Too Afraid to Disconnect? Investigating the Influence of Nomophobia on Problematic Internet Use and Sleep Quality among College Students

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Abstract. Nomophobia has become an important issue in the digital era as it can trigger Problematic Internet Use (PIU) and disturb sleep quality. College students, as active internet users, are vulnerable to these negative effects. However, research on the relationship between these three variables in Indonesia remains limited. This study aims to examine the relationship between nomophobia, PIU, and sleep quality among students. Using a quantitative correlational design, data were collected from 302 students through the Generalized Problematic Internet Use Scale 2 (GPIUS2), Pittsburgh Sleep Quality Index (PSQI), and Nomophobia Questionnaire (NMP-Q). Results showed: (1) a positive relationship between nomophobia and PIU, and (2) a positive relationship between nomophobia and sleep quality. The unexpected positive link between nomophobia and sleep quality indicates the need for further studies to explore moderating factors such as smartphone use for positive coping. The findings support the importance of digital literacy promoting adaptive technology use.

Keywords: College Students, Nomophobia, Problematic Internet Use, Sleep Quality.

1 Introduction

The development of information technology today plays a very important role, as it meets the need for faster and more accurate information exchange [1]. One of the communication tools that has emerged from this technological development is the smartphone. A survey conducted in 2015 by CLSA showed that 36% of smartphone users in Indonesia spent between 4 to 8 hours per day using their smartphones [2].

Smartphones bring positive impacts, such as convenience in daily life; however, their use can also lead to negative consequences. Prolonged smartphone use can result in nomophobia (no mobile-phone phobia), which is characterized by the tendency to constantly check one's phone and feelings of anxiety when unable to part from it [3].

Nomophobia has become a concerning issue because it can affect various aspects of an individual's life, such as problematic internet use and sleep quality. This issue is particularly significant in today's digital era, especially among university students who rely heavily on technology to achieve their academic and social goals.

Nomophobia can trigger anxiety when access to a smartphone is lost, which may lead individuals to use the internet more frequently as a coping mechanism. This anxiety can cause

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individuals to check their phones more often and spend more time online. This tendency can lead to Problematic Internet Use (PIU), which refers to uncontrolled internet use that disrupts other areas of life [4].

According to a survey conducted by APJII (Indonesian Internet Service Providers Association) with 8,720 respondents, internet users in Indonesia in 2023–2024 reached 79.50%, or 221,563,479 people out of a total population of 278,696,200. The survey results indicate a steady increase over the years: in 2023, the figure was 78.19%; in 2022, 77.01%; and from 2018 to 2020, 73.70%. Internet use based on education level is dominated by undergraduate (S1) and diploma (D1/D2/D3) degree holders, with a penetration rate of 99.91% and a contribution rate of 8.42% [5].

Bashir et al. (6) stated that many students use the internet and consider it a functional tool due to its various roles in facilitating interactions with others and providing academic information. However, students are also considered a vulnerable group when it comes to Problematic Internet Use (PIU), as they often have more free time, irregular schedules, and unlimited campus Wi-Fi access [7].

A previous study by Buctot et al. [8], which examined junior and senior high school students in the Philippines, found that nomophobia could lead to internet addiction. Another study involving nursing students found that nomophobia could trigger Problematic Internet Use [9]. Similarly, Pavithra et al. [10] found that respondents with high levels of problematic internet use also had high levels of nomophobia.

These findings are consistent with a more recent study by Lesmana [11], which showed that individuals with nomophobia symptoms were more likely to exhibit symptoms of problematic internet use. The results suggest that fear of being away from one's smartphone (nomophobia) can lead to problematic internet use, as individuals increasingly rely on smartphones as a medium for internet access—resulting in negative effects such as impaired interpersonal skills and other psychological symptoms.

According to Bragazzi [12], a characteristic of nomophobia is the tendency to keep one's phone on at all times (24/7), even sleeping with it in bed. Excessive smartphone use has been linked to greater sleep disturbances and poorer sleep quality [13].

King et al. [14] found that nomophobia can lead to persistent anxiety, including stress. Chronic stress can negatively affect an individual's sleep quality. Good sleep quality is defined by the absence of sleep deprivation symptoms and lack of sleep-related problems [15].

