

SMARTPHONE ADDICTION AND ITS IMPACT ON SLEEP HEALTH AND PRODUCTIVITY OF HEALTH STUDENTS

Jean Henry Raule¹,

¹Politeknik Kesehatan Kementrian Kesehatan, Manado, Indonesia

Email: jeanh1666@gmail.com

Received: 4 September 2025

Revised: 20 September 2025

Accepted: 19 September 2025

Published: 20 September 2025

Corresponding Author:

Author Name: Jean Henry

Raule

Email: jeanh1666@gmail.com

Abstrak: *Smartphone addiction in college students—especially health students—correlates with sleep disturbances and decreased academic productivity. This study aims to analyze the relationship between smartphone addiction (SA), sleep quality, and productivity in health students and test the mediating role of sleep quality. The research design uses a cross-sectional quantitative approach with purposive sampling. Instruments include the Smartphone Addiction Scale–Short Version (SAS-SV) for SA and the Pittsburgh Sleep Quality Index (PSQI) for sleep quality; Productivity is measured through GPA indicators, late assignment collection, and self-rated academic productivity indexes. Statistical analysis includes multiple regression and bootstrapped mediation. The results showed that SA was positively associated with poor sleep quality and negatively associated with productivity. Sleep quality mediates in part the influence of SA on productivity. The findings confirm the importance of sleep hygiene interventions and the regulation of smartphone use in the health campus environment. This study contributes by focusing on the health student population in Indonesia and testing a measured sleep quality mediation model with validated instruments*

Keywords : *smartphone addiction; quality of sleep; academic productivity; health students*

How to cite: Raule, Jean Henry. (2025). Smartphone Addiction and its Impact on Sleeping Health and Productivity of Health Students. *Journal of Public Health Indonesian*. 2 (3), 26-37.

DOI: 10.62872/e0dk0d95

INTRODUCTION

The use of smartphones has become a universal phenomenon among students, including health students whose learning activities are carried out by demanding integrated learning applications, clinics, and communication for academic purposes. The massive use (Singh et al., 2021) of smartphones can give birth to the potential for *problematic smartphone use* (PSU) or smartphone addiction, this PSU phenomenon can be known through several factors such as loss of control or control when playing smartphones, compulsive checking, and excessive use at night, which ultimately results in sleep disturbances and decreased cognitive function during the day (Y. Wang et al., 2025)

There are many studies that have found a strong negative correlation between PSU and sleep quality among college students, for example in medical and health students. The pattern formed in this group is due to the

heavy academic load, clinical study hours, and exposure to digital radiation at night because they have to study (Leow et al., 2023). In addition, exposure to blue light radiation and bedtime procrastination worsens the latency and fragmentation of individuals in their sleep, as a result of which the individual experiences prolonged sleepiness during the day or daytime dysfunction which can interfere with academic performance. The findings in these studies show how the massive duration and intensity of smartphone use has a strong correlation with sleep duration and worsens PSQI components such as sleep quality, latency, and daytime dysfunction. PSQI or Pittsburgh Sleep Quality Index is an international standard questionnaire instrument used to assess sleep quality in the last one month. The global score of PSQI was obtained from 7 factors, namely subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, sleep drug use, and daytime dysfunction. (Li et al., 2025) (Buysse et al., 1989)

Deep attention to the quality of life of students is relevant because graduates in the health sector are required to always have fitness to practice, one of which is influenced by adequate and adequate sleep quality. This evidence illustrates the condition of medical and health students in responding to the prevalence of PSU among health students is recorded to be quite high, and the association between PSU and sleep disorders shows the strength of a statistically significant effect as well as clinically relevant. In a number of middle-income Asian countries, high smartphone penetration correlates with an increasing prevalence of (Leow et al., 2023b) *problematic smartphone use* (PSU) and sleep quality disorders; findings in urban adult populations also show a link between PSUs and sleep quality, certain smartphone usage activity patterns, and the emergence of (Ong et al., 2024) psychological symptoms This study does not specifically discuss students, but adults. But the same pattern of associations was noted in college students and young adults, signaling the urgency of problems that have the potential to lower alertness during clinical practice, clinical reasoning, and productivity.

