ASSOCIATION BETWEEN SMARTPHONE ADDICTION AND SLEEP DISTURBANCES AMONG UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY

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Abstract
Background: Smartphone addiction has become a rising behavioral concern, especially among university students who are extensively engaged with digital platforms for academic and social activities. Excessive smartphone use has been increasingly associated with poor sleep quality, a key determinant of cognitive performance and overall health.
Objective: To assess the association between smartphone addiction and sleep disturbances among undergraduate students in Pakistan.
Methods: A cross-sectional study was conducted from January 2024 to April 2025 among 100 undergraduate students selected through stratified random sampling from Fatima Jinnah Medical University / Sir Ganga Ram Hospital, Lahore, and Sahara Medical College, Narowal, Pakistan. Smartphone addiction was assessed using the Smartphone Addiction Scale–Short Version (SAS-SV), while sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using SPSS version 25. Descriptive statistics, Pearson's correlation, and binary logistic regression were used to explore the relationship between smartphone addiction and sleep quality, adjusting for potential confounders such as screen time before bed, caffeine intake, and academic stress.
Results: The mean age of participants was 21.1 ± 1.8 years; 58% were female. High-risk smartphone addiction was observed in 47% of students, while 66% reported poor sleep quality (PSQI > 5). A significant positive correlation was found between smartphone addiction and poor sleep ($r = 0.43$, $p < 0.001$). Logistic regression analysis showed that high-risk smartphone addiction was independently

associated with increased odds of poor sleep quality (AOR = 2.74; 95% CI: 1.31–5.75; p = 0.007). Smartphone use before bedtime also significantly predicted poor sleep (AOR = 2.11; 95% CI: 1.01–4.39; p = 0.046).

Conclusion: Smartphone addiction is significantly associated with poor sleep quality among university students. These findings underscore the need for awareness programs promoting digital hygiene and healthy sleep habits within academic settings.

Keywords: Smartphone addiction, sleep disturbances, university students, PSQI, SAS-SV, digital health, Pakistan.

Introduction:
The rapid evolution of mobile technology over the past two decades has significantly transformed modern lifestyles, with smartphones emerging as a central component of communication, education, social interaction, and entertainment. Globally, smartphone ownership has surged, with young adults being the most prolific users due to their higher technological adaptability and engagement with digital platforms[1, 2]. In university settings, smartphones serve a variety of functional purposes ranging from academic support and virtual learning to leisure activities and social connectivity. However, this constant connectivity and the accessibility of unlimited content have led to a growing public health concern: smartphone addiction [3].

Smartphone addiction is defined as a behavioural pattern characterized by excessive or compulsive smartphone use that interferes with daily life activities and leads to psychological, physiological, and social dysfunctions [4]. Unlike substance-related disorders, smartphone addiction is a form of behavioural addiction that often goes unnoticed until it begins to manifest in the form of health-related consequences. The addictive nature of smartphones is largely attributed to their design, which employs attention-capturing features such as instant notifications, social media interactions, gaming, and short-form video content. These features are designed to reinforce continuous engagement, thereby increasing screen time and risk of dependency[5].

Among university students, the prevalence of smartphone addiction is rising at an alarming rate. This demographic is particularly susceptible due to multiple factors, including academic stress, irregular schedules, peer pressure, social media use, and the lack of structured digital behavior guidelines[6]. A growing body of literature has documented the high levels of smartphone dependency in this group, with reported prevalence ranging from 30% to over 50% in various countries. In Pakistan, although smartphone use among youth has increased rapidly, there remains a scarcity of data regarding its psychological and physiological consequences, especially in academic settings[7].

One of the most commonly reported negative outcomes associated with smartphone addiction is poor sleep quality. Sleep is a vital physiological process that plays a crucial role in learning, memory consolidation, emotional regulation, and overall mental and physical health[8]. However, recent trends indicate that university students are experiencing increasing levels of sleep disturbances including insomnia, delayed sleep onset, shortened sleep duration, and excessive daytime sleepiness. Current study has suggested that excessive screen time, especially before bedtime, can negatively influence sleep by delaying circadian rhythms, reducing melatonin production, and increasing mental stimulation. These mechanisms are particularly relevant to smartphone use, given the interactive and often emotionally arousing nature of digital content consumed through mobile devices[9, 10].