During sleep, the body undergoes a recovery process that restores stamina and returns the body to an optimal state [16]. However, sleep deprivation is common among young adults. University students, who fall within this age group, often experience insufficient sleep [17]. Poor sleep quality among students affects both physical and psychological well-being, including health problems, decreased concentration, stress, memory disturbances, and lower academic performance [18].

A study by the National Sleep Foundation [19] revealed that around 36% of 1,000 college students in the U.S. experienced difficulty waking up in the morning, compared to 20% of individuals aged 30–64, and 9% of those over 65. Moreover, nearly a quarter of young adults aged 18–29 often arrived late to class or work due to difficulty waking up, and 40% reported feeling drowsy during other activities.

Another study by Ratnasari et al. [20] involving 98 Electrical Engineering students at Diponegoro University—using the Pittsburgh Sleep Quality Index (PSQI)—found that 71 students (72.4%) had poor sleep quality, while the remaining 27 (27.6%) had good sleep quality.

Excessive phone use (nomophobia) disrupts sleep architecture, reducing Rapid Eye Movement (REM), slow-wave sleep, and overall sleep efficiency [21]. Nomophobia can also cause physical discomfort and headaches, which further impact sleep quality. This is supported by Ghanate et al. [22], whose study found that among participants with nomophobia-related issues, 39.5% experienced poor sleep quality—indicating a link between nomophobia and poor sleep.

Based on the above explanation, the researcher is interested in conducting a study on the relationship between nomophobia, Problematic Internet Use (PIU), and sleep quality in university students. The choice of students as subjects is based on findings from the National Sleep Foundation [19], which reported that individuals aged 18–29 struggle the most with waking up in the morning and feel drowsy during other activities—40% on average, the highest among all age groups. The average age range of university students is 18–24 years [23].

Although some previous studies share similar variables and participant selection, this research incorporates a broader range of variables. The researcher also believes that the title of this study differs from earlier ones, even if one of the variables may overlap with previous research.

For example, the study by Ghanate et al. [22], titled *"A study on nomophobia, quality of sleep and associated behavioural problems in engineering students,"* examined variables similar to those in this study (nomophobia and sleep quality), but it was conducted outside Indonesia. Since it is difficult to find studies in Indonesia exploring the relationship between nomophobia and sleep quality, this research aims to further investigate this topic using Indonesian university students as participants.

Another study by Lesmana [11], titled *"The Relationship Between Nomophobia and Problematic Internet Use Among University Students in Jakarta,"* also investigated similar variables (problematic internet use and nomophobia) and used students as participants. However, that study focused solely on students from a single university in Jakarta who were studying online. In contrast, the current study focuses on students from various universities across Indonesia.

Based on the background of the problem that has been explained, the researcher formulated the research problem as follows "Is there a relationship between Nomophobia and Problematic Internet Use (PIU) and the quality of sleep of students?". This study employed a correlational design to address the empirical gap regarding the relationship between nomophobia, PIU, and sleep quality in Indonesian college students. Although it does not directly test a new theoretical model, this study can still contribute by enriching the cross-cultural evidence base and possibly yielding unexpected findings regarding the relationship between nomophobia and sleep quality. It is also hoped that this research will provide both theoretical and practical contributions, not simply "searching for a relationship".

Hypothesis

H1: There is a positive relationship between nomophobia and problematic internet use in students.

H2: There is a negative relationship between nomophobia and sleep quality in college students.

2 Literature Review

In the adolescent age group of 18–25 years who are pursuing higher education and have student status [24], daily activities are generally closely tied to internet access. Students frequently rely on the internet, which is accessible at their fingertips through smartphones. Many academic needs such as accessing journals, e-books, and other course-related information require internet connectivity.

However, the extensive use of the internet among students often leads to constant dependence, with a persistent urge to access online activities across various platforms. This dependency may result in negative consequences, such as the development of nomophobia. Nomophobia is characterized by a tendency to constantly check one's smartphone and can trigger anxiety when individuals are unable to separate themselves from their phones [3]. When using smartphones as communication tools, individuals require internet access to interact remotely without limits in exchanging or searching for information or engaging in any form of interaction [25]. Therefore, if nomophobic tendencies persist, they may lead to internet use disorders or Problematic Internet Use (PIU) [11].

