



The Relationship Between Smartphone Addiction and Sleep Quality Among 2016 Freshmen in The Faculty of Medicine at Pelita Harapan University

Jeanette Rachel Audrey Leo*, Michael Tanaka, Stevent Sumantri, Irma Lusiana Tantri

Universitas Pelita Harapan, Indonesia

Email: jeanrachelau@gmail.com*, michael.tanaka@uph.edu, stevent.sumantri@uph.edu, irma.tantri@uph.edu

Keywords:

Smartphone Addiction; Sleep Quality; Medical Students; Anxiety; Smartphone Usage

Abstract

The proliferation of smartphone use among university students has raised concerns about addiction and its potential consequences on sleep health, with medical students representing a particularly vulnerable population due to their demanding academic schedules, high stress levels, and extensive use of digital devices for learning purposes; despite growing evidence linking smartphone addiction to sleep disturbances globally, limited research has examined this relationship specifically among Indonesian medical students while controlling for important confounding factors such as anxiety. This study aims to determine the relationship between smartphone addiction and sleep quality among 2016 cohort medical students at Universitas Pelita Harapan, while also identifying the most dominant factors affecting sleep quality in this population. A cross-sectional analytic study was conducted involving 52 medical students selected through simple random sampling, with data collected using four standardized instruments: a demographic questionnaire, the Generalized Anxiety Disorder 7-Item (GAD-7), the Smartphone Addiction Scale-Short Version (SAS-SV), and the Pittsburgh Sleep Quality Index (PSQI); bivariate analysis employed Chi-Square or Fisher Exact tests, followed by multivariate logistic regression using SPSS version 22 to identify the most dominant predictors of poor sleep quality. The results revealed that 56% of respondents (n=29) had high smartphone addiction, while 62% (n=32) experienced poor sleep quality. Bivariate analysis demonstrated a significant association between smartphone addiction and poor sleep quality ($p=0.003$; $OR=6.626$; 95% CI 1.760–19.725), with anxiety showing an even stronger association ($p=0.000$; $OR=15.443$; 95% CI 3.106–76.644). Multivariate logistic regression confirmed that both smartphone addiction ($p=0.017$) and anxiety ($p=0.001$) were independent predictors of poor sleep quality, with anxiety being the more dominant factor, while lifestyle factors including smoking, alcohol consumption, caffeine intake, and medication use showed no significant associations with sleep quality ($p>0.05$). The high prevalence of poor sleep quality among medical students underscores the urgent need for institutional interventions, and medical education institutions should implement educational programs addressing smartphone usage management and anxiety reduction to promote better sleep health, with future research employing longitudinal designs and objective sleep measures needed to establish causal relationships and evaluate intervention effectiveness.

INTRODUCTION

The proliferation of smartphone technology has transformed global communication and information access, with penetration rates reaching unprecedented levels across all demographics. According to Statista, global smartphone users surpassed 6.8 billion in 2023, representing approximately 85% of the world's population. In Indonesia, the rapid adoption of smartphones has been particularly pronounced, with the number of smartphone users

estimated to reach 81.87 million in 2020, making it one of the largest smartphone markets in Southeast Asia. The integration of smartphones into daily life has created unprecedented convenience, enabling instant communication, access to information, and entertainment. However, this widespread adoption has also raised concerns about dependency and potential addictive behaviours, particularly among younger populations who constitute the majority of users.

The phenomenon of smartphone addiction has emerged as a significant public health concern in the digital age. Addiction is characterized by maladaptive patterns of smartphone use leading to clinically significant impairment or distress when the user is unable to access their device. Research indicates that excessive smartphone use can lead to tolerance, withdrawal symptoms, and impaired control over usage, mirroring patterns observed in substance use disorders. The prevalence of smartphone addiction among university students has been reported to range from 20% to 50% across various international studies, with particularly high rates observed in Asian populations where smartphone penetration and social media engagement are especially high (Long et al., 2016). In Indonesia, a recent survey on 200 junior high school students, 200 senior high school students, and 100 college students aged 12-24 years revealed differences in smartphone addiction based on gender and education level, with female students showing higher addiction rates and students aged 24 years exhibiting the highest addiction levels.

