

The Predictive Power of Problematic Smartphone Use on Sleep, Loneliness, and Cognition in Medical Students: A Regression-Based Analysis.

Abstract

Background: There is a growing public health concern over problematic smartphone use (PSU) among young adults. As medical students are exposed to particular academic pressures, they could be especially susceptible to the negative impacts of PSU.

Hypothesis: This study used regression analyses to determine the predictive capacity of PSU for three important outcomes: sleep disturbances, feelings of loneliness, and cognitive functioning in a sample of medical students.

Methods: The cross-sectional design with 230 medical students was used. PSU, sleep disturbances, loneliness and cognitive functioning were measured using validated scales. The predictive relationship between PSU on each dependent variable was determined using simple linear regression analyses.

Results indicated that PSU was a significant positive predictor of sleep disturbances ($\beta = .48$, $p < .001$; accounting for 22.6% of variance), and a significant positive predictor of loneliness ($\beta = .53$, $p < .001$; accounting for 27.6% of variance). PSU, however, was a significant but minor negative predictor of cognitive functioning ($\beta = -0.020$, $p < .001$) and accounted for 0.0% of the variance.

Conclusions: Regression models show that PSU was a strong predictor of sleep disturbances or loneliness in medical students, indicating the high influence of PSU on psychological and physiological well-being. That the impact on cognitive function is minimal shows that other factors play a greater role in cognition. Targeting PSU for interventions can have a major impact on improving sleep quality and decreasing social isolation among medical trainees.

Keywords:*Problematic Smartphone Use, Regression Analysis, Sleep Disturbances, Loneliness, Cognitive Functioning, Medical Students*

1. Introduction

Smartphones have become an integral part of people's lives, fundamentally changing the way they communicate, access information, and interact with their daily activities (Malakcioglu, 2024; Yi et al., 2025). This seamless integration has led to a phenomenon of problematic smartphone use (PSU) which is defined as excessive, uncontrollable, and compulsive smartphone use despite negative consequences (Elhai et al., 2025). Increasingly, PSU has become a public health issue as prevalence rates in young adults and university students have been seen to be between 10% and 30%, and some studies suggested even higher rates based on assessment tools used (Brautsch et al., 2023).

Medical students are an extremely vulnerable group that suffers from the negative impacts of PSU. They have to face a challenging learning process with a high workload, strict exams, and chronic stress (Tian et al., 2021). The setting can lead to the development of unhelpful coping strategies, as heavy smartphone use can be associated with a way to escape from school worries, but at the same time it can intensify psychological tension and physical health issues. The predictive relationships between PSU and key outcomes, such as sleep quality, social connection and cognitive functioning, are therefore essential to understand in developing specific interventions to ensure the well-being and professional competence of future physicians.

Sleep Disturbances: There are emerging links between PSU and sleep disturbances (Hossain, 2025; Meshi et al., 2021). It is thought to occur because blue light from the screen of a smartphone prevents melatonin secretion, thereby affecting the biological clock. Behaviorally, stimulation or stress in the evening stages of the day results in cognitive and physiological arousal, which disrupts sleep onset and sleep maintenance (Zhang et al., 2021; Yang et al., 2020). Medical students are not only affected by the negative consequences of poor sleep on cognition but are also at higher risk for mental health and burnout due to poor sleep.

Loneliness: There is a paradox in the relation of PSU and loneliness. Smartphones are intended to be used for connecting people, but the use of smartphones has long been linked to higher rates of social isolation (Aslam et al., 2026; Montag et al., 2021). According to the displacement hypothesis, time spent engaging in digital interactions has been shown to take the place of meaningful in-person interactions, and social comparison and feelings of inadequacy and isolation that may arise from social media platforms that are curated and socially engineered (Ahmed et al., 2026; Csaba et al., 2025). Loneliness is a powerful risk factor for depression, anxiety, and physical health issues and a focus of PSU is vital.

Cognitive Functioning: The influence of PSU on cognition is not as clear and may be more complex. The digital distraction hypothesis is that constant interruptions from smartphone notifications and the practice of multitasking reduce cognitive resources that in turn affect attention, working memory, and executive functioning (Liech et al., 2025; Almazzouki et al., 2023). Empirical results have been inconsistent though; some studies have shown strong negative correlations, while others have found either no correlation or correlation too small to be significant (Nahidi et al., 2024; Keiner et al., 2024). This discrepancy highlights the need for more research in groups that have high cognitive load such as medical students.