One symptom of nomophobia, according to Bragazzi [12], is the constant need to keep the smartphone on (24 hours a day), even sleeping with it in bed. One factor that can affect sleep quality is excessive smartphone use (nomophobia), which can interfere with sleep architecture by reducing Rapid Eye Movement (REM) sleep, slow-wave sleep, and sleep efficiency [21].

Yildirim et al. [26] identified four aspects of nomophobia. The first is *not being able to communicate*, which refers to the feeling of loss when communication with others is suddenly cut off or when one is unable to use smartphone features when urgently needed. This creates anxiety due to the inability to communicate or receive responses from others. This anxiety can, in turn, affect sleep quality. As explained by Audina et al [27], anxiety can lead to difficulty falling asleep. Anxiety makes it hard for individuals to initiate sleep, ultimately resulting in poor sleep habits [28].

Similarly, in problematic internet use, anxiety experienced by individuals—especially students—can contribute to internet addiction. Higher anxiety levels are associated with increased internet use, which can develop into problematic internet use and reduce students' academic performance [29].

The second aspect is *losing connectedness*, which relates to the sense of loss when individuals cannot connect to their smartphone systems. This aspect shows that nomophobia and internet addiction (PIU) are closely intertwined. When the internet connection is lost, individuals may feel disconnected and will attempt to reconnect as quickly as possible.

When reconnected, individuals may become absorbed in their smartphones. As Lesmana et al. (11) state, problematic internet use arises from negative behaviors that make it difficult for individuals to separate from their smartphones, even causing fear of losing phone signal.

In terms of sleep quality, when individuals feel a sense of loss from not being connected to their smartphones, they may try to stay online continuously, even during nighttime. Nighttime smartphone use emits light that reaches the retina and disrupts sleep patterns [30].

The third aspect is *not being able to access information*, which describes the discomfort felt when individuals cannot retrieve or search for information via smartphones, which are typically a convenient source of information. In this context, students heavily depend on smartphones and

internet access to support their academic activities. When internet access is unavailable, the information flow is disrupted, often causing students to panic or feel anxious. This is supported by Sharma et al. [31], who found that 83% of students experienced panic attacks when they couldn't use their smartphones.

In relation to sleep quality, students' reliance on smartphones as an easy way to gather information often causes them to lose track of time, especially at night. Since daytime is occupied with classes, students tend to seek information or entertainment at night. This aligns with Mangapi et al. [32], who found that many students perceive smartphones as essential in daily life and tend to spend long hours at night on their phones, increasing the risk of sleep disturbances by reducing sleep duration and altering sleep processes.

Although smartphones are used to access information via the internet, much of this usage often occurs late at night, causing students to stay up. As Mangapi et al. [32] suggest, nighttime should be reserved for rest, not excessive internet use, as this affects sleep duration and, consequently, sleep quality.

The final aspect is *giving up convenience*, which refers to the comfort experienced when using smartphones and the desire to maintain this comfort. This often causes individuals to continually seek the comfort of their smartphones, leading to excessive use that interferes with daily activities, including changes in sleep time and, ultimately, poor sleep quality.

This is consistent with Supartini et al [13], who states that excessive smartphone use has a significant impact on sleep disturbances and sleep quality. Similarly, excessive and unregulated internet usage through smartphones can lead to problematic internet use (PIU), including addictions related to social media, email, online gaming, and other internet-related disorders [33].

3 Method

Participant

This study uses the following criteria: (a) College students (b) Aged 18-25 years (c) Have a gadget (d) Using the internet. Individuals aged 18-25 are included in the late adolescent and early adult phases who need to sleep approximately 7-9 hours per day (34). Participants of this study were 302 college students, with 21.19% male and 78.81% female, and came from 41.72% public universities and 58.28% private universities in Indonesia. The detail of participant's description can be seen on Table 1 in the results section.

Measurement

Problematic Internet Use (PIU) in this study will be measured using a scale adapted from the Generalized Problematic Internet Use Scale 2 (GPIUS 2) developed by Caplan (35). This scale measures problematic internet use in individuals, there are 15 items that will be measured in the GPIUS 2 scale which includes aspects, namely preference for online social interaction (POSI), mood regulation, cognitive preoccupation, compulsive internet use, negative outcomes.