The blue light emitted by smartphone screens has been shown to suppress melatonin, a hormone that regulates the sleep-wake cycle, thereby contributing to insomnia and circadian rhythm disturbances[11]. Furthermore, psychological arousal resulting from engagement with social media, emotionally charged messages, or stimulating content such as videos and games may prolong sleep latency and reduce total sleep time. Behavioral displacement is another factor, wherein time spent on smartphones during the evening replaces time that would otherwise be allocated for sleep, study, or relaxation. These disruptions can lead to a cascade of consequences, including cognitive fatigue, impaired

academic performance, increased stress levels, and heightened risk for anxiety and depression among students[12].

Several international studies have established a statistically significant association between smartphone addiction and sleep disturbances. For instance, previous studies found that South Korean college students who scored higher on the Smartphone Addiction Scale experienced poorer sleep quality and longer sleep latency periods[13]. Likewise, a study in Saudi Arabia revealed that nearly 70% of university students reporting high smartphone use also reported frequent sleep disruptions. In Pakistan, although studies have been conducted to assess smartphone usage trends among youth, very limited research has explored its relationship with sleep quality, especially using standardized tools such as the Smartphone Addiction Scale–Short Version (SAS-SV) and the Pittsburgh Sleep Quality Index (PSQI)[14].

Given the growing reliance on smartphones and the increasing rates of sleep problems among young adults, there is a pressing need to examine this association within the Pakistani university student population. Such research is essential for developing targeted interventions and health promotion strategies aimed at improving sleep hygiene, reducing digital overexposure, and fostering a healthier academic environment[15].

This cross-sectional study was conducted to assess the association between smartphone addiction and sleep disturbances among university students in Pakistan. It also aimed to quantify the prevalence of smartphone addiction and poor sleep quality using validated assessment tools and to evaluate the impact of smartphone addiction on sleep after adjusting for potential confounding factors such as screen time before bed, caffeine intake, and academic stress[16]. Understanding these relationships offers critical insight into behavioral patterns affecting student health and may assist academic institutions in developing evidence-based policies and interventions to address this emerging concern[17].

Materials and Methods
Study Design and Duration
This was a descriptive, cross-sectional analytical study designed to evaluate the association between smartphone addiction and sleep disturbances among undergraduate university students. The study was conducted over a four-month period, from January to April 2025, enabling the researchers to collect comprehensive behavioral and self-reported data during a standard academic semester. The design was chosen due to its suitability in identifying prevalence and associations between behavioral patterns and health outcomes at a single point in time.

Study Settings
The research was conducted at two recognized academic institutions in Pakistan: the Department of Psychiatry, Fatima Jinnah Medical University / Sir Ganga Ram Hospital, Lahore, and Sahara Medical College, Narowal,Pakistan, provided access to a large, diverse student body with high exposure to digital media and academic stress. In contrast, Sahara Medical College, situated in a semi-urban locality, offered representation of students from less metropolitan areas, ensuring variability in lifestyle, technology access, and sleep-related behaviors. This multi-site setting allowed the inclusion of students from different socio-academic environments, thereby improving the generalizability of findings.

Study Population
The target population comprised full-time undergraduate students aged between 18 and 25 years. Eligible participants were those who were enrolled in regular academic programs, had completed at least one full academic year, and were actively attending classes during the Spring 2025 semester. These inclusion criteria ensured that participants had stable academic routines and consistent exposure to digital devices. Students were excluded from the study if they reported any prior diagnosis of psychiatric illness (e.g., depression, anxiety disorders), were currently taking medications known to

alter sleep patterns (e.g., sedatives, stimulants), or had any neurological or endocrine disorders such as epilepsy, hypothyroidism, or sleep apnea, which could independently influence sleep quality. These exclusions were intended to minimize confounding and ensure that observed associations were primarily attributable to smartphone use behaviors.