One of the most significant consequences of smartphone addiction is its impact on sleep quality and patterns. Sleep disruption occurs through multiple mechanisms, including the displacement of sleep time by screen-based activities, cognitive and physiological arousal from content consumption, and the disruptive effects of blue light emitted by smartphone screens on the circadian system. The short-wavelength blue light suppresses melatonin production, the hormone responsible for regulating the sleep-wake cycle, effectively delaying the internal body clock and making it more difficult to initiate sleep (Mortazavi et al., 2018). Research by Randjelović et al. (2023) demonstrated that reducing blue light emission from smartphone screens during the night significantly improved subjective sleep quality among medical students, with mean PSQI scores decreasing from 6.83 (poor quality) to 3.93 (good quality) following intervention. Siraji et al. (2023) further established that increased mobile phone use before sleep predicted circadian phase delay, reduced sleep quality, and increased trouble in memory and concentration among Malaysian adults, highlighting the far-reaching cognitive consequences of nighttime smartphone use.

The relationship between smartphone uses and sleep disruption is particularly concerning for medical students, who face unique pressures that may exacerbate vulnerability to both smartphone addiction and poor sleep quality. Medical education is characterized by high academic demands, significant stress, irregular schedules, and constant availability of study materials through digital platforms. A study by Demirci et al. (2015) involving 319 university students found that high smartphone use severity was significantly correlated with poor sleep quality, depression, and anxiety, with females showing higher addiction scores than males. The researchers identified that depression and anxiety scores were higher in the high smartphone use group compared to the low use group, and positive correlations were found between Smartphone Addiction Scale scores and depression levels, anxiety levels, and some sleep quality scores, a pattern subsequently confirmed among medical students

specifically, among whom smartphone addiction has been shown to co-occur with poorer sleep quality, depression, anxiety, and stress (Nikolic et al., 2023). Soni, Upadhyay, and Jain (2017) demonstrated that adolescents with high smartphone addiction rates had substantially worse sleep quality compared to those with low addiction rates. Furthermore, Boumosleh and Jaalouk (2017) found that depression and anxiety independently predicted smartphone addiction, suggesting a bidirectional relationship between mental health and problematic smartphone use. Consistent with this, anxiety has been shown to partially mediate the association between mobile phone addiction and poor sleep quality, underscoring anxiety's role as more than a simple confounder in this relationship (Gong & Liu, 2023).

Despite the growing body of evidence linking smartphone addiction to sleep disruption, significant research gaps remain, particularly regarding medical student populations in Indonesia. Most studies have been conducted in Western or East Asian contexts, with limited research examining these relationships in Southeast Asian medical education settings. Research conducted in Jakarta (2025) involving 165 medical students found that 94% of male respondents and 100% of female respondents were strongly addicted to smartphones, with data analysis revealing no significant relationship between smartphone addiction and sleep quality in that specific population. This finding contrasts with studies from other regions; a large multicenter study among medical students across six Latin American countries, for example, found that mobile phone addiction was independently associated with poorer sleep quality even after adjusting for sex, age, and educational level (Izquierdo-Condoy et al., 2025), highlighting the need for context-specific research in Indonesia. Additionally, a study at Muhammadiyah University of Surabaya (2024) found a significant relationship between smartphone addiction and insomnia among medical students across cohorts of 2019, 2020, 2021, and 2022. The prevalence of poor sleep quality among medical students at Universitas Halu Oleo reached 89.1%, with poor sleep quality shown to cause a decline in medical student achievement and interfere with short-term memory consolidation. Similar patterns have been documented outside Southeast Asia, where high levels of smartphone addiction among medical students were significantly correlated with poorer sleep quality, suboptimal health status, and mental health difficulties (Amin et al., 2024). Understanding the specific risk factors and mechanisms affecting Indonesian medical students is essential for developing targeted interventions.