Participants were asked to evaluate how much they agreed with the situation described in the item, such as an example of an item from the POSI aspect, namely "I prefer to interact socially online rather than interact face to face". The response answers were modified by the researcher

using a Likert scale to avoid participant errors when choosing answer options. The scale has a score range of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree).

This shows that the higher the score obtained, the higher the individual's problems in using the internet, and vice versa, the lower the score obtained, the lower the individual's problems in using the internet. The results of the analysis on the PIU variable using the Generalized Problematic Internet Use Scale 2 (GPIUS 2) obtained a Cronbach's Alpha reliability value $\alpha = 0.921$.

Sleep quality is supported using the Pittsburgh Sleep Quality Index (PSQI) adaptation scale developed by Famodu et al (36). This scale measures an individual's sleep quality, and was developed to evaluate several aspects measured such as sleep duration and efficiency, sleep latency, sleep disturbances, waking up in the middle of the night, coughing or snoring, daytime dysfunction.

The type of measuring instrument (questionnaire) is closed and open, where in open questions, participants are asked to fill in short answers related to the questions asked, such as an example of an item from the sleep duration and efficiency aspect, namely "What time do you usually start to sleep at night?". In closed questions, participants are asked to choose one of the available answers.

There are several items along with answer choices that researchers modify, for example, such as the response answers modified by researchers using a Likert scale to avoid participant errors when reading items and choosing answer options. Answers have a score range of 1 (never at all), 2 (never), 3 (sometimes), 4 (often), 5 (always).

This shows that the higher the score obtained, the worse the quality it has, and vice versa, the lower the score obtained, the better the quality of sleep it has. There is a sleep quality variable that is measured using an adaptation scale from the Pittsburgh Sleep Quality Index (PSQI) obtained a Cronbach's Alpha reliability value $\alpha = 0.770$.

Nomophobia was measured using an adapted scale from the Nomophobia Questionnaire (NMP-Q) developed by Yildirim and Correia (37). This scale measures the level of addiction and anxiety related to lack of access to smartphones. Some aspects measured are not being able to communicate, losing connectedness, not being able to access information, giving up convenience.

Participants were asked to evaluate how much they agreed with the situation described in the item, such as an example of an item from the aspect of not being able to access information "I feel uncomfortable when I cannot use a smartphone". The responses that participants can choose are 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree).

This shows that the higher the score obtained, the higher the tendency of individuals to experience nomophobia, and vice versa, the lower the score obtained, the more individuals tend to experience nomophobia. The results of the analysis of the nomophobia variable with the Nomophobia Questionnaire (NMP-Q) scale produced a Cronbach Alpha reliability coefficient of 0.931.

4 Result

As for the description of the participants in this study, it can be seen in the participant characteristics table as follows:

Table 1. Description of Research Participants

Age	M = 20.77; SD = 1.550; R = 18 - 25
Gender	% Male = 21.19 (n=64) % Female = 78.81 (n=238)
Status of College	% Public = 41.72 (n=126) % Private = 58.28 (n=176)
Type of Device	% Handphone/ Smartphone = 99.66 (n=301) % Laptop/ Notebook = 67.89 (n=205) % Tablet/ Pad = 18.54 (n=56) % Computer/ PC = 13.58 (n=41)
Duration of Gadget Usage in a Day (24 Hours)	% <2 hours = 1.99 (n=6) % 2 - 4 hours = 4.30 (n=13) % 4 - 6 hours = 23.18 (n=70) % 6 - 8 hours = 32.11 (n=97) % >8 hours = 38.41 (n=116)

Researchers categorize respondents into three categories, namely low, medium, high. The description of data categorization is taken based on hypothetical and empirical data. The following is a description of hypothetical and empirical data in this study:

Table 2. Hypothetical and Empirical Data Description

Variable	**N**	**Hypothetical**				**Empirical**			
		Score		Mean	SD	Score		Mean	SD
		Min	Max			Min	Max		
Sleep Quality	302	10	50	30	10	14	48	27.38	7.14
Problematic Internet Use	302	15	75	45	15	22	66	45.98	11.50
Nomophobia	302	20	100	60	20	30	90	65.93	14.82

Table 3. Categorization of Problematic Internet Use

Categorization	Interval	Frequency	Percentage
High	$X \leq 60$	42	14%
Medium	$30 \leq X \leq 60$	236	78%
Low	$X < 30$	24	8%

Based on the score results in the table above, it can be seen that problematic internet use in respondents is mostly in the medium category, which is 236 (78%) respondents. As many as 42 (14%) respondents are in the high category, 24 (8%) respondents are in the low category.

