tablet/computer/television), were willing to participate in both the pre-intervention and post-intervention assessments, and provided written informed consent. Exclusion criteria included individuals who did not consent or were unwilling/unable to complete follow-up, those with a known diagnosis of a sleep disorder (or currently receiving treatment for sleep-related problems), those with major medical, psychiatric, or neurological illnesses likely to influence sleep, participants engaged in regular night-shift work or rotating shift duties, and those using medications/substances that could significantly affect sleep architecture or alertness (e.g., sedatives, stimulants) during the assessment period.

Sample size was calculated for a within-subject (pre–post) comparison of the primary sleep outcome using a paired-mean framework. The expected magnitude of change was derived from Kaku et al. (2012),(15) which planned for an approximate 1.0-point improvement in global Pittsburgh Sleep Quality Index (PSQI) score with sleep-hygiene education/behavioural approaches and reported baseline PSQI variability in the range of SD 2.8. Assuming a two-sided α of 0.05, 80% power, a minimum clinically relevant mean pre–post difference (δ) of 1.0 PSQI point, and using a conservative estimate of the SD of paired differences (σ_d), the minimum sample required was estimated using the paired t-test formula $n = [(Z_{1-\alpha/2} + Z_{1-\beta})\sigma_d/\delta]^2$ as n = 100 participants. Data were collected at two time points (pre-intervention and post-intervention) using a structured, interviewer-administered case-record form. At baseline, participants' socio-demographic details and relevant lifestyle factors were recorded, followed by

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assessment of screen exposure patterns, including average daily recreational screen time (weekday/weekend), timing of last screen use before sleep, frequency of in-bed device use, and use of night-mode/blue-light filters. To improve measurement accuracy beyond recall alone, participants' total daily smartphone screen time and evening/bedtime use (as available) were additionally documented from the device's built-in usage dashboards (iOS 'Screen Time' or Android 'Digital Wellbeing'). Sleep outcomes were assessed using the Pittsburgh Sleep Quality Index (PSQI), a 19-item instrument that evaluates sleep quality and disturbances over a one-month reference period and provides a global score for overall sleep quality. Sleep-hygiene behaviours were measured using the Sleep Hygiene Index (SHI), a 13-item questionnaire developed to quantify engagement in behaviours known to influence sleep. Immediately after the baseline assessment, a structured health education intervention was delivered in small groups through a face-to-face, slide-assisted interactive session (approximately 30–40 minutes) with a brief question–answer component and a take-home handout. The content focused on (i) the evidence-based pathways by which screen use can impair sleep – time displacement, psychological/cognitive arousal, and the alerting/circadian effects of evening light exposure – and (ii) practical, behaviourally specific strategies to reduce screen-related sleep disruption. Key recommendations included powering down or disconnecting from electronic devices at least 30–60 minutes before bedtime, keeping phones away from the bed to reduce 'digital distractions,' avoiding stimulating content close to bedtime, and replacing late-evening screen exposure with a wind-down routine. Participants were counselled on core sleep-hygiene elements – regular sleep–wake scheduling, limiting caffeine and heavy meals near bedtime, optimising the sleep environment (dark/quiet/comfortable), and using the bed primarily for sleep. Participants were encouraged to set an evening 'screen curfew,' enable do-not-disturb modes, and activate night-shift/blue-light reduction settings where applicable. Reinforcement of key messages was provided periodically during the follow-up window. At post-intervention follow-up, the same screen-time measures (self-report and device-dashboard logs) and the same sleep instruments (PSQI and SHI) were re-administered using identical procedures to quantify changes attributable to the health education session.

