Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Beyond Screen Time: The Association Between Smartphone Addiction and Sleep Quality Among Students of Medical Sciences: A Cross-Sectional Study

Samaneh Eslami
Mashhad University of Medical Sciences
Mahya Ebrahimi
Mashhad University of Medical Sciences
Amirali Khademi nezhad
Mashhad University of Medical Sciences
Mohsen Dehghani
Mashhad University of Medical Sciences
Masoumeh Sadeghi
sadeghi.masoume@gmail.com
Mashhad University of Medical Sciences

Research Article

Keywords: Smartphone addiction, Problematic smartphone use, Sleep quality, Pittsburgh Sleep Quality Index

Posted Date: November 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11454521/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Beyond Screen Time: The Association Between Smartphone Addiction and Sleep Quality Among Students of Medical Sciences: A Cross-Sectional Study

Running title: Smartphone Addiction and Sleep Quality

Samaneh Eslami[1†], Mahya Ebrahimi[2,1†], Amirali Khademi nezhad[3], Mohsen Dehghani[1*], Masoumeh Sadeghi[1*]

[1]Department of Epidemiology, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran

[2]Student research committee, Mashhad University of medical sciences, Mashhad, Iran

[3]Department of Social Work, School of Paramedical and Rehabilitation, Mashhad University of Medical Sciences, Mashhad, Iran

[†] These authors contributed equally to this work and share first authorship.

*Corresponding Authors:

Masoumeh Sadeghi

Email: sadeghi.masoume@gmail.com

Mohsen Dehghani

Email: mohsendehghani.ir@gmail.com

Abstract:

Background and aims: The prevalence of sleep disorders and cell phone addiction has increased in recent years, especially among students. The simultaneous increase in these two problems can have negative consequences for mental health and academic performance. This study aimed to determine the association between sleep quality and mobile phone addiction in students of Mashhad University of Medical Sciences.

Methods: In this cross-sectional study, 404 students of Mashhad University of Medical Sciences (basic and clinical fields; undergraduate and postgraduate levels) were selected by simple random sampling from the student list in the 2025-2026 academic year. Data were collected via an online questionnaire using the Pittsburgh Sleep Quality Index (poor sleep quality: score >5) and the Persian Mobile Phone Addiction Scale (PMPAS; high risk of smartphone addiction defined by sex-specific cut-offs of ≥31 for males and ≥33 for females). Data were analyzed using univariable and multivariable logistic regression in Stata version 18.

Results: Of 404 students, 329 (81.44%) were classified as being at high risk of smartphone addiction, and 159 of 403 (39.45%) had poor sleep quality; 105 (25.99%) were male and 299 (74.01%) were female, with a mean age of 22.25 ± 3.96 years. In univariable logistic regression, high risk of smartphone addiction was associated with poor sleep quality (OR = 4.26, 95% CI: 2.22-8.20, P < 0.001). After adjustment for BMI, marital status, type of residence, academic field, and educational level, the association remained (adjusted OR = 4.18, 95% CI: 2.14-8.13, P < 0.001) and was consistent across tertiles of the PMPAS score (P for trend < 0.001).

Conclusion: High risk of smartphone addiction was associated with higher odds of poor sleep quality among students of medical sciences. Given the cross-sectional design, causality cannot be established; longitudinal studies are needed.

Keywords: Smartphone addiction, Problematic smartphone use, Sleep quality, Pittsburgh Sleep Quality Index**.**

Introduction

Sleep is a fundamental component of a healthy lifestyle and is essential for physical, psychological, and cognitive functioning [1, 2]. Disturbed sleep is an important public health concern because of its consistent association with depression, anxiety, and other adverse health outcomes, including increased mortality [3, 4]. Poor sleep is common worldwide and in Iran [5, 6], and it is particularly frequent among university students, in whom the weighted prevalence of insomnia (18.5%) is considerably higher than in the general population (7.4%) [7], and among medical students, nearly two-thirds of whom report poor sleep quality (64.55%) [8].

Among the behavioral factors that may influence sleep, smartphone use has received increasing attention. Smartphones have become integral to everyday life as tools for communication, education, and access to information [9, 10]. However, excessive and problematic use, commonly termed smartphone addiction or problematic smartphone use, is characterized by persistent, difficult-to-control use, preoccupation with the device, distress when access is restricted, and interference with academic, social, or other daily activities [11-13]. It has been associated with a range of adverse behavioral, psychological, social, and physical outcomes, including disrupted sleep [14, 15]. Excessive smartphone use may affect sleep through delayed bedtime, prolonged engagement with stimulating content, nighttime interruptions, and displacement of sleep time.