Table 4. Categorization of Sleep Quality

Categorization	Interval	Frequency	Percentage
High	$X \leq 40$	22	7%
Medium	$20 \leq X \leq 40$	243	80%
Low	$X < 20$	37	12%

Based on the score results in the table above, it can be seen that the quality of sleep in most respondents is in the moderate category, which is 243 (80%) respondents. As many as 37 (12%) respondents are in the low category, 22 (18%) respondents are in the high category.

Table 5. Categorization of Nomophobia

Categorization	Interval	Frequency	Percentage
High	$X \leq 80$	71	24%
Medium	$40 \leq X \leq 80$	210	70%
Low	$X < 40$	21	7%

Based on the score results in the table above, it can be seen that nomophobia in most respondents is in the moderate category, namely 210 (70%) respondents. As many as 71 (24%) respondents are in the high category. 21 (7%) respondents are in the low category.

The normality test is carried out using the test of normality model, if the Kolmogorov-Smirnov coefficient value produces a p value>0.5, then the research data is normally distributed. Conversely, if the p value <0.5 then the data is not normally distributed. The results of the normality test can be seen in table below:

Table 6. Data Normality Test

Variable	p	Category
Problematic Internet Use (PIU)	0.186	Normal
Sleep Quality	0.064	Normal
Nomophobia	0.093	Normal

Based on the results of the normality test, it can be seen that the Problematic Internet Use (PIU) variable has a normal data distribution with a significance value of $p = 0.186$ ($p > 0.05$), in the sleep quality variable the data is normally distributed because the significance value is $p = 0.064$ ($p < 0.05$). As for the nomophobia variable, the data distribution is normally distributed with a significance value of $p = 0.093$ ($p > 0.05$). Therefore, it can be concluded that the three variables in this study are normally distributed.

Linearity test to find out whether there is a linear relationship between the variables to be tested. Both variables can be said to be linear if the p value is <0.05, and the data is not linear if p>0.05.

Table 7. Data Linearity Test

Variable	F	p	Category
Nomophobia * Problematic Internet Use	252.288	<.001	Linear
Nomophobia * Kualitas Tidur	51.481	<.001	Linear

Based on the results of the linearity test, it is shown that the nomophobia and Problematic Internet Use (PIU) variables have a linearity coefficient (F) of 252,288 and a significance value of p = <.001 (p <0.05), which means that the two variables have a linear relationship. As for the nomophobia and sleep quality variables, they have a linearity coefficient (F) of 51,481 and a significance value of p = <0.01 (p <0.05), therefore the two variables have a linear relationship.

The correlation test used was using Pearson correlation because all variables were normally distributed, the results of the correlation test can be seen in the following table:

Table 8. Pearson's Correlation Test

Variable	r	p
Nomophobia - Problematic Internet Use	0.677	<.001
Nomophobia – Sleep quality	0.385	<.001

Based on the results of the Pearson correlation test, between the nomophobia and Problematic Internet Use (PIU) variables, the correlation coefficient value is r = 0.677 which is positive, with p = <.001 (p <0.05). This shows that the Nomophobia variable is positively correlated with Problematic Internet Use (PIU) and is included in the high (strong) category, meaning that if the nomophobia variable increases, it is also followed by an increase in the PIU variable. Likewise, if nomophobia is low, it will also be followed by a low PIU variable.

Based on the results of the Pearson correlation test on the Nomophobia and sleep quality variables, the correlation coefficient value is r = 0.385 which is positive, with p = <.001 (p <0.05). This shows that the nomophobia variable is positively correlated with sleep quality and is included in the moderate (sufficient) category, meaning that if the nomophobia variable increases, it is also followed by an increase in the sleep quality variable. Likewise, if the nomophobia variable is low, it will also be followed by low sleep quality.