Statistical analysis: Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarised as mean ± standard deviation (SD) for approximately normally distributed data and as median with interquartile range (IQR) for skewed distributions, while categorical variables were expressed as frequency and percentage. Normality of continuous variables was assessed using the Shapiro–Wilk test and visual inspection of histograms/Q–Q plots. Pre-intervention and post-intervention comparisons were conducted using the paired t-test for normally distributed continuous outcomes and the Wilcoxon signed-rank test for ordinal or non-normally distributed outcomes; paired categorical outcomes were compared using McNemar's test. Associations between change in screen-time measures and change in sleep outcomes were evaluated using Pearson or Spearman correlation as appropriate, and simple linear regression was used to estimate effect sizes with 95% confidence intervals. All tests were two-tailed, and a p value <0.05 was considered statistically significant.

Results

Among the 100 participants, the mean age was 23.3 ± 5.4 years, with a near-equal gender distribution (47.0% male and 53.0% female). Most were students (85.0%), while 15.0% were staff; among students, representation was highest from 1st-year UG (24.7%) and interns (22.4%), followed by final-year UG (15.3%) and 3rd-year UG (14.1%). A majority resided at home (59.0%), and 41.0% stayed in the hostel. With respect to BMI categories, 43.0% had normal BMI, while 29.0% were obese and 20.0% were overweight. Just over half were physically active (53.0%), and 60.0% reported caffeine intake, with a mean consumption of 1.9 ± 0.7 cups/day among users. Late-evening meals after 9 pm were common (59.0%). Current smoking was infrequent (5.0%), whereas 16.0% reported alcohol use. One-fifth of participants (20.0%) reported a medical or psychiatric condition affecting sleep, and 6.0% reported baseline use of sleep medication.

Following the health education session, mean weekday screen time decreased from 6.28 ± 1.64 to 5.17 ± 1.85 hours/day and weekend screen time reduced from 7.30

± 1.81 to 6.14 ± 2.04 hours/day (both $p<0.001$). Recreational screen time also declined significantly (3.96 ± 1.47 to 3.24 ± 1.55 hours/day, $p<0.001$), alongside a reduction in evening screen exposure after 8 pm (2.57 ± 1.12 to 1.82 ± 1.23 hours/day, $p<0.001$). Bedtime device use improved, with screen use in bed falling from 68.0% to 49.0% ($p<0.001$) and its frequency decreasing from a median of 5 (IQR 2–6) to 2 (IQR 1–4) days/week ($p<0.001$). Participants also reported a longer gap between last screen use and sleep, with the median time since last screen use before bedtime increasing from 11 (IQR 5–23) to 37 (IQR 28–54) minutes ($p<0.001$). Protective device settings increased significantly, including night-mode/blue-light filter use (37.0% to 62.0%) and do-not-disturb/notification control (28.0% to 64.0%) (both $p<0.001$).

Post-intervention, overall sleep quality improved significantly. The mean PSQI global score decreased from 9.56 ± 6.48 at baseline to 5.64 ± 5.89 after the health education session ($p<0.001$), and the proportion classified as poor sleepers (PSQI >5) reduced from 65.0% to 43.0% ($p<0.001$), with a corresponding increase in good sleepers from 35.0% to 57.0%. Mean self-reported sleep duration increased from 5.43 ± 0.92 to 5.97 ± 0.89 hours/night ($p<0.001$), and the daytime sleepiness/fatigue score reduced from 11.3 ± 3.9 to 9.1 ± 4.1 ($p<0.001$). Sleep timing also changed significantly, with bedtime and wake time showing statistically significant shifts between assessments ($p<0.001$ and $p=0.031$, respectively).

Sleep hygiene improved after the intervention, with the mean SHI score decreasing from 29.1 ± 5.3 to 24.3 ± 6.2 ($p<0.001$), indicating better overall sleep-hygiene practices. The proportion reporting a regular sleep–wake schedule increased from 26.0% to 47.0% ($p<0.001$), while caffeine intake after 6 pm reduced from 47.0% to 27.0% ($p<0.001$). Participants also reported improvements in the sleep environment, with adequate sleep conditions (dark/quiet/comfortable) increasing from 49.0% to 64.0% ($p=0.003$). In contrast, changes in heavy meals close to bedtime (59.0% to 51.0%), late-evening naps (26.0% to 21.0%), and vigorous exercise within 2 hours of bedtime (20.0% to 21.0%) were not statistically significant ($p>0.05$). Change-score analysis showed that greater reductions in weekday screen time were significantly associated with greater improvement in overall sleep quality (Δ weekday screen time vs Δ PSQI: $r = 0.38$, $\beta = 1.77$; 95% CI 0.90 to 2.64, $p<0.001$). A strong association was observed between reductions in evening screen exposure after 8 pm and improvements in sleep latency ($r = -0.93$, $\beta = -28.5$ minutes; 95% CI −30.7 to −26.3, $p<0.001$), whereas change in evening screen exposure was not significantly related to change in sleep duration ($r = 0.06$, $p=0.551$).