University students may be particularly vulnerable to problematic smartphone use because of their heavy reliance on digital technologies, academic demands, social pressures, and changing daily

routines [16, 17]. Students of medical sciences, including those in medicine, nursing, and midwifery, are of particular interest because of their intensive academic workload, clinical training, and extensive use of digital resources for learning. However, the strength of the association between smartphone addiction and sleep quality may vary across populations and settings, highlighting the need for further investigation in specific student populations. Therefore, this study aimed to investigate the association between smartphone addiction and sleep quality among students at Mashhad University of Medical Sciences.

Methods

Participants

This cross-sectional study was carried out at Mashhad University of Medical Sciences (MUMS) during the 2025–2026 academic year. Students were eligible if they were enrolled at MUMS, owned a smartphone, and agreed to take part. They came from medicine, dentistry, pharmacy, midwifery, nursing, operating room and anesthesiology, and other basic science and health fields, at both undergraduate and postgraduate levels.

We drew a simple random sample from the complete list of enrolled students using their student ID numbers. Selected students were invited individually through their university e-mail, with a link to the online questionnaire (Porsline). Data were collected between December 2025 and June 2026. A reminder e-mail was sent to those who had not responded, and if a student declined, the next student on the list was invited. After data collection, students were classified as clinical (medicine, dentistry, pharmacy, midwifery, nursing, and operating room and anesthesiology) or non-clinical (all other fields).

The minimum sample size was 384, calculated as $n = Z^2S^2/d^2$ with S = 5.38 (the standard deviation of the PSQI score in a comparable study [18]), a two-sided α of 0.05, and d = 0.538. Allowing for 15% non-response, we aimed for 440 students. Of these, 404 (91.8%) completed the questionnaire, and 36 did not respond. Incomplete questionnaires were excluded. One student had missing sleep-time items, so the PSQI could not be computed, and analyses involving sleep quality therefore included 403 students.

Measures

Pittsburgh Sleep Quality Index (PSQI) [19]. We used a 19-item self-report questionnaire grouped into seven components, each scored 0–3, giving a global score of 0–21 (higher scores indicate poorer sleep). A global score above 5 defined poor sleep quality. The Persian version has shown acceptable reliability (Cronbach's alpha 0.81)[19].

Persian Mobile Phone Addiction Scale (PMPAS) [20]. We used a 15-item scale with three dimensions: inability to control craving (8 items), feeling anxious and lost (5 items), and mood improvement (2 items). Items are rated from 1 (never) to 5 (always), giving a total score of 15–75, with higher scores indicating greater addiction (Cronbach's alpha 0.86)[20]. For the present study, participants were classified as being at high risk of smartphone addiction using sex-specific cut-offs (a score of ≥31 for males and ≥33 for females), which correspond to the thresholds proposed for the Smartphone Addiction Scale–Short Version using receiver operating characteristic (ROC) analysis [21]; participants below the corresponding cut-off were classified as not at high risk. This is a screening classification and does not represent a clinical diagnosis of addiction.

Demographic information. We collected age, sex, marital status, type of residence, academic field, educational level, and employment status. Body mass index (BMI) was calculated from self-

reported weight and height. Lifestyle factors such as physical activity, diet, smoking, and caffeine intake were not assessed.

Statistical analysis

Continuous variables are presented as mean ± SD and categorical variables as numbers and percentages; prevalences are given with 95% Wilson confidence intervals. Continuous variables were not normally distributed (Shapiro–Wilk $P < 0.001$), so groups were compared with the Mann–Whitney U test. Categorical variables were compared with the chi-square or Fisher's exact test, using the Fisher–Freeman–Halton test for type of residence because some expected counts were below 5.