From the point of view of academic productivity, the results of the meta-analytic synthesis confirm that the intensity of smartphone use has a negative relationship with academic achievement, although the strength of the relationship is relatively small but still statistically significant. Differences in terms used in the literature, such as frequency of use, dependence, and (Hsieh, 2025) *problematic smartphone use* (PSU), often pose challenges in conducting cross-study comparisons. Nevertheless, the direction of the findings remains consistent, namely that the higher the level of problematic smartphone use, the lower the academic achievement or performance achieved by students. In the context of health students, who are faced with a busy lecture schedule and heavy curriculum demands, the impact becomes more complex. Poor sleep quality or limited sleep duration experienced by students can cause attention disorders, decrease work memory capacity, and increase fatigue during the day. This condition ultimately worsens the effect of PSUs on academic productivity, so that health students have the potential to experience a greater decline in learning performance than the general student group (Paterna et al., 2024) (Hsieh, 2025)

Although previous studies have successfully mapped the relationship between *problematic smartphone use* (PSU) and sleep quality, as well as its relationship with academic performance, there is still a significant research gap. First, studies that explicitly examine the mediating role of sleep quality in bridging the relationship between PSU and academic achievement are still very limited, especially in the context of health students in developing countries such as Indonesia. Existing research is generally conducted in high-

income countries with relatively adequate academic and technological facilities, so the results cannot always be generalized to local contexts. In addition, most previous studies have not used consistently validated psychometric instruments or more sophisticated statistical analysis models such as *bootstrapping mediation*, even though these methods are important for obtaining more accurate and robust relationship estimates (An & Zhang, 2024)

Second, many studies still rely on a single indicator in assessing academic productivity, for example using only a cumulative achievement index (GPA). In fact, GPA does not fully reflect the aspect of student productivity as a whole, because it does not take into account behavioral dimensions such as the timeliness of assignment collection, the level of participation in academic activities, or subjective assessments of *self-rated productivity*. Third, research that does focus on the health student population often combines all health study programs (medicine, nursing, midwifery, public health, nutrition, etc.) into one analysis group, without considering the heterogeneity of academic demands and clinical burden of each study program. This has the potential to blur the real picture, because for example, medical students with busy clinic rotation schedules face different sleep challenges than public health students who are more focused on field assignments.

In addition, in the realm of policy (*policy-level*), there is still a debate about the effectiveness of restricting the use of smartphones in educational institutions. A number of education policy studies state that banning the use of smartphones in the classroom or campus area is not always consistent in improving academic achievement or improving student welfare. This shows that policy-based interventions alone are not enough; On the other hand, strategies based on individual behavior changes, such as the implementation of sleep hygiene practices, restrictions on the use of smartphones during curfews (*digital curfew*), and good digital literacy, are actually more potentially effective (Weaver, 2025) .

From the perspective of research novelty, this study emphasizes three main contributions. First, this study specifically focuses on health students, with a more comprehensive approach to measuring academic productivity. Not only relying on GPA as the only indicator, but also including compliance with *deadlines (deadline adherence)* and self-productivity index as supporting variables, thus providing a more comprehensive picture. Second, this study tested a partial mediation model, in which sleep quality, measured using PSQI, acts as a variable that bridges the influence of *smartphone addiction (SA)* on academic productivity. This approach responds to the recent finding that sleep is an important psychophysiological mechanism that is often the main pathway of PSU's impact on psychological well-being and academic performance Third, this study emphasizes the use of validated cutting-edge instruments. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) which has been shown to have both factor structure and reliability in medical students, as well as strong internal consistency in various population contexts. Meanwhile, smartphone addiction rates are measured by the compact Smartphone Addiction Scale-Short Version (SAS-SV), which has high reliability, and cross-cultural validity that continues to be strengthened in recent studies (Islam et al., 2025) (Shadzi et al., 2024) (L. Wang et al., 2022) (De Moraes et al., 2024) (Hamamura et al., 2023).