Discussion

The present pre–post evaluation in a young adult academic cohort (mean age 23.3 years; 85% students) demonstrated a high baseline burden of suboptimal sleep and heavy screen exposure, followed by favourable shifts in screen-use behaviours, sleep hygiene, and sleep outcomes after a structured health education session. The baseline profile – high proportions of overweight/obesity (49% combined), frequent late-evening meals (59%), and common caffeine use (60%) – is relevant because lifestyle behaviours and stimulants can interact with circadian timing and sleep continuity in students and early-career staff; as noted by Hasler et al. (2012), Logan et al. (2018) and Sejbuk et al. (2022).(16-18) At baseline, the cohort reported substantial daily screen exposure (weekday mean 6.3 h/day; weekend 7.3 h/day), with particularly concerning patterns around bedtime: two-thirds used screens in bed and the median gap between last screen use and sleep was short (11 minutes). Such bedtime-centric exposure is mechanistically important because screen use can impair sleep through (i) time displacement (delaying bedtime and reducing sleep opportunity),(2) (ii) cognitive/emotional arousal from interactive or socially salient content,(19) and (iii) light-mediated circadian effects that can suppress melatonin and delay the circadian phase when exposure occurs in the evening.(20) Chang et al. (2015) and Chinoy et al. (2018) shows that evening exposure to light-emitting screens can suppress melatonin, delay circadian timing, prolong sleep onset, and reduce next-morning alertness compared with non–light-emitting alternatives.(21, 22) AlShareef (2022) and Krishnan et al. (2020) similarly links bedtime smartphone/screen exposure with longer sleep latency, reduced sleep duration/efficiency, and greater daytime dysfunction – patterns that mirror the pre-intervention symptom profile in the current cohort.(23, 24)

After health education, the cohort demonstrated significant improvements in screen metrics: reduced weekday and weekend total screen time, lower recreational and post-8 pm exposure, reduced screen use in bed (68% to 49%) with fewer in-bed screen days per week, and a markedly longer 'screen-free' interval before sleep (median 11 to 37 minutes). These changes align closely with Tienoven et al. (2014) recommended behavioural targets that emphasize limiting evening device exposure and creating a buffer period before bedtime to facilitate sleep initiation and minimize sleep disruption.(25) The concurrent rise in night-mode/blue-light filter use and do-not-disturb/notification control is clinically coherent: while light spectrum and intensity can influence circadian physiology, the interruption burden from alerts and the behavioural habit loop of checking devices are also major contributors to sleep fragmentation and prolonged sleep initiation.(26) Notably, the primary device remained predominantly the smartphone, implying that the intervention shifted how and when devices were used rather than changing device ownership or access – an important point for feasibility in academic settings where smartphones are integral to learning and communication.(27)