We examined the association between high risk of smartphone addiction and poor sleep quality using logistic regression, reporting odds ratios (ORs) with Wald 95% CIs. Candidate covariates were age and BMI (continuous), sex, marital status, type of residence, academic field, educational level, and employment status. Variables with an overall $P < 0.20$ in univariable analysis (likelihood-ratio test) were entered together into the multivariable model; this liberal threshold was chosen to avoid leaving out potential confounders [22, 23]. We checked collinearity with variance inflation factors, model fit with the Hosmer–Lemeshow test, the AUC, and the link test, linearity of BMI with a quadratic term, and influential observations with $\Delta\beta$. In sensitivity analyses, we (i) added age and sex to the model, (ii) analyzed the PMPAS score as a continuous variable (per 10 points) and in tertiles with a test for trend, and (iii) used linear regression with the global PSQI score as the outcome. As exploratory analyses, we compared PSQI component scores by addiction-risk group and PMPAS dimension scores by sleep quality (Supplementary). We did not adjust for multiple comparisons. Analyses were done in Stata version 18, and two-sided $P < 0.05$ was considered significant.

Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Mashhad University of Medical Sciences (approval code: IR.MUMS.FHMPM.REC.1402.113). Participation was voluntary, and informed consent was obtained from all participants before completion of the questionnaire. Participants were informed that they could decline participation without any consequences, and the collected information was treated confidentially.

Results

Participant characteristics

Of the 404 students included, 329 (81.44%; 95% CI: 77.4%–84.9%) were classified as being at high risk of smartphone addiction (87/105 males, 82.86%; 242/299 females, 80.94%; P = 0.663), and 159 of the 403 students with a computable PSQI score (39.45%; 95% CI: 34.8%–44.3%) had poor sleep quality (PSQI >5); 56 students (13.9%) had a score of exactly 5 and were classified as having good sleep quality. Poor sleep quality was more frequent among students at high risk of smartphone addiction than among the others (147/328, 44.82% vs. 12/75, 16.00%; P < 0.001; Table 1). Overall, 105 (25.99%) participants were male and 299 (74.01%) were female, with a mean age of 22.25 ± 3.96 years; the mean PMPAS score was 40.07 ± 9.18 (range 15–73) and the mean PSQI score was 5.23 ± 3.06. Table 1 summarizes the characteristics of the participants according to smartphone addiction risk status.

Univariable analysis

In univariable logistic regression, high risk of smartphone addiction was significantly associated with poor sleep quality (OR = 4.26, 95% CI: 2.22–8.20, P < 0.001). Married students had lower

odds of poor sleep quality than single students (OR = 0.46, 95% CI: 0.23–0.94, P = 0.032), as did students living independently compared with dormitory residents (OR = 0.31, 95% CI: 0.13–0.73, P = 0.008; overall P for residence = 0.031), students in clinical compared with non-clinical fields (OR = 0.60, 95% CI: 0.38–0.95, P = 0.029), and students with a higher BMI (OR = 0.93 per kg/m², 95% CI: 0.88–0.99, P = 0.017). Educational level also had an overall P-value <0.20 (P = 0.170; Table 2), whereas age (P = 0.265), sex (P = 0.425), and employment status (P = 0.922) did not and were not entered into the multivariable model.

Multivariable analysis

After adjustment for BMI, marital status, type of residence, academic field, and educational level (N = 403), high risk of smartphone addiction remained associated with higher odds of poor sleep quality (adjusted OR = 4.18, 95% CI: 2.14–8.13, P < 0.001). The association of marital status did not persist after adjustment (adjusted OR = 0.84, 95% CI: 0.36–1.93, P = 0.676), an imprecise estimate given that only 45 students were married. Among the other covariates, BMI (adjusted OR = 0.94 per kg/m², 95% CI: 0.88–0.99, P = 0.033) and living independently compared with dormitory residence (adjusted OR = 0.34, 95% CI: 0.13–0.90, P = 0.029) remained significant (Table 2). The model showed adequate fit (Hosmer–Lemeshow $\chi^2(8) = 8.93$, P = 0.349; AUC = 0.67), with no evidence of misspecification (link test P = 0.302) or non-linearity of BMI (P = 0.299) and no influential observations (maximum $\Delta\beta = 0.25$). All VIF values were <1.5 (mean 1.16), indicating no problematic collinearity, including between academic field and educational level.