The urgency of this research is underscored by the high prevalence of poor sleep quality and smartphone addiction among medical students and the significant professional implications of sleep deprivation in future physicians. Medical students represent the next generation of healthcare providers, and their sleep health directly impacts patient safety and care quality. Poor sleep quality has been associated with impaired cognitive function, reduced attention, compromised clinical decision-making, and increased risk of medical errors, with poor sleep quality repeatedly shown to negatively affect the academic performance of medical students (Maheshwari & Shaukat, 2019). The prevalence of poor sleep quality among university students has been reported to exceed 60% in some studies, and medical students may be at even higher risk due to their demanding schedules and academic pressures. A study on preclinical students at Universitas Udayana found that more than half (58.3%) had poor sleep quality. Furthermore, sleep deprivation can exacerbate emotional problems, impair social and occupational performance, and compromise both physical and mental health,

creating a cycle of declining well-being that affects both students and their future patients. High stress levels and irregular study-rest schedules among medical students disrupt circadian rhythm, leading to sleep disturbances that impair academic performance, a finding echoed among medical students in other developing-country contexts, where poor sleep quality was similarly widespread and linked to academic and psychological strain (Attal et al., 2021).

This research offers novelty by examining the relationship between smartphone addiction and sleep quality specifically among medical students in Indonesia, using validated instruments and controlling for multiple confounding variables. The study employs the Smartphone Addiction Scale-Short Version (SAS-SV), Pittsburgh Sleep Quality Index (PSQI), and Generalized Anxiety Disorder 7-Item (GAD-7) questionnaire, providing a comprehensive assessment of the key constructs. The inclusion of anxiety as a potential confounder and mediator, along with lifestyle factors such as smoking, alcohol consumption, caffeine intake, and medication use, allows for a more nuanced understanding of the relationship, in line with recent mediation-moderation models demonstrating that smartphone addiction and sleep quality interact closely with anxiety rather than operating as independent variables (Qin et al., 2025). By focusing on a specific cohort of medical students at Pelita Harapan University, this research addresses the gap in understanding how these phenomena manifest in Indonesian medical education contexts, where limited research has been conducted. Recent studies have also examined the relationship between sleep quality and personality types in terms of emotional intelligence among medical students, with findings showing that introverted students had better sleep quality than extroverted ones, further highlighting the complex interplay of psychological factors in sleep health.

The primary objective of this research is to determine the relationship between smartphone addiction and sleep quality among 2016 cohort medical students at Universitas Pelita Harapan. The study aims to identify the prevalence of smartphone addiction and poor sleep quality in this population, examine the association between these variables while controlling for potential confounders, and identify the most significant factors affecting sleep quality. The findings will contribute to the growing body of literature on digital health behaviors and their consequences, while providing practical insights for medical education institutions. Ultimately, this research can inform the development of evidence-based interventions to promote healthier smartphone use patterns and better sleep hygiene among medical students, improving their well-being and professional competency. As previous research has established that cognitive-behavioral interventions targeting blue light reduction can improve sleep quality, institutional programs addressing smartphone usage management and anxiety reduction may prove effective in addressing this growing public health concern.

METHOD

This study used a categorical research design that does not pair with a cross-section design and statistical analysis with a two-proportion difference test. Data collection will be carried out using standardized measuring tools. Tabulation was carried out using the Microsoft Excel 2019 electronic data collection program, while data analysis used the SPSS-22 program. Demographic data were described using a descriptive statistical method. Numerical data is described by mean/median and includes standard deviations. Univariate analysis is used to look at the data distribution of each variable and then presented in the form

of a table. Bivariate analysis is used to express the relationship between independent variables and bound variables. Bivariate analysis will be performed to express the relationship between independent variables and bound variables. The analysis will be carried out using the Chi Square test if the data is qualified or by the Fisher exact test if the data is not eligible. The null hypothesis is rejected, meaning that there is a relationship. Multivariate analysis of logistic regression to see what factors have the most influence on dependent factors. The test with the logistic regression model used in this study is to determine the influence of each independent variable on the dependent variable. The confidence level testing criteria used was 95% or a significant level of 5% ($\alpha = 0.05$). If the p value is (0.05), then the hypothesis is accepted, or there is a relationship. If the p value is rejected, then the hypothesis is rejected, or there is no correlation.