Sleep outcomes improved in parallel. The PSQI global score decreased substantially and the proportion of poor sleepers (PSQI >5) fell from 65% to 43%. The PSQI is a validated composite of seven domains (0–21 total), and the >5 cut-off is widely used to distinguish poor from good sleepers with good diagnostic performance.(28) The largest improvements in PSQI component medians occurred in domains most plausibly affected by reduced bedtime stimulation (subjective sleep quality, sleep latency, sleep duration, disturbances, and daytime dysfunction), while sleep-medication use was unchanged – consistent with a behaviour-focused intervention that did not directly address pharmacologic sleep management and with the typically low medication use expected in young adults. The increase in self-reported sleep duration (0.5 hours/night) and reduction in daytime sleepiness/fatigue are clinically meaningful, because even modest extensions of sleep opportunity can improve daytime functioning in sleep-restricted students, as noted by Arnal et al. (2015).(29) The significant shifts in sleep timing (bedtime and wake time) further suggest that the intervention influenced sleep scheduling, potentially through earlier cessation of evening screen exposure and strengthened routine cues.(30) This interpretation is consistent with behavioural sleep recommendations by Castro-Santos et al. (2023) that stress regular sleep–wake timing, minimizing evening bright light, and creating a wind-down period.(31)

The sleep-hygiene findings reinforce the behavioural pathway. SHI total scores improved significantly – most notably an increase in regular sleep–wake schedules and a reduction in evening caffeine use. The Sleep Hygiene Index developed by Mastin and colleagues' captures maladaptive behaviours known to correlate with sleep quality and daytime sleepiness, and higher scores indicate poorer sleep hygiene.(32, 33) From a behavioural-change perspective, the pattern of selective improvement is instructive: 'easier-to-modify' practices (routine regularity, evening caffeine avoidance, and environment optimization) shifted significantly, whereas practices more constrained by timetables or cultural/hostel contexts (heavy late meals, naps, late vigorous exercise) did not change significantly – yet overall sleep outcomes still improved, suggesting that targeting the strongest proximal disruptors (evening screen exposure and bedtime routines) can yield measurable benefit even when not all lifestyle factors shift. The change-score associations support an exposure–response relationship between screen behaviour change and sleep improvement. First, reductions in weekday total screen time correlated with improvements in PSQI global score ($r = 0.38$), and the regression coefficient indicates that larger reductions in screen time were associated with larger improvements in global sleep quality. This is consistent with Krishnan et al. (2020) and Mishra et al. (2022) linking higher daily screen exposure with poorer PSQI-defined sleep quality.(23, 34) Second, the very strong association between reduced evening (post-8 pm) screen exposure and improved sleep latency ($\beta \approx -28.5$ minutes) is physiologically plausible because the period immediately preceding sleep is when cognitive arousal, device-related 'checking' behaviours, and evening light exposure can most directly delay sleep onset. The lack of association between reduced evening screen exposure and change in sleep duration suggests that sleep duration may be more strongly shaped by fixed wake-time demands (classes/clinical postings) and overall time available for sleep, whereas sleep latency is more

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sensitive to the immediate pre-sleep behavioural environment.(35) Overall, the results indicate that a pragmatic health education package focused on bedtime screen reduction, creation of a pre-sleep screen-free buffer, and reinforcement of core sleep hygiene behaviours can be associated with concurrent improvements in screen-time patterns, sleep hygiene, and PSQI-defined sleep outcomes within a six-month academic setting.

The present study had several limitations. First, the pre–post design without a parallel control group limits causal inference, as observed improvements could partly reflect secular trends, regression to the mean, or other concurrent academic or lifestyle changes rather than the health education alone. Outcomes and exposures were predominantly self-reported, which are susceptible to recall and social desirability bias, particularly at post-intervention when participants may report behaviours consistent with the education message. Objective measures such as device-based screen-time logs, actigraphy, or sleep diaries over multiple days were not used, which could affect measurement precision and reduce comparability with physiologic sleep parameters. The follow-up interval and assessment schedule may not fully capture the sustainability of behaviour change, and repeated measurement could itself influence participant responses (testing effect). Potential confounding factors – including academic workload, examination periods, stress, mental health symptoms, caffeine dose variability, and environmental factors such as noise/light in hostel settings – may not have been fully measured or adjusted for, and some lifestyle behaviours (e.g., late meals, naps, and late exercise) showed limited change, suggesting residual influences on sleep. Finally, the single-centre setting with a predominantly student sample restricts generalisability to other institutions, age groups, and occupational profiles.