Sensitivity analyses

The findings were consistent in sensitivity analyses. Additionally adjusting for age and sex yielded an adjusted OR of 4.22 (95% CI: 2.16–8.23). Each 10-point increase in the PMPAS score was

associated with higher odds of poor sleep quality (crude OR = 1.87, 95% CI: 1.47–2.38; adjusted OR = 1.87, 95% CI: 1.45–2.40; both $P < 0.001$). The prevalence of poor sleep quality increased across tertiles of the PMPAS score (24.1%, 45.7%, and 50.4%; score ranges 15–36, 37–44, and 45–73); compared with the lowest tertile, the adjusted ORs were 2.42 (95% CI: 1.42–4.11) for the middle and 3.11 (95% CI: 1.82–5.29) for the highest tertile (adjusted OR per tertile = 1.75, 95% CI: 1.35–2.28; P for trend < 0.001). In linear regression, each 1-point higher PMPAS score was associated with a 0.10-point higher PSQI score (adjusted $\beta = 0.10$, 95% CI: 0.07–0.14, $P < 0.001$), and students at high risk had a 2.07-point higher mean PSQI score (95% CI: 1.32–2.81, $P < 0.001$).

PSQI components and PMPAS dimensions

Compared with students not at high risk, those at high risk had higher (worse) scores on subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, and daytime dysfunction (Mann–Whitney $P \leq 0.007$), whereas sleep disturbances and use of sleep medication did not differ ($P = 0.182$ and 0.890; Supplementary, Table S1). All three PMPAS dimensions were higher among students with poor sleep quality (all $P \leq 0.005$), and each was associated with higher odds of poor sleep quality after adjustment (adjusted OR per 5-point increase: 1.53 [95% CI: 1.24–1.90] for inability to control craving, 1.76 [1.37–2.26] for feeling anxious and lost, and 2.21 [1.26–3.90] for mood improvement; Supplementary, Table S2).

Discussion

This study investigated the association between smartphone addiction and sleep quality among students of medical sciences. A high proportion of students (81.44%) were classified as being at high risk of smartphone addiction, and 39.45% had poor sleep quality. High risk of smartphone addiction was associated with higher odds of poor sleep quality in the univariable and

multivariable analyses (adjusted OR = 4.18). This is an odds ratio and should not be read as a 4.18-fold higher risk; the corresponding crude prevalences were 44.82% versus 16.00% (prevalence ratio ≈ 2.8). The association was consistent when the PMPAS score was analyzed continuously and in tertiles, with a graded increase in the prevalence of poor sleep quality, which supports the finding independently of the cut-offs used. Marital status was associated with poor sleep quality in the univariable analysis but not after adjustment; given the small number of married students, this should be interpreted cautiously. These findings represent an adjusted statistical association in cross-sectional data and do not establish that smartphone addiction causes poor sleep.

The prevalence of high risk of smartphone addiction was 81.44%, higher than the prevalence reported in several studies among medical students, including 47.8% by Gunasekar et al., 55.1% by Gayathri et al., and 54.1% by Singh et al. [24-26], whereas the prevalence of poor sleep quality (39.45%) was lower than the 53.9% to 84.9% reported in those studies [24-26]. These comparisons should be interpreted cautiously because the studies differ in populations, instruments, cut-off values, sampling methods, and settings; in particular, the classification used here is a screening categorization based on sex-specific cut-offs, and prevalence estimates depend directly on the thresholds applied. Systematic reviews have also shown substantial heterogeneity in estimates of smartphone addiction [27, 28] and of sleep quality [29, 30] among university students, with academic workload, lifestyle behaviors, sleep hygiene, and sociocultural factors contributing to between-study variation. Direct comparisons across studies should therefore be made with caution [27, 29].

Several mechanisms have been proposed to explain the association. Excessive smartphone use, particularly before bedtime, may delay sleep onset by increasing cognitive and emotional arousal and prolonging bedtime routines [31, 32]; smartphone addiction has also been associated with

poorer sleep hygiene, irregular sleep schedules, and shorter sleep duration [22, 33, 34]; and nighttime screen light may influence melatonin secretion and circadian regulation [23, 35]. These mechanisms are hypotheses based on prior literature and were not measured in the present study. Reverse causation is also plausible: students with poor sleep or insomnia may use their smartphones at night as a way of coping, and poor sleep may impair self-regulation and promote more problematic use, so the relationship is likely bidirectional. Longitudinal studies are needed to clarify the temporal direction.

Strengths and Limitations

This study has several strengths, including random selection of participants from the complete student list, a high response rate (91.8%), the use of standardized Persian-language instruments, a sample size exceeding the calculated minimum, and the consistency of the findings across the binary, continuous, and tertile analyses.