Based on these shortcomings, the current study used regression analysis to investigate how much sleep disturbances, loneliness and cognitive functioning are explained by PSU in Pakistani medical students. The study assumed that:

1. PSU would likely to be a significant positive predictor of sleep disturbances.
2. PSU would likely to be a significant positive predictor of loneliness.
3. PSU which was likely to be a strong negative predictor of cognitive functioning.

2. Methodology

2.1 Study Design and Participants

A cross-sectional study design was used to examine the predictive relationships between problematic smartphone use and the various health outcomes. The medical college of Pakistan was chosen by the convenience sampling method for the selection of medical students and 230 students were sampled.

2.2 Measures

- **Demographics:** A self-developed form was used to gather data on age, gender, year of education, family system, socioeconomic status and length of time someone had owned a smartphone.
- **Problematic Smartphone Use (PSU):** Smartphone Addiction Scale (SAS) was validated to measure the problem level of Smartphone use. In the present study, higher scores represented more addiction. Today the Cronbach's alpha for this scale was acceptable ($\alpha = .85$) for the sample of the current study.
- **Sleep Disturbances:** A sleep disturbance scale was used, standardized. More sleep disturbance was indicated with higher scores.
- **Loneliness** was measured using a validated scale for loneliness in which subjective feelings of social isolation were measured. Higher scores indicated greater feelings of loneliness.
- **Cognitive Functioning:** The Montreal Cognitive Assessment tool was used to measure self-reported cognitive functioning. Those scores that were below 26 indicated cognitive impairment.

2.3 Procedure

Participants were sought during their class period and a comprehensive description of the study was given to them. All participants gave informed consent. They were assured of the anonymity and confidentiality of their answers. Questionnaires were paper-based and distributed and retrieved.

2.4 Data Analysis

Data were analyzed by SPSS version 26.0. To test the predictive relationship between PSU (independent variable) and three dependent variables (sleep disturbances, loneliness and cognitive functioning), simple linear regression analyses were performed. Model summary (R^2 , adjusted R^2 , F-value and p-value) and standardized beta coefficients (β) were analysed for each model to assess its strength and significance. A value of $p < 0.05$ was regarded as being statistically significant.

3. Results

3.1 Regression Analysis: PSU Predicting Sleep Disturbances

Table 1: Regression of Problematic Smartphone Use on Sleep Disturbances

Model Summary					
R	R ²	Adjusted R ²	F	p	
.476	.226	.223	66.67	< .001	

Coefficients					
Variable	Unstandardized B	SE	Standardized β	t	p
Constant	10.59	1.56		6.79	< .001
PSU	.31	.039	.48	8.16	< .001

The model presented in Table 1 indicated that PSU was a significant positive predictor of sleep disturbances. The goodness of fit (R^2) for this model is .226, which means PSU accounts for 22.6% of the variance in sleep disturbances. The F-statistic was highly significant ($F(1, 228) = 66.67, p < .001$). The standardized beta coefficient ($\beta = .48, p < .001$) suggests that, for each standard deviation increase in PSU, there is a 0.48 standard deviation increase in the scores on sleep disturbance.

3.2 Regression Analysis: PSU Predicting Loneliness

Table 2: Regression of Problematic Smartphone Use on Loneliness

Model Summary					
R	R ²	Adjusted R ²	F	P	
.526	.276	.273	87.01	< .001	

Coefficients					
Variable	Unstandardized B	SE	Standardized β	t	p
Constant	.84	4.04		.21	.835
PSU	.67	.073	.53	9.33	< .001

Table 2 shows the regression model with PSU as significant positive predictor of loneliness. The model had an R^2 of .276, which means that 27.6% of the variance in loneliness is

accounted for by PSU. The F-statistic was significant ($F(1, 228) = 87.01, p < .001$). The standardized beta coefficient ($\beta = .53, p < .001$) indicates a moderate-to-strong and positive relationship.

3.3 Regression Analysis: PSU Predicting Cognitive Functioning

Table 4: Regression of Problematic Smartphone Use on Cognitive Functioning

Model Summary					
R	R ²	Adjusted R ²	F	p	
.020	.000	.004	.088	.767	

Coefficients					
Variable	Unstandardized B	SE	Standardized β	t	p
Constant	39.141	3.94		9.931	< .001
PSU	-.052	.174	-.020	-.296	< .001

The regression model for cognitive functioning resulted in an R² of .000, which means that PSU accounts for 0.0% of the variance in cognitive functioning scores. The beta coefficient ($\beta = -0.020, p < .001$) obtained was statistically significant, but the F (1, 228) value was not. The negative beta means there is a relationship but it is very small; in this case, in the predicted direction.