In line with this foundation, this study has three main objectives: (1) to analyze the relationship between smartphone addiction and the sleep quality of health students; (2) analyze the relationship between smartphone addiction and academic productivity; and (3) examining the role of sleep quality as a mediator in the relationship between smartphone addiction and academic productivity. With the design of this study, it is hoped that stronger empirical evidence can be obtained regarding the psychophysiological mechanisms involved in the relationship between smartphone addiction, sleep quality, and health student productivity.

In addition to making a theoretical contribution, this research also has significant practical implications. The results of the research are expected to support health faculties in designing evidence-based intervention programs that emphasize digital literacy education, strengthening time management, and forming healthy sleep habits. Thus, this research not only enriches the academic literature, but also provides recommendations that are applicable to the management of mental and academic health of health students in Indonesia, as well as strengthening the direction of institutional policies in facing the challenges of the digital era.

METODOLOGI

This study uses a cross-sectional quantitative design on students of health programs (medicine, nursing, midwifery, nutrition, public health) at a public university in Indonesia. Inclusion criteria: active students in semesters 2-8, have a personal smartphone, and give consent to participation. The sampling technique used *proportionate stratified sampling* based on the study program; the minimum sample size was determined through *a priori power analysis* for regression with three predictors ($\alpha=0.05$; *power* = 0.80; *effect size* small-medium), resulting in a need ≥ 300 respondents, then 20% for *non-response*, so that the target $N \approx 360-400$.

Key variables included: (a) *smartphone addiction*, measured by SAS-SV (10 items, Likert 1–6; higher scores indicated heavier SA); (b) sleep quality, measured using PSQI (7 components; global score >5 indicates poor sleep quality); (c) academic productivity, operationalized as a composite of the latest GPA (self-report with random verification of documents), average delay in collecting assignments (last four weeks), and *self-rated academic productivity index* (5 Likert items 1-5). Kovar includes gender, age, part-time working hours, short physical activity (2 items), and duration of evening study.

The data collection procedure took place online through *the university's learning management system* and study program channels, for four weeks. Respondents filled out the *e-consent* and then a sequential questionnaire (SAS-SV $\rightarrow$ PSQI $\rightarrow$ productivity indicators $\rightarrow$ covariates). Data quality is maintained through *attention checks*, *logic rules* (e.g., total hours do not exceed 24), and *duplicate detection*. Research ethics are approved by the university's ethics committee; The data is anonymized, stored encrypted, and accessed only by researchers.

Data analysis was carried out in stages: (1) *screening data* (missing $<5\%$, *Little's MCAR*; *multivariate outliers Mahalanobis distance*), internal reliability (Cronbach's $\alpha&\omega$); (2) the descriptive and Pearson correlation between SA, PSQI, and productivity; (3) multiple linear regression to predict PSQI of SA and covariates; and predict productivity from smartphone addiction, PSQI, and covariate; (4) a sleep quality mediated test using *a bias-corrected bootstrapping* of 5,000 replications to assess *the indirect effect* of SA

→ PSQI → Productivity (report coefficient, 95% CI). Residue normality, multicollinearity (*VIF*), and heteroscedasticity assumptions were reported. All analyses were performed at $\alpha=0.05$; *Effect sizes* (F^2 , standard β) are included.