Conclusion

This pre–post study demonstrated that a structured health education session was associated with meaningful improvements in screen-use behaviours, sleep hygiene, and overall sleep quality among participants over the study period. Following the intervention, participants reported significant reductions in weekday and weekend screen time, recreational use, evening exposure after 8 pm, and screen use in bed, along with increased adoption of night-mode and do-not-disturb settings and a longer screen-free interval before sleep. These behavioural changes were accompanied by a significant decrease in PSQI global scores, a reduction in the proportion of poor sleepers, increased self-reported sleep duration, and lower daytime sleepiness/fatigue, alongside improved SHI scores and better adherence to key sleep-hygiene practices such as regular sleep–wake schedules and reduced evening caffeine intake. Importantly, greater reductions in screen time – particularly evening exposure – were associated with greater improvements in sleep outcomes, supporting the relevance of targeted screen-time modification as a practical strategy to enhance sleep health in young adults. Overall, the findings suggest that brief, feasible educational interventions can promote healthier digital and sleep practices in academic settings and may contribute to improved well-being and daytime functioning.

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Table 1: Baseline sociodemographic and lifestyle profile of participants

		Value
Age (years), Mean ± SD		23.3 ± 5.4
Gender, n (%)	Male	47 (47.0)
	Female	53 (53.0)
Role, n (%)	Student	85 (85.0)
	Staff	15 (15.0)
Year of study (students), n (%)	1st year UG	21 (24.7)
	2nd year UG	10 (11.8)

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	3rd year UG	12 (14.1)
	Final year UG	13 (15.3)
	Intern	19 (22.4)
	Postgraduate	10 (11.8)
Residence, n (%)	Hostel	41 (41.0)
	Home	59 (59.0)
Body mass index (kg/m2), n (%)	Underweight (<18.5)	8 (8.0)
	Normal (18.5–22.9)	43 (43.0)
	Overweight (23.0–24.9)	20 (20.0)
	Obese (>=25.0)	29 (29.0)
Physically active (>=150 min/week), n (%)	Yes	53 (53.0)
	No	47 (47.0)
Caffeine intake, n (%)	Yes	60 (60.0)
	No	40 (40.0)
Caffeine (cups/day among users), Mean ± SD		1.9 ± 0.7
Late-evening meals (after 9 pm), n (%)	Yes	59 (59.0)
	No	41 (41.0)
Current smoking, n (%)	Yes	5 (5.0)
	No	95 (95.0)
Alcohol use, n (%)	Yes	16 (16.0)
	No	84 (84.0)
Self-reported medical/psychiatric condition affecting sleep, n (%)	Yes	20 (20.0)
	No	80 (80.0)
Baseline sleep medication use, n (%)	Yes	6 (6.0)
	No	94 (94.0)

Table 2: Screen-time behaviour profile at baseline and post-intervention

	Pre-intervention	**Post-intervention**	**p-value**
Total daily screen time – Weekdays (hours/day), Mean ± SD	6.28 ± 1.64	5.17 ± 1.85	<0.001*
Total daily screen time – Weekends (hours/day), Mean ± SD	7.30 ± 1.81	6.14 ± 2.04	<0.001*

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Recreational screen time (hours/day), Mean ± SD		3.96 ± 1.47	3.24 ± 1.55	<0.001*
Evening screen exposure after 8 pm (hours/day), Mean ± SD		2.57 ± 1.12	1.82 ± 1.23	<0.001*
Screen use in bed (Yes), n (%)		68 (68.0)	49 (49.0)	<0.001*
Screen use in bed - frequency (days/week), Median (IQR)		5 (2–6)	2 (1–4)	<0.001*
Time since last screen use before sleep (minutes), Median (IQR)		11 (5–23)	37 (28–54)	<0.001*
Night-mode or blue-light filter enabled (Yes), n (%)		37 (37.0)	62 (62.0)	<0.001*
Do-not-disturb or notification control at night (Yes), n (%)		28 (28.0)	64 (64.0)	<0.001*
Primary device used, n (%)	Smartphone	87 (87.0)	89 (89.0)	0.446
	Laptop	11 (11.0)	6 (6.0)	
	Tablet	1 (1.0)	3 (3.0)	
	Television	1 (1.0)	2 (2.0)	
*Statistically significant at p<0.05				