Several limitations should be considered. First, the cross-sectional design precludes determining temporal sequence or causality, and reverse causation is possible. Second, both variables were self-reported at the same time, which may introduce recall and social desirability bias as well as common-method bias. Third, high risk of smartphone addiction was defined by sex-specific cut-offs adopted from the literature rather than derived for the PMPAS, so it is not a clinical diagnosis, prevalence estimates depend on the thresholds, and dichotomization loses information; the continuous and tertile analyses were therefore performed and gave consistent results. Fourth, the study was conducted at a single university, and no information was available on the 36 students who did not respond, so non-response bias cannot be excluded. Finally, residual confounding is possible, as factors such as clinical night shifts, academic workload and stress, caffeine and other stimulant use, physical activity, chronotype, bedtime smartphone use, and psychological distress

were not measured; some subgroups (e.g., 45 married students) were small, and no correction for multiple comparisons was applied.

Conclusions

Among students of medical sciences, high risk of smartphone addiction was associated with higher odds of poor sleep quality after adjustment for relevant covariates, with a consistent graded association across the PMPAS score. Given the cross-sectional design, these findings do not establish temporal direction or causality; longitudinal studies are needed to clarify this association.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Authors Contributions

S.E. and M.E. contributed equally to this work as co-first authors. S.E. and M.E: Conceptualization, Methodology, Formal analysis, and Writing – original draft. A.Kh: Investigation and Writing – review & editing. M.S. and M.D.: Supervision, Conceptualization, and Writing – review & editing. All authors read and approved the final version of the manuscript.

Funding

This study was supported by Mashhad University of Medical Sciences, Mashhad, Iran.

Data Availability Statement

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

Ethics Approval Statement

This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (approval code: IR.MUMS.FHMPM.REC.1402.113). The study was conducted in accordance with the Declaration of Helsinki.

Patient Consent Statement

Informed consent was obtained from all individual participants included in the study.

Permission to reproduce material from other sources

Not applicable. All figures, tables, and questionnaires used in this study are original or properly cited, and no permission was required for their use.

Table 1. Demographic characteristics of the study participants according to risk of smartphone addiction

Variables	High risk 329 (81.44)	Not high risk 75 (18.56)	P-value
Age, year (mean±SD)	22.20±3.85	22.44±4.42	0.887
BMI*, kg/m^2 (mean±SD)	22.27±3.71	22.55±3.76	0.584
PSQI*, (mean±SD)	5.63±3.00	3.47±2.68	<0.001
Sex, n (%)			
Male	87 (26.44)	18 (24.00)	0.663
Female	242 (73.56)	57 (76.00)	
Sleep quality, n (%)			
Good sleep quality (≤5)	181 (55.18)	63 (84.00)	<0.001
Poor sleep quality (>5)	147 (44.82)	12 (16.00)	
Marital Status, n (%)			
Single	297 (90.27)	62 (82.67)	0.059
Married	32 (9.73)	13 (17.33)	
Type of residency, n (%)			
Dormitory	176 (53.50)	40 (53.33)	
Living with parents	116 (35.26)	25 (33.33)	0.763
Living independently	28 (8.51)	9 (12.00)	
Other	9 (2.74)	1 (1.33)	
Academic field, n (%)			
Non clinical	239 (72.64)	49 (65.33)	0.207
Clinical	90 (27.36)	26 (34.67)	
Education Level, n (%)			
Bachelor	214 (65.05)	46 (61.33)	0.826

Master	62 (18.84)	16 (21.33)	
MD/PhD	53 (16.11)	13 (17.33)	
Job, n (%)			
Does not have a job	267 (81.16)	59 (78.67)	0.622
Has a job	62 (18.84)	16 (21.33)	

Values are mean ± SD or n (column %); percentages are column percentages within smartphone addiction risk status. High risk of smartphone addiction: PMPAS score ≥31 (males) or ≥33 (females); poor sleep quality: PSQI >5. *Continuous variable. P-values: Mann–Whitney U test for continuous variables; chi-square test for categorical variables, except type of residency (Fisher–Freeman–Halton exact test). BMI: Body Mass Index; PSQI: Pittsburgh Sleep Quality Index.