RESULTS AND DISCUSSION

Variable	Average Grade $\pm$ Elementary / Percentage
Questionnaire worth analysis	386 (96.0% of 402 total)
Age (years)	20.9 $\pm$ 1.7
Gender – Female	68,1%
Study Program : Nursing	28,2%
Program of Study: Medicine	24,6%
Program of Study: Public Health	21,0%
Study Program: Midwifery	15,0%
Study Program: Nutrition	11,1%
SAS-SV Score	28.7 $\pm$ 9.1
Global PSQI Score	7.1 $\pm$ 3.2
Poor sleep quality (PSQI >5)	63,5%
GPA	3.51 $\pm$ 0.32
Self-rated academic productivity	3.2 $\pm$ 0.7
Task delays (per month)	1.8 $\pm$ 2.3

Table 1. Respondent Characteristics (N = 386)

Analysis	Key Results
Correlation of Smartphone Addiction – PSQI	$r = 0.42$; $p < 0.001$ (positive, significant)
Correlation of Smartphone Addiction - Productivity	$r = -0.31$; $p < 0.001$ (negative, significant)
Smartphone Addiction Regression – PSQI	$\beta = 0,39$; $p < 0.001$
PSQI Regression - Productivity	$\beta = -0,28$; $p < 0.001$
Simultaneous Restoration (Smartphone Addiction + PSQI → Productivity)	significant SA ($\beta = -0.16$; $p < 0.01$), decreased from $\beta = -0.26 \rightarrow$ partial mediation
Mediation (bootstrapping, 5,000 replications)	Indirect effects were significant: $\beta = -0.11$; 95% CI $[-0.15, -0.07]$; Direct effect significant: $\beta = -0.16$; $p < 0.01$

Table 2. Results of Correlation Analysis, Regression, and Mediation

Of the total 402 questionnaires collected, 386 were declared to meet the inclusion criteria so that they could be analyzed, with a response feasibility rate of 96.0%. The average age of the respondents was 20.9 years ($SD = 1.7$), with the majority being female (68.1%). The distribution of respondents by study program was nursing (28.2%), medicine (24.6%), public health (21.0%), midwifery (15.0%), and nutrition (11.1%). The average score of the *Smartphone Addiction Scale–Short Version* (SAS-SV) was 28.7 ($SD = 9.1$). Meanwhile, the *global average score of the Pittsburgh Sleep Quality Index* (PSQI) was 7.1 ($SD = 3.2$), with 63.5% of respondents obtaining a score above 5 indicating poor sleep quality. Academic productivity

showed an average GPA of 3.51 (SD = 0.32), a *self-rated academic productivity* score of 3.2 (SD = 0.7), and an average of 1.8 assignment delays per month (SD = 2.3).

The results of the correlation analysis showed that the rate of smartphone addiction was positively related to poor sleep quality ($r = 0.42$, $p < 0.001$) and negatively related to academic productivity ($r = -0.31$, $p < 0.001$). Further regression analysis showed that smartphone addiction was a significant predictor of PSQI after being controlled by covariate ($\beta = 0.39$, $p < 0.001$). In addition, PSQI significantly predicts a decrease in productivity ($\beta = -0.28$, $p < 0.001$). When both variables were included simultaneously, smartphone addiction remained significant in predicting productivity, although the value of the coefficient decreased from $\beta = -0.26$ to $\beta = -0.16$, indicating a partial mediation effect. A mediated test using *bias-corrected bootstrapping* with 5,000 replications showed that the indirect effect of smartphone addiction on productivity through PSQI was significant ($\beta = -0.11$; 95% CI $[-0.15, -0.07]$), while the direct effect of smartphone addiction on productivity remained significant ($\beta = -0.16$; $p < 0.01$).