Research flow

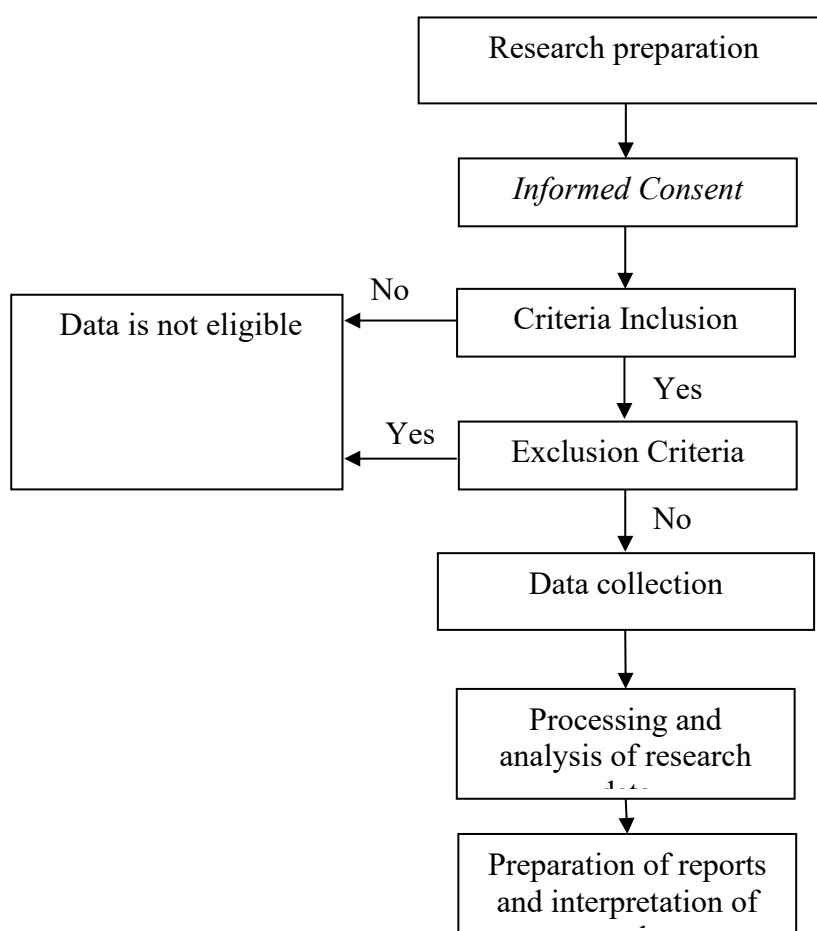


Figure 1. Research flow

Source: Prepared by the authors based on the research methodology of this study.

RESULTS AND DISCUSSION

Demographic Data and Respondent Characteristics

This research was conducted at the Faculty of Medicine, Pelita Harapan University, and the data collection was carried out by the researchers themselves. The study was followed by 52 respondents. From table 1, it can be seen that this study is more predominantly female

respondents, consisting of 32 people (62%) compared to the number of male respondents of 20 people (38%). The average age of the respondents overall was 21 years old, with the youngest age being 20 years old and the oldest age being 25 years old. There were 43 respondents (83%) who had no history of disease and 9 respondents (17%) who had a history of diseases such as asthma, allergies, alopecia, major depressive disorder, hypertension and hyperthyroidism. The majority of respondents, consisting of 36 people (69%), did not have a family disease. Meanwhile, the remaining respondents, as many as 16 people (31%), had a history of family diseases such as hypertension, stroke, diabetes, asthma, allergies, hypothyroidism, and hypotension.

Table 1. General Characteristics of Research Subjects

Variabel	N
Gender	
Male	20 (38%)
Women	32 (62%)
Age	
Minimal - Maximum	20 - 25
Average	21,52
Disease History	
Ya	9 (17%)
No	43 (83%)
Family History of Illness	
Ya	16 (31%)
No	36 (69%)

Source: Primary data collected from respondents and analyzed by the authors (2026).