Table 3: Sleep outcomes at baseline and post-intervention

		Pre-intervention	**Post-intervention**	**p-value**
PSQI global score, Mean ± SD		9.56 ± 6.48	5.64 ± 5.89	<0.001*
PSQI, n (%)	Poor sleeper (PSQI >5)	65 (65.0)	43 (43.0)	<0.001*
	Good sleeper (PSQI ≤5)	35 (35.0)	57 (57.0)	
Subjective sleep quality (0–3), Median (IQR)		2 (0–3)	0 (0–2)	<0.001*
Sleep latency (PSQI) (0–3), Median (IQR)		2 (0–3)	0 (0–2)	<0.001*
Sleep duration (PSQI) (0–3), Median (IQR)		2 (0–3)	0 (0–2)	<0.001*
Habitual sleep efficiency (0–3), Median (IQR)		2 (1–2)	1 (0–2)	<0.001*
Sleep disturbances (0–3), Median (IQR)		2 (1–3)	0 (0–2)	<0.001*
Use of sleeping medication (0–3), Median (IQR)		0 (0–0)	0 (0–0)	0.317
Daytime dysfunction (0–3), Median (IQR)		2 (1–3)	0 (0–2)	<0.001*
Self-reported sleep duration (hours/night), Mean ± SD		5.43 ± 0.92	5.97 ± 0.89	<0.001*
Sleep latency (minutes), Median (IQR)		36 (28–45)	50 (35–66)	<0.001*
Bedtime (hh:mm), Mean ± SD (minutes from midnight)		13:44 ± 684 min	18:50 ± 521 min	<0.001*

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Wake time (hh:mm), Mean ± SD (minutes from midnight)	06:47 ± 35 min	06:51 ± 42 min	0.031*
Daytime sleepiness/fatigue score (0–24), Mean ± SD	11.3 ± 3.9	9.1 ± 4.1	<0.001*
*Statistically significant at p<0.05			

Table 4: Sleep hygiene practices at baseline and post-intervention

	Pre-intervention	**Post-intervention**	**p-value**
Sleep Hygiene Index (SHI) total score, Mean ± SD	29.1 ± 5.3	24.3 ± 6.2	<0.001*
Regular sleep–wake schedule (Yes), n (%)	26 (26.0)	47 (47.0)	<0.001*
Caffeine intake after evening (after 6 pm) (Yes), n (%)	47 (47.0)	27 (27.0)	<0.001*
Heavy meals close to bedtime (after 9 pm) (Yes), n (%)	59 (59.0)	51 (51.0)	0.169
Long naps late evening (after 5 pm, >30 min) (Yes), n (%)	26 (26.0)	21 (21.0)	0.302
Vigorous exercise within 2 h of bedtime (Yes), n (%)	20 (20.0)	21 (21.0)	1.000
Adequate sleep environment (dark/quiet/comfortable) (Yes), n (%)	49 (49.0)	64 (64.0)	0.003*
*Statistically significant at p<0.05			

Table 5: Correlation between change in screen time and change in sleep outcomes

	Correlation	**Effect estimate**	**p-value**
Δ weekday screen time (h/day) vs Δ PSQI global score	r = 0.38	β = 1.77 (95% CI 0.90 to 2.64)	<0.001*
Δ evening screen exposure after 8 pm (h/day) vs Δ sleep latency (minutes)	r = -0.93	β = -28.5 (95% CI -30.7 to -26.3)	<0.001*
Δ evening screen exposure after 8 pm (h/day) vs Δ sleep duration (hours/night)	r = 0.06	β = 0.03 (95% CI -0.07 to 0.14)	0.551
*Statistically significant at p<0.05			