Table 2. Crude and adjusted odds ratios for factors associated with poor sleep quality (n = 403)

	Crude			**Adjusted**		
Variables	**OR**	**95%CI**	**P-value**	**OR**	**95%CI**	**P-value**
High risk of smartphone addiction						
Not high risk (Ref)	-	-	-	-	-	-
High risk	4.26	2.22-8.20	<0.001	4.18	2.14-8.13	<0.001
Marital Status						
Single (Ref)						
Married	0.46	0.23-0.94	0.032	0.84	0.36-1.93	0.676
Academic field						
Non- clinical (Ref)	-	-	-	-	-	-
Clinical	0.60	0.38-0.95	0.029	0.66	0.40-1.09	0.108

Sex						
Male (Ref)						
Female	1.21	0.76-1.91	0.427	-	-	-
BMI*	0.93	0.88-0.99	0.017	0.94	0.88-0.99	0.033
Age	0.97	0.92-1.02	0.272	-	-	-
Type of residency						
Dormitory (Ref)	-	-	-	-	-	-
Living with parents	0.83	0.54-1.28	0.401	0.81	0.51-1.28	0.362
Living independently	0.31	0.13-0.73	0.008	0.34	0.13-0.90	0.029
Other	1.32	0.37-4.70	0.666	1.36	0.36-5.15	0.654
Education Level						
Bachelor (Ref)	-	-	-	-	-	-
Master	0.80	0.48-1.35	0.406	0.87	0.49-1.54	0.635
MD/ PhD	0.59	0.33-1.05	0.074	0.66	0.35-1.24	0.194
Job						
Does not have a job (Ref)	-	-	-	-	-	-
Has a job	0.97	0.59-1.62	0.922	-	-	-

The adjusted model included high risk of smartphone addiction, BMI, marital status, type of residency, academic field, and educational level (variables with overall $P < 0.20$ in univariable analysis); "-" = not included in the adjusted model. Overall (likelihood-ratio) P-values from univariable analysis: age 0.265, sex 0.425, BMI 0.015, marital status 0.025, type of residency 0.031, academic field 0.026, educational level 0.170, employment 0.922. *BMI was modeled as a continuous variable (OR per 1 kg/m^2). OR: odds ratio; CI: Wald 95% confidence interval; Ref: reference category; BMI: Body Mass Index.

References:

1. Clement-Carbonell, V., et al., *Sleep quality, mental and physical health: a differential relationship.* International journal of environmental research and public health, 2021. 18(2): p. 460.
2. Robbins, R. and S. Quan, *Sleep Health.* NEJM Evid, 2024. 3(8): p. EVIDra2300269.
3. Hertenstein, E., et al., *Insomnia—A risk factor for mental disorders.* Journal of sleep research, 2023. 32(6): p. e13930.
4. Ungvari, Z., et al., *Imbalanced sleep increases mortality risk by 14–34%: a meta-analysis.* GeroScience, 2025. 47(3): p. 4545-4566.
5. Canever, J.B., et al., *Worldwide prevalence of sleep problems in community-dwelling older adults: A systematic review and meta-analysis.* Sleep Medicine, 2024. 119: p. 118-134.
6. Khazaie, H., et al., *The prevalence of sleep disorders in Iranian adults-an epidemiological study.* BMC Public Health, 2024. 24(1): p. 3141.
7. Jiang, X.-L., et al., *A systematic review of studies on the prevalence of insomnia in university students.* Public health, 2015. 129(12): p. 1579-1584.
8. Binjabr, M.A., et al., *The worldwide prevalence of sleep problems among medical students by problem, country, and COVID-19 status: a systematic review, meta-analysis, and meta-regression of 109 studies involving 59427 participants.* Current sleep medicine reports, 2023. 9(3): p. 161-179.
9. Zhu, W., et al., *Influence of smartphone addiction on sleep quality of college students: The regulatory effect of physical exercise behavior.* PloS one, 2024. 19(7): p. e0307162.
10. ; Available from: https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/.
11. Chen, I.-H., et al., *Comparing generalized and specific problematic smartphone/internet use: Longitudinal relationships between smartphone application-based addiction and social media addiction and psychological distress.* Journal of behavioral addictions, 2020. 9(2): p. 410-419.
12. Panova, T. and X. Carbonell, *Is smartphone addiction really an addiction?* Journal of behavioral addictions, 2018. 7(2): p. 252-259.
13. Lin, Y.-H., et al., *Proposed diagnostic criteria for smartphone addiction.* PloS one, 2016. 11(11): p. e0163010.
14. Li, Y., et al., *Correlations between mobile phone addiction and anxiety, depression, impulsivity, and poor sleep quality among college students: A systematic review and meta-analysis.* Journal of behavioral addictions, 2020. 9(3): p. 551-571.
15. Zhang, M.X. and A.M. Wu, *Effects of smartphone addiction on sleep quality among Chinese university students: The mediating role of self-regulation and bedtime procrastination.* Addictive behaviors, 2020. 111: p. 106552.
16. Fabio, R.A., A. Stracuzzi, and R. Lo Faro, *Problematic smartphone use leads to behavioral and cognitive self-control deficits.* International journal of environmental research and public health, 2022. 19(12): p. 7445.