Univariate Analysis

Univariate analysis was carried out to find out the distribution picture of each variable studied. The results of univariate analysis are presented in table 2. From table 2, it can be seen that the majority of respondents, as many as 51 people (98%) do not smoke and 1 person (2%) smokes. There were 50 respondents (96%) who did not consume alcohol regularly, while 2 respondents (4%) consumed alcohol. A total of 39 respondents (75%) did not consume caffeine regularly, and 13 respondents (25%) consumed caffeine regularly. 48 respondents (90%) did not take medication regularly, while the other 4 respondents (10%) regularly took medication. Anxiety levels were tested using the Generalized Anxiety Disorder 7-Item (GAD-7) questionnaire. The results of the analysis showed that 24 respondents (46%) had a high level of anxiety, while 28 respondents (54%) had a low level of anxiety. The level of smartphone addiction was tested using the Smartphone Addiction Scale-Short Version (SAS-SV) questionnaire. The results of the analysis showed that 29 respondents (56%) had a high level of addiction and 23 respondents (44%) had a low level of addiction. Sleep quality was tested using the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The results of the analysis showed that 20 respondents (38%) had good sleep quality, while 32 respondents (62%) had poor sleep quality.

Table 2. Univariate Analysis Results

Variabel	N
Status Merokok	
Ya	1 (2%)
No	51 (98%)
Alcohol Consumption Status	
Ya	2 (4%)
No	50 (96%)
Caffeine Consumption Status	
Ya	13 (25%)
No	39 (75%)
Drug Consumption Status	
Ya	4 (10%)
No	48 (90%)
Anxiety Level	
High Anxiety	24 (46%)
Low Anxiety	28 (54%)
Smartphone Addiction Rate	
High Addiction	29 (56%)
Low Addiction	23 (44%)
Sleep Quality	
Good Quality	20 (38%)
Poor Quality	32 (62%)

Source: Primary data analyzed using descriptive statistics with IBM SPSS Statistics Version 22 (2026).

Bivariate Analysis

Bivariate analysis is used to determine the relationship between independent variables and dependent variables. Analysis using SPSS 22. In this study, statistical analysis with the Chi Square test was used to see the relationship between variables. If the results obtained that the expected value or expected value are not eligible for the Chi Square test, an alternative test is used, namely the Fisher Exact test. The results of the analysis are presented in table 3.

Table 3. Results of Fisher Exact bivariate analysis Indicators of Smartphone Addiction and Confounding Factors with Sleep Quality

Variabel	Sleep Quality		<i>p</i>	OR	95% CI	
	Bad	Good			Lower	Upper
Smartphone Addiction						
Height	22 (75,9%)	7 (24,1%)	0,003	5,893	1,760	19,725
Low	8 (34,8%)	15 (65,2%)				
Anxiety						
Height	21 (87,5%)	3 (12,5%)	0,000	14,000	3,283	59,707
Low	10 (35,7%)	18 (64,3%)				
Drug Consumption Status						
Ya	3 (75%)	1 (25%)	0,466	2,333	0,226	24,076
No	27 (56,2%)	21 (43,8%)				
Status Merokok						
Ya	1 (100%)	0 (0%)	0,387	1,759	1,385	2,234
No	29 (56,9%)	22 (43,1%)				
Alcohol Consumption Status						

Ya	1 (50%)	1 (50%)	0,822	0,724	0,043	12,248
No	29 (58%)	21 (42%)				
Caffeine Consumption Status						
Ya	7 (53,8%)	6 (46,2%)	0,746	0,812	0,229	2,871
No	23 (59%)	16 (41%)				

Source: Primary data analyzed using Fisher's Exact Test with IBM SPSS Statistics Version 22 (2026).

The bivariate results showed a $p < 0.05$ (0.003) value, so there was a meaningful correlation between smartphone addiction and sleep quality, so H_a was accepted. The risk of poor sleep quality in people with high rates of smartphone addiction is 6 times greater than in people with low rates of smartphone addiction.

A $p < 0.05$ (0.000) value then there is a significant correlation between the level of anxiety and sleep quality and H_a received. The risk of poor sleep quality in people with high levels of anxiety is 14 times greater than in people with low levels of anxiety.

The $p > 0.05$ (0.466), so there was no meaningful correlation between drug consumption and sleep quality and H_a was rejected. The risk of poor sleep quality in people who regularly take medication is 2 times greater than in people who do not take medication regularly.

The $p > 0.05$ (0.387) so there was no meaningful correlation between smoking and sleep quality and H_a was rejected. The risk of poor sleep quality in people who regularly smoke is 2 times greater than in people who do not smoke regularly.