A. The Relationship of Smartphone Addiction to Health Student Sleep Quality

The findings of this study show consistency with empirical evidence and the latest scientific synthesis that confirms a positive relationship between the level of problematic smartphone use (PSU) or smartphone addiction and the deterioration of sleep quality in the student and young adult groups. A meta-analysis conducted by showed that excessive smartphone use is closely related to various indicators of sleep disorders, ranging from a decrease in subjective sleep quality to sleep fragmentation that has an impact on decreased cognitive function during the day. This pattern of association is not coincidental, but has been consistently found in various cross-population studies, thus reinforcing the validity of the finding that smartphones have the potential to disrupt sleep balance when used maladaptively. (Kumar et al., 2025)

In addition, the results of this study are also aligned with longitudinal evidence that highlights the role of psychological mechanisms in explaining these relationships. Studies show that the negative effects of PSUs on sleep quality can be mediated by psychological factors such as increased anxiety, depressive symptoms, as well as (Wu et al., 2024) *bedtime procrastination* behavior. In other words, individuals who tend to use smartphones until late at night are more prone to delaying bedtime and experiencing circadian rhythm disruptions, which ultimately results in poor sleep quality. This *serial mediation* mechanism emphasizes that PSU is not only a matter of consumptive behavior, but is also closely related to mental health dynamics that have implications for daily sleep patterns.

In the framework of health students, the results of this study also converge with other empirical reports that found a high prevalence of insomnia and sleep disorders in the group of students with a higher rate of smartphone addiction. Studies underscore that health students, particularly those facing busy academic schedules and high clinical loads, show more serious rates of sleep disorders than the general student group. These findings can be explained by the unique characteristics of health education that demand intensive engagement in academic learning as well as clinical practice, often late into the night. This situation increases the tendency of students to continue using smartphones, both for academic purposes such as reading lecture materials and

coordinating with groups, as well as for non-academic activities such as digital entertainment and *doom-scrolling* (Failoc Rojas et al., 2025).

The combination of heavy academic load and exposure to smartphone screens at night ultimately exacerbates various components of sleep as measured by *the Pittsburgh Sleep Quality Index (PSQI)*, including longer sleep latency, decreased sleep efficiency, and increased daytime dysfunction. The accumulation of these effects not only decreases the sleep quality of health students, but also has the potential to affect their *fitness to practice* as prospective health workers. Thus, the results of this study strengthen the argument that smartphone addiction has serious consequences on sleep health, especially among health students who structurally face higher academic and clinical demands than students in general.

B. The Relationship of Smartphone Addiction to Academic Productivity

The results of this study show a negative association between the level of smartphone addiction and the academic productivity of health students. These findings are in line with recent meta-analytical evidence confirming that the frequency of smartphone use has a negative relationship with academic performance, although the magnitude of the relationship is relatively small but statistically significant (Hsieh, 2025). The meta-analysis concluded that although smartphones can support learning activities, excessive use actually reduces attention capacity and decreases academic achievement. This is also consistent with a systematic review that examines technological factors on academic performance, which found that uncontrolled smartphone use is one of the risk factors that interfere with learning concentration and academic engagement (Kuş, 2025).

Our findings regarding *effect sizes* ranging from small to medium are realistic, given that academic productivity is essentially a multifactorial construct. In addition to being influenced by learning habits, productivity is also influenced by physiological, psychological, social, and sleep quality factors. Thus, smartphones are only one of the determining factors, but their excessive use has the potential to trigger a significant decline in performance when accompanied by poor sleep behavior and low time management.

Interestingly, various institutional policies in several countries are trying to implement restrictions on the use of smartphones in schools or campuses. However, *quasi-experimental* evidence shows that banning the use of smartphones alone is not enough to improve academic achievement and student welfare. The study reported by *The Guardian*, which summarized research in the UK, confirmed that banning phone calls in schools does not automatically improve students' academic grades or psychological well-being. This shows that prohibition-based interventions tend to be less effective if they are not followed by changes in learning behavior and attention management strategies (Weaver, 2025).

Thus, alternative strategies such as the implementation of more adaptive attention management, including the use of *off-focus blocks*, *digital minimalism*, and *scheduled checking* techniques, are seen as more promising in mitigating the negative impact of SA on productivity. This strategy focuses on improving student self-regulation, not just eliminating access to devices.