Sample Size and Sampling Technique
A total of 100 undergraduate students were enrolled in the final sample. The sample size was calculated based on anticipated prevalence estimates of smartphone addiction and sleep disturbances in student populations, with a 95% confidence level and 10% margin of error. To ensure representative inclusion across academic disciplines and genders, a stratified random sampling method was employed. Faculties or departments within the universities served as individual strata. Within each stratum, a random selection of students was made proportionally, using a computer-generated list of student registration numbers. This approach ensured balanced representation from various academic streams, such as health sciences, business studies, IT, and social sciences, as well as proportional inclusion of male and female students.

Data Collection Procedure
Data were collected using a self-administered, structured questionnaire distributed in printed form during classroom sessions, with the assistance of faculty coordinators. The questionnaire consisted of three major components: demographic/lifestyle characteristics, smartphone addiction assessment, and sleep quality evaluation. The first section gathered basic details including age, gender, academic year, and course of study, along with lifestyle factors such as daily screen time, smartphone use before bedtime, caffeine intake, physical activity levels, and perceived academic stress. These factors were included as potential covariates influencing sleep quality.

Assessment of Smartphone Addiction
Smartphone addiction was measured using the Smartphone Addiction Scale – Short Version (SAS-SV), a 10-item validated instrument specifically designed to assess smartphone dependency in young adult populations. Each item was rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), producing a total score range of 10 to 60, with higher scores reflecting greater addiction severity. Based on previously validated cutoff values, males scoring ≥ 31 and females scoring ≥ 33 were classified as high-risk for smartphone addiction. The SAS-SV demonstrated strong internal consistency and construct validity in both global and South Asian populations, making it a reliable tool for behavioral assessment in this study.

Assessment of Sleep Quality
Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), a widely accepted and psychometrically validated tool that captures sleep patterns over the past one month. The PSQI consists of seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. Each component was scored from 0 (no difficulty) to 3 (severe difficulty), and the component scores were summed to yield a global PSQI score ranging from 0 to 21. A score >5 indicated poor sleep quality, in line with international criteria. The PSQI has been used extensively in both clinical and non-clinical settings, and it was chosen in this study for its sensitivity to various dimensions of sleep behavior.

Ethical Approval and Participant Consent
The study protocol was approved by the Institutional Review Boards (IRBs) of both Fatima Jinnah Medical University and Sahara Medical College. Before data collection began, all participants were informed of the study's aims, procedures, confidentiality safeguards, and their right to withdraw without any penalty. Written informed consent was obtained from each student. To ensure anonymity,

no personal identifiers such as names, roll numbers, or phone numbers were collected. The data were used exclusively for academic research purposes.

Statistical Analysis
Data were entered and analyzed using IBM SPSS Statistics Version 25.0 (Armonk, NY, USA). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize demographic and behavioral characteristics of the sample, as well as SAS-SV and PSQI scores. The association between smartphone addiction scores and sleep quality scores was first evaluated using the Pearson correlation coefficient to determine the linear relationship. To explore independent predictors of poor sleep quality (PSQI >5), binary logistic regression was performed. The regression model included key covariates such as gender, caffeine consumption, smartphone use before bedtime, and self-reported academic stress, alongside the primary predictor (high-risk smartphone addiction). Results were reported as Adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CI). A p-value less than 0.05 was considered statistically significant for all analyses.

Results
This study included a total of 100 undergraduate students from Fatima Jinnah Medical University / Sir Ganga Ram Hospital, Lahore, and Sahara Medical College, Narowal. All participants completed the questionnaire in full, resulting in a 100% response rate with no missing data. The results are presented under descriptive, correlational, and regression analyses, with each table clearly cited and interpreted within the text.

Descriptive Analysis
The demographic and lifestyle characteristics of the participants are summarized in Table 1. The mean age of the participants was 21.1 ± 1.8 years. Of the total sample, 58% (n = 58) were female and 42% (n = 42) were male. The average daily screen time was 6.3 ± 1.9 hours, and a significant majority of students (72%) reported using their smartphones within one hour before bedtime. Additionally, 65% of students reported regular caffeine consumption, while 54% rated their academic stress levels as moderate to high. As shown in Table 1, a considerable portion of the sample demonstrated behavioral and lifestyle patterns commonly associated with sleep disruption. Specifically, late-night screen exposure and regular caffeine intake both of which are established risk factors for impaired sleep were highly prevalent in this cohort. These baseline characteristics provide essential context for interpreting the relationship between smartphone addiction and sleep quality in subsequent analyses.