The $p > 0.05$ (0.822), then there was no meaningful correlation between alcohol consumption and sleep quality and H_a was rejected. The risk of poor sleep quality in people who regularly consume alcohol is the same as in people who do not consume alcohol regularly.

The $p > 0.05$ (0.746) so there was no significant correlation between caffeine consumption and sleep quality and H_a was rejected. The risk of poor sleep quality in people who regularly consume caffeine is the same as in people who do not consume caffeine regularly.

Multivariate Analysis

A multivariable logistic regression correlation test was conducted to identify the relationship of one or more independent variables with a dependent variable and obtain a model consisting of several independent variables that are considered the best to predict dependent events. Multivariable logistics correlation test with the backward method. The variables included were data from bivariate analysis which had a $p < 0.250$.

It can be seen in table 4 that the results of the bivariate selection of smartphone addiction and anxiety have a $p < 0.250$ value so that statistically they can be continued to multivariate analysis, while for the bivariate selection of drug consumption status, smoking status, alcohol consumption status, and caffeine consumption status have a $p > 0.250$ value so that statistically it cannot be continued to multivariate analysis.

Table 4. Bivariate Selection of Indicators of Smartphone Addiction and Confounding Factors with Sleep Quality

Independent Variables	Value p	Conclusion
Smartphone Addiction	0,003	Candidate
Anxiety	0,000	Candidate
Drug Consumption Status	0,466	Non-Candidate
Status Merokok	0,387	Non-Candidate
Alcohol Consumption Status	0,822	Non-Candidate
Caffeine Consumption Status	0,746	Non-Candidate

Source: Primary data analyzed by the authors for multivariate logistic regression selection using IBM SPSS Statistics Version 22 (2026).

The results of the fisher exact test were known to have two variables that were tested in the logistic regression test, namely smartphone addiction and anxiety. Multivariable logistics correlation test with the backward method. The final results can be seen in table 5.5, where the results have 2 variables, namely smartphone addiction which has a p value of 0.017 ($p < 0.05$) and anxiety which has a p value of 0.001 ($p < 0.05$), so it can be concluded that there is a relationship between smartphone addiction and sleep quality in students of the Faculty of Medicine, Universitas Pelita Harapan class of 2016. However, compared to smartphone addiction, it can be seen that the anxiety variable has a greater influence on sleep quality.

Table 5. Logistic Regression of the Relationship Between Indicators of Smartphone Addiction and Confounding Factors with Sleep Quality (n= 52)

Variabel	B	p	OR	95% CI	
				Lower	Upper
Smartphone Addiction	1,835	0,017	6,626	1,760	19,725
Anxiety	2,736	0,001	15,443	3,106	76,644

Source: Primary data analyzed using multivariate logistic regression with IBM SPSS Statistics Version 22 (2026).

The results of the study on the subjects of the 2016 batch of students of the faculty of medicine, Universitas Pelita Harapan with the age of 18 – 26 years, obtained a sample of 52 respondents who were included in the inclusion criteria consisting of 32 female respondents and 20 male respondents. Sampling is carried out by a simple random technique, where samples are randomly selected from existing data. The data obtained using a questionnaire is then used as data analysis material.

The purpose of this study was to look at the relationship between smartphone addiction and sleep quality in college students. The results of the bivariate test using the Chi Square test, obtained a significance value of 0.003 which is smaller than 0.05. This shows that there is a relationship between smartphone addiction and the quality of students' sleep. This is in line with what Demirci stated in 238 adolescents who showed a decrease in sleep quality and a decrease in sleep hours of more than 1 hour in the last 20-30 years caused by various factors, one of which is the use of smartphones⁸, and a study conducted by Soni, Upadhyay, and Jain on 587 students in Ajmer schools, India, showed that the group with a high rate of smartphone addiction had a much worse quality of sleep compared to the group with a low rate of smartphone addiction.¹ A comparable moderate positive correlation between

smartphone addiction and poorer sleep quality has since been reported among medical students in Serbia, reinforcing the cross-cultural consistency of this relationship (Perić Prkosovački & Gajić, 2024).