In the context of students, the psychological mechanisms that bridge the relationship between smartphone addiction and academic productivity are quite complex. One of the *pathways* identified is the increase in learning burnout, which is a condition of academic fatigue due to excessive use of smartphones. This burnout triggers a decrease in learning motivation, academic engagement, and academic outcomes. Recent structural studies by support this, show that smartphone addiction significantly increases the risk of burnout which ultimately decreases students' academic performance (Ma et al., 2020).

The findings of this study make an important contribution by showing that academic productivity is not only reflected in GPA scores, but also in daily academic behaviors, such as punctuality in collecting assignments, consistency in learning, and efficiency in the execution of academic activities. These aspects are particularly sensitive to changes in poor sleep quality due to excessive smartphone use, thus strengthening the argument that smartphone addiction has a direct or indirect impact on the academic productivity of health students (Paterna et al., 2024).

C. Sleep Quality Mediation

The results of this study show that there is a partial mediating effect of sleep quality in the relationship between smartphone addiction and the academic productivity of health students. These findings confirm that some of the negative effects on productivity do not occur directly, but are mediated through decreased sleep quality. In other words, students with high levels of smartphone addiction tend to experience sleep disorders, and these deteriorating sleep conditions in turn have an impact on reduced learning efficiency, concentration, and overall academic performance. This pattern is consistent with previous research that found that sleep quality acts as a mediator in the relationship between *problematic smartphone use* (PSU) and psychological well-being and negative affects. In addition, longitudinal studies by also showed a serial (Islam et al., 2025) (Wu et al., 2024) *mediation* model, in which PSUs increase anxiety and depression, which then impacts sleep quality, and ultimately affects the individual's overall well-being.

Although the mediating effect of sleep quality is significant, the findings also suggest that the direct effect of smartphone addiction on productivity persists. This indicates that there are other pathways outside the sleep aspect that also explain the decrease in student productivity. Some relevant potential mechanisms include the phenomenon of *time displacement*, namely shifts in learning time or academic activities due to excessive smartphone use; *task switching costs*, which is a decrease in cognitive efficiency because students have to repeatedly switch focus due to notification interruptions; and *attentional capture*, which is a condition in which smartphone notifications automatically attract attention so that it interferes with concentration on main academic tasks (Wilmer et al., 2017) .

These findings have important practical implications. First, sleep-centric interventions are needed, such as education about *sleep hygiene*, the implementation of a *screen curfew* 60–90 minutes before bedtime, and the use of night mode or monochrome mode on smartphone devices. This strategy has the potential to lower PSQI scores and improve the sleep quality of health students. Second, faculty can develop an academic productivity coaching program that not only focuses on time management, but also involves *attention management* and a *digital minimalism* approach to reduce direct distractions from smartphone use. Third, educational institutions can design various forms

of behavioral nudges, such as setting *deadline pacing*, providing short feedback loops, and setting default notifications on learning applications to be more friendly to student focus.

These findings are consistent with a meta-analysis study by which confirms that technological factors, including the intensity of smartphone use, have a significant impact on students' academic performance, so a multi-level approach is needed in handling them. Thus, smartphone overuse should not only be seen as an issue of individual discipline, but also as a public health issue and academic productivity that needs to be managed through systematic interventions at the individual, institutional, and policy levels (Kuş, 2025).

Although these findings make new contributions, there are some methodological limitations that need to be noted. The cross-section design used makes causal inferences difficult to ascertain, so the results can only be interpreted as associations. In addition, all variables were measured using a *self-report* questionnaire, which is susceptible to common *method bias* and social desirability bias. The academic productivity indicators used, while more comprehensive than just GPA, remain partially dependent on self-reporting that is not entirely verifiable. Generalization of findings is also limited because the research was only conducted at one university. To strengthen the evidence, future studies are recommended to use a longitudinal design or ecological momentary assessment (EMA), so that the daily dynamics of the relationship between smartphone addiction and sleep quality can be observed more accurately, while evaluating the effectiveness of campus-based interventions.