Table 1: Demographic and Lifestyle Characteristics of Participants (n = 100)

Variable	Frequency (%) / Mean ± SD
Age (years)	21.1 ± 1.8
Gender	
• Male	42 (42%)
• Female	58 (58%)
Average Daily Screen Time	6.3 ± 1.9 hours
Smartphone Use Before Bedtime	72 (72%)
Caffeine Consumption	65 (65%)
Academic Stress (Moderate/High)	54 (54%)

Smartphone Addiction and Sleep Quality Scores
The results related to smartphone addiction and sleep quality are summarized in Table 2. The mean Smartphone Addiction Scale–Short Version (SAS-SV) score was 34.7 ± 8.3. Based on the gender-specific cutoff values (≥31 for males and ≥33 for females), 47 participants (47%) were classified as having high-risk smartphone addiction. In terms of sleep quality, the mean Pittsburgh Sleep Quality

Index (PSQI) score was 7.1 ± 2.9. A total of 66 students (66%) had a PSQI score > 5, indicating poor sleep quality. As illustrated in Table 2, nearly half of the university students were at high risk for smartphone addiction, and two-thirds experienced sleep disturbances. These figures suggest a considerable overlap between problematic smartphone use and impaired sleep health in this population.

Table 2: Smartphone Addiction and Sleep Quality (n = 100)

Measure	Mean ± SD / Frequency (%)
SAS-SV Score	34.7 ± 8.3
High-Risk Smartphone Addiction	47 (47%)
PSQI Score	7.1 ± 2.9
Poor Sleep Quality (PSQI > 5)	66 (66%)

Correlation Between Smartphone Addiction and Sleep Quality

To explore the relationship between smartphone addiction and sleep quality, a Pearson correlation analysis was performed. As shown in Table 3, there was a significant positive correlation ($r = 0.43$, $p < 0.001$) between SAS-SV scores and PSQI scores, indicating that as smartphone addiction severity increased, sleep quality decreased. The moderate strength of this positive correlation (Table 3) supports the hypothesis that smartphone addiction is linked to sleep disturbances. The statistical significance confirms that this is unlikely to be a chance finding.

Table 3: Correlation Between Smartphone Addiction and Sleep Quality (n = 100)

Variables	Correlation Coefficient (r)	p-value
SAS-SV Score vs. PSQI Score	0.43	<0.001

Logistic Regression Analysis:

A binary logistic regression was conducted to determine the independent association between high-risk smartphone addiction and poor sleep quality. The regression model was adjusted for confounding variables including gender, caffeine consumption, smartphone use before bed, and academic stress. As shown in Table 4, students with high-risk smartphone addiction were significantly more likely to experience poor sleep quality (AOR = 2.74; 95% CI: 1.31–5.75; $p = 0.007$). In addition, smartphone use before bedtime also emerged as a statistically significant predictor of poor sleep (AOR = 2.11; 95% CI: 1.01–4.39; $p = 0.046$). Gender, caffeine use, and academic stress showed associations but did not reach statistical significance. The findings from Table 4 reinforce the primary outcome of the study that high smartphone addiction is independently associated with sleep problems. Smartphone use immediately before sleep also appears to significantly contribute to disturbed sleep, likely due to light exposure and psychological arousal.