In line with the results of research conducted by Scott and Woods, the increased use of social media through smartphones will result in a decrease in sleep quality, low levels of self-confidence and increased levels of anxiety and depression.⁴³ This clearly affects the level of well-being of individuals, a conclusion supported by evidence that smartphone addiction is consistently associated with poorer sleep quality among college students even after accounting for lifestyle factors such as physical activity (Zhu et al., 2024). Not only that, Moulin and Chung's research reported that 72% of adolescent subjects who were still in high school slept with their smartphones or tablets placed in bed.⁴⁴ This is in line with the results of a study that reported that 86% of subjects slept with smartphones, tablets, or laptops placed in the subjects' beds. Some subjects also reported that the subject occasionally woke up to access and respond to messages that came into the subject's device. This indicates unhealthy sleep habits that can lead to deteriorating sleep quality. Notably, smartphone addiction has also been identified as a mediating factor linking lower psychological resilience to greater insomnia symptoms among medical students, suggesting that psychological resources may buffer against the sleep-related harms of problematic smartphone use (Li, 2024).

CONCLUSION

Based on the results of this study involving 52 medical students from the 2016 cohort at Universitas Pelita Harapan, several important conclusions can be drawn. First, there is a significant relationship between smartphone addiction and sleep quality ($p = 0.003$; OR = 6.626; 95% CI 1.760-19.725). Medical students with high levels of smartphone addiction have approximately 6 times greater risk of experiencing poor sleep quality compared to those with low addiction levels. Among the 29 respondents with high smartphone addiction, 75.9% had poor sleep quality, while only 34.8% of the 23 respondents with low addiction experienced poor sleep quality. Second, there is a significant relationship between anxiety levels and sleep quality ($p = 0.000$; OR = 15.443; 95% CI 3.106-76.644). Based on multivariate logistic regression analysis, anxiety emerged as the more dominant factor affecting sleep quality compared to smartphone addiction, indicating that smartphone addiction and anxiety together play important roles as predictors of poor sleep quality in medical students. Third, the other factors examined in this study—medication use, smoking habits, alcohol consumption, and caffeine intake—did not show statistically significant relationships with sleep quality in this study population ($p > 0.05$). This finding may be attributed to the low proportion of respondents engaging in these behaviors, which limited statistical power to detect meaningful associations. The findings of this study have important implications for medical education institutions, given that 62% of all respondents experienced poor sleep quality. Higher education institutions are expected to provide comprehensive educational programs addressing the impact of smartphone addiction and anxiety management on students' sleep health. Medical schools should consider implementing institutional policies that encourage healthy smartphone use patterns, such as promoting "digital curfews" before bedtime, reducing blue light exposure, and integrating stress management and mental health support services into the curriculum. For future research,

studies with larger sample sizes and longitudinal designs are needed to reinforce these findings and explore the cause-and-effect mechanisms between smartphone addiction, anxiety, and sleep quality in greater depth. Research incorporating objective sleep measures such as actigraphy or polysomnography alongside subjective questionnaires would provide more comprehensive assessment of sleep quality. Additionally, intervention studies examining the effectiveness of smartphone usage reduction programs combined with anxiety management techniques would provide valuable evidence for developing targeted prevention and treatment strategies. Comparative studies across different medical education years and between medical and non-medical students could help identify discipline-specific risk factors and inform tailored interventions to improve sleep health among students.