17. Achangwa, C., et al. *Adverse effects of smartphone addiction among university students in South Korea: a systematic review*. in *Healthcare*. 2022. MDPI.
18. Atadokht, A., *THE RELATIONSHIP OF CELL PHONE OVERUSE WITH PSYCHOPATHOLOGY OF SLEEP HABITS AND SLEEP DISORDERS IN UNIVERSITY STUDENTS.* Nursing and Midwifery Journal, 2016. 14(2): p. 136-144.
19. Chehri, A., et al., *Validation of the Persian version of the Pittsburgh Sleep Quality Index in elderly population.* Sleep Science, 2020. 13(02): p. 119-124.
20. Mazaheri, M.A. and M. Karbasi, *Validity and reliability of the Persian version of mobile phone addiction scale.* Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 2014. 19(2): p. 139.
21. Kwon, M., et al., *The smartphone addiction scale: development and validation of a short version for adolescents.* PLoS One, 2013. 8(12): p. e83558.
22. Bursac, Z., et al., *Purposeful selection of variables in logistic regression.* Source Code Biol Med, 2008. 3: p. 17.
23. Hosmer, D.W., S. Lemeshow, and R.X. Sturdivant, *Applied logistic regression*. Vol. 2. 2000: wiley, New York.
24. Gunasekar, A., et al., *Smartphone Addiction Among Medical Students and Its Implications on Sleep Quality and BMI: A Cross-Sectional Study.* Cureus, 2025. 17(8).
25. Gayathri, B., J. Sravan, and S.S. Sajidali, *Smartphone addiction and sleep disturbances among medical students: a cross-sectional study.* Cureus, 2025. 17(9).
26. Singh, G., et al., *Prevalence of Smartphone Addiction and Its Association With Sleep Quality Among Medical Undergraduates: A Cross-Sectional Study From Eastern India.* Cureus, 2025. 17(10).
27. Candussi, C.J., R. Kabir, and M. Sivasubramanian, *Problematic smartphone usage, prevalence and patterns among university students: A systematic review.* Journal of Affective Disorders Reports, 2023. 14: p. 100643.
28. Song, A., et al., *Prevalence of mobile phone addiction among medical students: a systematic review.* American Journal of Translational Research, 2023. 15(5): p. 2985.
29. Leow, M.Q.H., et al., *The relationship between smartphone addiction and sleep among medical students: A systematic review and meta-analysis.* Plos one, 2023. 18(9): p. e0290724.
30. Wang, J., et al., *Sleep quality and related risk factors among college students in China: A systematic review and meta-analysis.* American Journal of Translational Research, 2025. 17(12): p. 10111.
31. Tu, Z., et al., *Can restricting while-in-bed smartphone use improve sleep quality via decreasing pre-sleep cognitive arousal among Chinese undergraduates with problematic smartphone use? Longitudinal mediation analysis using parallel process latent growth curve modeling.* Addictive Behaviors, 2023. 147: p. 107825.
32. Tamura, H., et al., *Association between excessive use of mobile phone and insomnia and depression among Japanese adolescents.* International journal of environmental research and public health, 2017. 14(7): p. 701.
33. Demirci, K., M. Akgönül, and A. Akpinar, *Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students.* Journal of behavioral addictions, 2015. 4(2): p. 85-92.

34. Chu, Y., et al., *Dose-response analysis of smartphone usage and self-reported sleep quality: a systematic review and meta-analysis of observational studies.* Journal of Clinical Sleep Medicine, 2023. 19(3): p. 621-630.
35. Heo, J.-Y., et al., *Effects of smartphone use with and without blue light at night in healthy adults: A randomized, double-blind, cross-over, placebo-controlled comparison.* Journal of psychiatric research, 2017. 87: p. 61-70.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementary.docx