Table 4: Logistic Regression Analysis for Predictors of Poor Sleep Quality (n = 100)

Predictor Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
High-Risk Smartphone Addiction	2.74	1.31 – 5.75	0.007
Female Gender	1.62	0.79 – 3.30	0.190
Caffeine Consumption	1.58	0.75 – 3.31	0.230
Smartphone Use Before Bedtime	2.11	1.01 – 4.39	0.046
Academic Stress (Moderate/High)	1.93	0.94 – 3.98	0.072

The results of this study clearly demonstrate that nearly half of the students surveyed were at risk for smartphone addiction and that poor sleep quality was highly prevalent. A moderate and statistically significant positive correlation was found between smartphone addiction scores and sleep disturbance levels. Furthermore, students categorized as high-risk for smartphone addiction were nearly three

times more likely to experience poor sleep, independent of other behavioral and lifestyle factors. Smartphone use before bedtime also significantly contributed to sleep disturbances, emphasizing the need for digital hygiene awareness among young adults.

Discussion

This study, conducted from January 2024 to April 2025 at Fatima Jinnah Medical University / Sir Ganga Ram Hospital, Lahore, and Sahara Medical College, Narowal, investigated the association between smartphone addiction and sleep disturbances among undergraduate university students[18]. The findings revealed that 47% of the participants were at high risk for smartphone addiction, while 66% reported poor sleep quality based on the Pittsburgh Sleep Quality Index (PSQI). A statistically significant moderate positive correlation was found between the severity of smartphone addiction and poor sleep quality, affirming the central hypothesis of the study[19].

These results highlight a growing concern regarding the impact of excessive smartphone use on sleep health in academic populations. The high prevalence of both smartphone overuse and sleep disturbances among students underscores the behavioral and lifestyle challenges faced by young adults in digitally connected environments[20].

A notable contribution of this study is the identification of high-risk smartphone addiction as an independent predictor of poor sleep quality. The adjusted odds ratio indicated that students with high-risk addiction levels were nearly three times more likely to experience poor sleep, even after accounting for potential confounding variables such as gender, caffeine consumption, bedtime screen exposure, and academic stress. This supports the interpretation that smartphone addiction may have a direct and detrimental influence on sleep regulation[21, 22].

Several plausible mechanisms may explain this association. The blue light emitted by smartphone screens can suppress melatonin secretion, thereby delaying sleep onset and disrupting circadian rhythms[23]. Additionally, the cognitive and emotional stimulation caused by engaging with digital content such as messaging, social media, and entertainment apps can delay the transition into restful sleep by increasing alertness and psychological arousal. Another critical factor is behavioral displacement, where screen time encroaches upon hours otherwise designated for sleep. In this study, a significant proportion of students (72%) reported using smartphones in the hour before bedtime, illustrating this displacement effect[24].

Furthermore, smartphone use before sleep was independently associated with increased odds of poor sleep quality. This finding emphasizes that not only the duration but also the timing of smartphone use plays a critical role in sleep disruption. Bedtime screen exposure can impair the ability to initiate and maintain quality sleep, fragmenting sleep cycles and contributing to long-term fatigue and daytime dysfunction[25].

Although other variables such as gender, caffeine intake, and academic stress did not show statistically significant associations in the adjusted model, trends toward increased risk were observed. These findings are consistent with broader behavioral health literature, where caffeine is recognized for its stimulant properties and academic stress is known to affect sleep latency and quality. Although these factors were not primary predictors in this sample, they remain important considerations for future research[26].

The high prevalence of sleep disturbance observed in this cohort is particularly concerning, as sleep is essential for memory consolidation, emotional regulation, academic performance, and overall mental and physical health. Persistent poor sleep may increase susceptibility to anxiety, depression, cardiovascular risk, and metabolic dysfunction, making it a critical area of intervention in student populations[27].

Based on the findings of this study, there is a clear need for institutional efforts to promote digital hygiene and healthy sleep practices. Educational institutions such as Fatima Jinnah Medical University and Sahara Medical College should implement structured awareness programs focusing on the risks of excessive smartphone use, particularly during late hours[28]. Interventions such as screen-time reduction campaigns, digital detox sessions, and the inclusion of sleep education in student

wellness initiatives could significantly benefit the student body. Promoting screen-free routines before bedtime and encouraging students to self-monitor their smartphone usage can contribute to improved sleep health and academic outcomes[29].