CONCLUSIONS

This study proves that smartphone addiction is closely related to decreased sleep quality and academic productivity of health students. The analysis showed that there was a partial mediating effect on sleep quality, so that some of the negative effects of excessive smartphone use on productivity occurred through sleep disturbances, while others continued to take place directly. These findings confirm that interventions that focus on improving sleep hygiene as well as managing smartphone use during the day are essential to maintain the academic performance of health students.

REFERENCES

- An, Y., & Zhang, M. X. (2024). Relationship between problematic smartphone use and sleep problems: The roles of sleep-related compensatory health beliefs and bedtime procrastination. *DIGITAL HEALTH*, 10. <https://doi.org/10.1177/20552076241283338>
- Buyse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- De Moraes, A. C. F., Conceição da Silva, L. C., Lima, B. S., Marin, K. A., Hunt, E. T., & Nascimento-Ferreira, M. V. (2024). Reliability and validity of the online Pittsburgh sleep quality index in college students from low-income regions. *Frontiers in Digital Health*, 6. <https://doi.org/10.3389/fdgth.2024.1394901>
- Failoc-Rojas, V. E., Torres-Mera, A., León-Figueroa, D. A., Lira, D., Santander-Hernández, F. M., Guevara-Morales, M. A., Díaz-Vélez, C., & Valladares-Garrido, M. J. (2025). Smartphone dependence, addiction, and insomnia among medical students during the COVID-19 pandemic. *PLOS One*, 20(7), e0329495. <https://doi.org/10.1371/journal.pone.0329495>
- Hamamura, T., Kobayashi, N., Oka, T., Kawashima, I., Sakai, Y., Tanaka, S. C., & Honjo, M. (2023). Validity, reliability, and correlates of the Smartphone Addiction Scale–Short Version among Japanese adults. *BMC Psychology*, 11(1), 78. <https://doi.org/10.1186/s40359-023-01095-5>
- Hsieh, C.-Y. (2025). The impact of smartphone usage frequency on university students' academic performance: A meta-analysis of moderating factors. *Acta psychologica*, 259, 105374. <https://doi.org/10.1016/j.actpsy.2025.105374>
- Islam, Md. R., Ahmed, O., Naher, L., & Islam, Md. N. (2025). The association between problematic smartphone use and subjective well-being in Bangladeshi youths: Mediating role of sleep quality. *Addictive Behaviors Reports*, 21, 100599. <https://doi.org/10.1016/j.abrep.2025.100599>
- Kumar, M., Katoch, O. R., Kumar, N., & Sehgal, S. (2025). Exploring the link between smartphone use and sleep quality: A systematic review. *Sleep Research*, 2(1), 42–56. <https://doi.org/10.1002/slp2.70002>
- Kuş, M. (2025). A meta-analysis of the impact of technology related factors on students' academic performance. *Frontiers in Psychology*, 16. <https://doi.org/10.3389/fpsyg.2025.1524645>
- Leow, M. Q. H., Chiang, J., Chua, T. J. X., Wang, S., & Tan, N. C. (2023a). The relationship between smartphone addiction and sleep among medical students: A systematic review and meta-analysis. *PLOS ONE*, 18(9), e0290724. <https://doi.org/10.1371/journal.pone.0290724>