REFERENCES

- Amin, M. H. J., Alhadi, H. A., Abdalla Mohamed, A. E., Kamal Eldin Taha Yacoub, H., MohammedAhmed Hassan Khalifa, R., Abusufian Elkabashi Dafallah, I., Osman Yasin, F. M., Taha, A. M., Abdalla Adam, M. Y., & Abualabasher, M. O. (2024). Impact of smartphone addiction on health status, mental well-being, and sleep quality among medical students in Sudan. *BMC Psychiatry*, 24, Article 965. <https://doi.org/10.1186/s12888-024-06377-9>
- Attal, B. A., Bezdan, M., & Abdulqader, A. (2021). Quality of sleep and its correlates among Yemeni medical students: A cross-sectional study. *Sleep Disorders*, 2021, Article 8887870. <https://doi.org/10.1155/2021/8887870>
- Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of Behavioral Addictions*, 4(2), 85–92.
- Gong, L., & Liu, Q. (2023). Mobile phone addiction and sleep quality: The mediating role of anxiety and the moderating role of emotion regulation. *Behavioral Sciences*, 13(3), Article 250. <https://doi.org/10.3390/bs13030250>
- Izquierdo-Condoy, J. S., Paz, C., Nati-Castillo, H. A., Gollini-Mihalopoulos, R., Aveiro-Róbaló, T. R., Valeriano Paucar, J. R., Laura Mamami, S. E., Caicedo, J. F., Loaiza-Guevara, V., Mejía, D. C., Salazar-Santoliva, C., Villavicencio-Gomezjurado, M., Hall, C., & Ortiz-Prado, E. (2025). Impact of mobile phone usage on sleep quality among medical students across Latin America: Multicenter cross-sectional study. *Journal of Medical Internet Research*, 27, Article e60630. <https://doi.org/10.2196/60630>
- Li, F. (2024). The role of smartphone addiction as a mediator between psychological resilience and insomnia in medical students at a university. *Psychiatry and Clinical Psychopharmacology*, 34(3), 238–244.
- Long, J., Liu, T.-Q., Liao, Y.-H., Qi, C., He, H.-Y., Chen, S.-B., & Billieux, J. (2016). Prevalence and correlates of problematic smartphone use in a large random sample of Chinese undergraduates. *BMC Psychiatry*, 16(1), Article 408. <https://doi.org/10.1186/s12888-016-1083-3>
- Maheshwari, G., & Shaukat, F. (2019). Impact of poor sleep quality on the academic performance of medical students. *Cureus*, 11(4), e4357. <https://doi.org/10.7759/cureus.4357>
- Matar Boumosleh, J., & Jaalouk, D. (2017). Depression, anxiety, and smartphone addiction in

- university students: A cross-sectional study. *PLoS ONE*, 12(8), e0182239.
- Mortazavi, S. A. R., Parhoodeh, S., Hosseini, M. A., Arabi, H., Malakooti, H., Nematollahi, S., Mortazavi, G., Darvish, L., & Mortazavi, S. M. J. (2018). Blocking short-wavelength component of the visible light emitted by smartphones' screens improves human sleep quality. *Journal of Biomedical Physics and Engineering*, 8(4), 375–380.
- Moulin, K., & Chung, C. J. (2016). Technology trumping sleep: Impact of electronic media and sleep in late adolescent students. *Journal of Education and Learning*, 6, 294.
- Nikolic, A., Bukurov, B., Kocic, I., Vukovic, M., Ladjevic, N., Vrhovac, M., Pavlović, Z., Grujicic, J., Kisic, D., & Sipetic, S. (2023). Smartphone addiction, sleep quality, depression, anxiety, and stress among medical students. *Frontiers in Public Health*, 11, Article 1252371. <https://doi.org/10.3389/fpubh.2023.1252371>
- Perić Prkosovački, B., & Gajić, M. (2024). Smartphone addiction and sleep quality among medical students. *Društvene i Humanističke Studije*, 9(1), 863–878. <https://doi.org/10.51558/2490-3647.2024.9.1.863>
- Qin, X., Liu, L., Yan, Y., Guo, X., Yang, N., & Li, L. (2025). Smartphone addiction and sleep quality in the physical activity–anxiety link: A mediation-moderation model. *Frontiers in Public Health*, 13, Article 1512812. <https://doi.org/10.3389/fpubh.2025.1512812>
- Scott, H., & Woods, H. C. (2019). Understanding links between social media use, sleep and mental health: Recent progress and current challenges. *Current Sleep Medicine Reports*, 5, 141–149.
- Soni, R., Upadhyay, R., & Jain, M. (2017). Prevalence of smartphone addiction, sleep quality and associated behaviour problems in adolescents. *International Journal of Research in Medical Sciences*, 5, 515.
- Zhu, W., Liu, J., Lou, H., Mu, F., & Li, B. (2024). Influence of smartphone addiction on sleep quality of college students: The regulatory effect of physical exercise behavior. *PLOS ONE*, 19(7), Article e0307162. <https://doi.org/10.1371/journal.pone.0307162>