Strengths and Limitations

This study, conducted over a 16-month period from January 2024 to April 2025, benefitted from the use of two well-validated tools: the Smartphone Addiction Scale–Short Version (SAS-SV) and the Pittsburgh Sleep Quality Index (PSQI). Their inclusion ensured objective and reliable assessment of both smartphone addiction and sleep quality[30]. The extended study period allowed for systematic data collection across two academic institutions Fatima Jinnah Medical University / Sir Ganga Ram Hospital, Lahore, and Sahara Medical College, Narowal providing exposure to both urban and semi-urban academic environments. The use of stratified random sampling across multiple faculties improved internal validity and enhanced the representativeness of the student sample. Nevertheless, certain limitations must be acknowledged. The cross-sectional nature of the study precludes any conclusions about causality between smartphone addiction and poor sleep quality. The reliance on self-reported data may have introduced recall and social desirability biases, particularly regarding screen time, caffeine intake, and academic stress. While the sample size of 100 was adequate for primary analysis, it limited the capacity for detailed subgroup analysis across academic years or specific usage patterns. Although the study was conducted at two distinct institutions, the findings may not be universally generalizable to students in different academic, cultural, or geographic contexts[31, 32].

Implications for Practice and Future Research

The findings of this study underline the need for universities to implement structured interventions promoting digital well-being and sleep hygiene. Over the course of the 16-month study duration, it became evident that excessive smartphone use, particularly near bedtime, significantly impacted students' sleep quality[33]. Institutions should consider integrating sleep health awareness into student counseling services, organizing digital detox workshops, and promoting screen-free routines during evening hours. Additionally, the use of mobile screen-time tracking applications may help students self-regulate digital habits. Future research should prioritize longitudinal designs to determine causal pathways between smartphone addiction and sleep disturbances. Investigating mediating psychological factors such as stress, anxiety, depression, or fear of missing out (FOMO) could offer deeper insight into behavioral dynamics. Interventional studies assessing the impact of limiting evening smartphone use on sleep quality and academic performance would provide practical evidence for policy recommendations. Expanding future studies to include larger, more diverse student populations across different provinces and educational tiers in Pakistan would enhance generalizability and support the development of national strategies to address digital overuse and its health consequences in youth[34, 35].

Conclusion

This study demonstrates a significant association between smartphone addiction and poor sleep quality among undergraduate students. Nearly half of the participants were identified as being at high risk for smartphone addiction, while approximately two-thirds reported disturbed sleep, as measured by the Pittsburgh Sleep Quality Index (PSQI). The analysis revealed that students with high-risk smartphone addiction were almost three times more likely to experience poor sleep quality, independent of other behavioral and lifestyle factors. Moreover, the use of smartphones before bedtime emerged as an additional significant predictor of sleep disturbances. These findings reflect a growing public health concern regarding excessive smartphone use among young adults and its adverse effects on sleep health. Given the critical role of sleep in academic performance, emotional regulation, cognitive functioning, and overall mental well-being, urgent attention is required at both institutional and individual levels. Universities should integrate digital wellness and sleep hygiene

education into student support and counseling services. Simultaneously, students should be encouraged to adopt healthier digital habits, including limiting screen exposure before bedtime and establishing consistent sleep routines. Further longitudinal and interventional studies are warranted to establish causality and to evaluate the effectiveness of strategies aimed at reducing smartphone dependency and improving sleep quality. Nonetheless, the current findings provide compelling evidence that managing smartphone addiction is a key factor in promoting better sleep and enhancing the holistic well-being of university students.

Availability of Data and Materials
The datasets generated or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests
The authors declare that they have no competing interests.

Authors' Contributions
- **A.R.**: Conceptualization, supervision, manuscript review
- **S.M.O.**: Study design, data analysis, manuscript drafting
- **N.A.**: Data collection, interpretation of results
- **A.Rh.**: Questionnaire distribution, data organization
- **A.W.**: Statistical analysis, methodology review
- **N.N.**: Literature review, manuscript editing
- **R.B.**: Institutional coordination, ethics documentation
- **N.B.**: Survey facilitation, participant engagement
- **A.S.**: Data entry, tabulation
- **A.Rz.**: Technical assistance, formatting

All authors reviewed and approved the final manuscript.

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