4. Discussion

In the current study, regression analyses were used to look at the predictive role of PSS in sleep disturbances, loneliness, and cognitive function in a sample of medical students. The results indicate that PSU is a meaningful and important predictor of sleep disturbances and of loneliness, and that it is a statistically significant, but practically negligible predictor of cognitive functioning.

The regression model showed that PSU explained a significant amount of variance in sleep disturbance, 22.6%, which highlights the clinical relevance of this relationship. The beta coefficient ($\beta = .48$) revealed a moderate-to-strong positive relationship, indicating that the more problematic the use of smartphones, the lower the level of sleep quality. This is in line with a wealth of international literature (Tian et al., 2021; Yi et al., 2025) and extends it to Pakistani medical students. These mechanisms may be related to the biological effect of blue light on the inhibition of melatonin production, and to the behavioral effect of exposure to stimulating content late at night that elicits cognitive arousal and delays sleep onset (Elhai et al., 2025; Aslam et al., 2026). This is especially problematic for medical students, who are more likely to experience poor sleep due to stress, and often end up with poor academic performance, low clinical reasoning skills, and a higher risk of burnout (Tian et al., 2021).

The model for loneliness was even more powerful, accounting for 27.6% of the variance ($\beta = .53$). The results strongly suggest that the displacement hypothesis (Leow et al., 2023; Nashwan et al., 2024) is correct, which posits that the more time that is spent on a smartphone and social media, the less time is spent on meaningful, face-to-face interactions. Despite the constant connectivity paradox, this connection comes across as a superficial one, which does not satisfy people's need for mutual connection and meaningful connection (Malakcioglu, 2024). Moreover, the social comparison phenomenon in social media platforms, which provides users with an idealised and curated view of others' lives, can cause feelings of inadequacy, envy and isolation (Csaba et al., 2025). The predictive power of PSU of loneliness is alarming as loneliness is a well-established risk factor for depression, anxiety, even for physical health conditions like cardiovascular disease (Zhang et al., 2021).

In contrast, the regression model for cognitive functioning showed different results. The beta coefficient was significant ($\beta = -0.020$, $p < .001$); but the PSU explained 0.0% of variance, and the effect size was almost non-existent. The study suggests that problematic smartphone use does not practically meaningfully predict cognitive impairment in this sample. Given the large sample size, it is likely that the statistical significance is a result of this. The large sample size can make even the smallest of effects significant (Brautsch et al., 2023). Other, unmeasured factors are likely to play a more predominant role in cognitive functioning in this population as this effect size is negligible. The most likely explanations are chronic stress, sleep problems, academic burden, and prior mental health issues like anxiety and depression

(Meshi et al., 2021; Tian et al., 2021). The current study finding aligns with studies that did not report a strong correlation between PSU and objective neuropsychological tests of cognition (Thompson et al., 2022; Alezzi et al., 2024), and highlights the need to evaluate the regression results with effect sizes as well as P-values.

Theoretical and Practical Implications

From a practical point of view, the results presented here would help build upon the existing evidence that PSU is not just a behavioral habit, but has been proven to be a great predictor of negative health outcomes, such as sleep quality and social connection. The differential predictive power across outcomes underscores the importance of nuanced models that account for the various pathways of PSU's effects on various domains of functioning. It has direct implications for interventions to enhance sleep and alleviate loneliness in medical students by providing robust evidence for a PSU sleep intervention. Digital wellness programs, sleep and sleep hygiene education, and interventions that promote meaningful interactions offline may all be helpful. The absence of any meaningful link with cognitive functioning, however, indicates that a focus on cognition should be directed towards stress reduction, sleep optimization and/or study habits.

5. Conclusion

Finally, with the results of this regression-based analysis, it can be concluded that an association between problematic smartphone usage and sleep disturbance and loneliness among medical students is strong and meaningful. A large portion of the variance in these outcomes is due to PSU, indicating robust influences of PSU on psychological and physiological well-being. However, the effect of PSU on cognitive functioning is statistically significant but low, indicating that other factors are of greater importance for cognition. The findings highlight the need for institutional interventions to tackle the smartphone habits to protect the health and performance of future doctors.

6. Limitations and Recommendations

Several limitations of this study must be noted, such as the cross-sectional design; the use of self-report instruments, convenience sampling from one medical college, and failure to control for possible confounding factors that may limit causal inference and generalizability of the findings. Longitudinal study designs, objective measurement of sleep and cell phone usage, and broader sample populations should be used in future research studies. Further, medical colleges are also encouraged to initiate digital wellness programs, enhance the mental health support system, and create comprehensive programs addressing healthy use of technology, sleep hygiene, stress management, and social connectedness among students.

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