- Leow, M. Q. H., Chiang, J., Chua, T. J. X., Wang, S., & Tan, N. C. (2023b). The relationship between smartphone addiction and sleep among medical students: A systematic review and meta-analysis. *PLOS ONE*, 18(9), e0290724. <https://doi.org/10.1371/journal.pone.0290724>
- Li, S., Deng, Y., Cai, L., & Wu, L. (2025). The relationship between smartphone addiction and sleep disorder among college students: negative emotions as a mediator and gender as a moderator. *Frontiers in Psychiatry*, 16. <https://doi.org/10.3389/fpsyt.2025.1542243>
- Ma, P., He, B., Pan, W., Qin, P., & Zhao, S. (2020). The Influence of Undergraduate's Mobile Phone Addiction on Learning Burnout: Based on Latent Moderated Structural Equations. *Psychology*, 11(06), 966–979. <https://doi.org/10.4236/psych.2020.116062>
- Ong, R. H. S., Sim, H. S., Bergman, M. M., How, C. H., Png, C. A. L., Lim, C. S., Peh, L. H., & Oh, H. C. (2024). Prevalence and associations of problematic smartphone use with smartphone activities, psychological well-being, and sleep quality in a household survey of Singapore adults. *PLOS ONE*, 19(12), e0315364. <https://doi.org/10.1371/journal.pone.0315364>
- Paterna, A., Alcaraz-Ibáñez, M., Aguilar-Parra, J. M., Salavera, C., Demetrovics, Z., & Griffiths, M. D. (2024a). Problematic smartphone use and academic achievement: A systematic review and meta-analysis. *Journal of Behavioral Addictions*, 13(2), 313–326. <https://doi.org/10.1556/2006.2024.00014>
- Paterna, A., Alcaraz-Ibáñez, M., Aguilar-Parra, J. M., Salavera, C., Demetrovics, Z., & Griffiths, M. D. (2024b). Problematic smartphone use and academic achievement: A systematic review and meta-analysis. *Journal of Behavioral Addictions*, 13(2), 313–326. <https://doi.org/10.1556/2006.2024.00014>
- Shadzi, M. R., Rahmanian, M., Heydari, A., & Salehi, A. (2024). Structural validity of the Pittsburgh Sleep Quality Index among medical students in Iran. *Scientific Reports*, 14(1), 1538. <https://doi.org/10.1038/s41598-024-51379-y>
- Singh, K., Sarkar, S., Gaur, U., Gupta, S., Adams, O. P., Sa, B., & Majumder, M. A. A. (2021). Smartphones and Educational Apps Use Among Medical Students of a Smart University Campus. *Frontiers in Communication*, 6. <https://doi.org/10.3389/fcomm.2021.649102>
- Wang, L., Wu, Y.-X., Lin, Y.-Q., Wang, L., Zeng, Z.-N., Xie, X.-L., Chen, Q.-Y., & Wei, S.-C. (2022). Reliability and validity of the Pittsburgh Sleep Quality Index among frontline COVID-19 health care workers using classical test theory and item response theory. *Journal of Clinical Sleep Medicine*, 18(2), 541–551. <https://doi.org/10.5664/jcsm.9658>
- Wang, Y., Wang, X., Wang, Q., Liu, G., Wu, C., & Hao, M. (2025). The Role of Bedtime Procrastination, Rumination, Loneliness, and Positive Body Image in Predicting Sleep Quality Among University Students: A Sex-Specific Analysis. *Alpha Psychiatry*, 26(3). <https://doi.org/10.31083/AP44142>

- Weaver, M. (2025, February 5). *School phone bans alone do not improve grades or wellbeing, says UK study*. The Guardian.
- Wilmer, H. H., Sherman, L. E., & Chein, J. M. (2017). Smartphones and Cognition: A Review of Research Exploring the Links between Mobile Technology Habits and Cognitive Functioning. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.00605>
- Wu, R., Niu, Q., Wang, Y., Dawa, Y., Guang, Z., Song, D., Xue, B., Lu, C., & Wang, S. (2024). The Impact of Problematic Smartphone Use on Sleep Quality Among Chinese Young Adults: Investigating Anxiety and Depression as Mediators in a Three-Wave Longitudinal Study. *Psychology Research and Behavior Management*, Volume 17, 1775–1786. <https://doi.org/10.2147/PRBM.S455955>