Additional analysis was conducted by the researcher to add to the research results by testing the correlation between each aspect of nomophobia to the problematic internet use variable and sleep quality. In the problematic internet use variable, the analysis results showed a positive correlation to four aspects of nomophobia. Among them are not being able to communicate (r = 0.444, p = <0.001), losing connectedness (r = 0.651, p = <0.001), not being able to access information (r = 0.627, p = <0.001), giving up convenience (r = 0.644, p = <0.001).

Table 9. Correlation Test of Nomophobia Aspects - Problematic Internet Use (PIU)

Aspect	r	p
Not Being Able To Communicate	0.444	<.001
Losing Connectedness	0.651	<.001
Not Being Able To Access Information	0.627	<.001
Giving Up Converience	0.644	<.001

In the nomophobia variable, the analysis results show a positive correlation with four aspects of nomophobia. Among them are not being able to communicate r = 0.257, p = <0.001), losing

connectedness (r = 0.440, p = <0.001), not being able to access information (r = 0.339, p = <0.001), giving up convenience (r = 0.357, p = <0.001.).

Table 10. Correlation Test of Nomophobia Aspects – Sleep Quality

Aspect	r	p
Not Being Able To Communicate	0.257	<.001
Losing Connectedness	0.440	<.001
Not Being Able To Access Information	0.339	<.001
Giving Up Converience	0.357	<.001

5 Discussion

The purpose of this study was to empirically determine the relationship between nomophobia and Problematic Internet Use (PIU) and sleep quality of students. The results of the correlation test showed that there was a relationship between nomophobia and Problematic Internet Use (PIU) in students, with r = 0.677 and p = <.001. This shows that the higher the nomophobia behavior, the higher the problematic internet use. The results of the nomophobia variable with sleep quality showed a positive relationship between the two, with a value of r = 0.385 p = <.001 (p <0.05).

The results of the correlation analysis of the nomophobia variable with problematic internet use support the first hypothesis (H1) proposed, namely that there is a positive relationship between nomophobia and problematic internet use. This finding is related to previous research conducted by Lesmana et al. [11], the correlation results showed that there was a positive relationship between nomophobia and problematic internet use in students in Jakarta.

For students themselves, smartphones and the internet are one of the important supporting tools, because they will help in obtaining information in lectures such as in completing lecture assignments. This is in line with Daeng et al. [1] who explained that smartphones will make it easier for students to access information related to their lecture activities.

According to Caplan [35] and Yildirim [26], it is explained that when someone depends on technology, especially on smartphones and the internet, then that person will be related to unhealthy use. In this case, nomophobia and problematic internet use that are related can show that students will always need smartphones that are connected to the internet as a source of information to support the fulfillment of their academic tasks. Therefore, it will lead to excessive smartphone use and will feel anxious when they do not have access to their smartphone, this will then lead to problematic internet use.

The results of the correlation analysis of nomophobia aspects on the problematic internet use variable. The losing connectedness aspect provides the greatest correlation to problematic internet use. This aspect is related to the feeling of loss when unable to connect to the system on the smartphone and unable to connect to social media.

Students will tend to experience problematic internet use when students feel anxious because they cannot check social media or access other information because they are not connected to their smartphone and are disconnected from their smartphone [35].

Based on the analysis in this study, the results showed a positive correlation between nomophobia behavior and sleep quality. Referring to these findings, it can be concluded that the higher the level of nomophobia behavior, the higher sleep quality in students. This finding is

certainly inconsistent with the second hypothesis (H2) proposed in this study, which initially predicted a negative correlation between nomophobia behavior and sleep quality in students.

In previous studies conducted by other researchers, such as Kurnia et al. [38], it was found that there was a positive and significant relationship between nomophobia and poor sleep quality, indicating that when nomophobia among students is high, their sleep quality tends to be poor. Many other studies have also shown similar results, which are in contrast to the findings of this study. In a cross-sectional study of 444 adult participants [39], nomophobia was significantly correlated with insomnia, but no significant association was found between nomophobia and sleep duration. This suggests that despite anxiety associated with nomophobia, sleep duration does not necessarily decrease.

A study of 215 college students compared those with mild, moderate, and severe nomophobia [40]. Although the severe nomophobia group showed significantly higher levels of sleepiness and sleep duration ($p<0.05$), there was no significant difference in sleep quality scores (PSQI) between the groups ($p>0.05$). This means that while there was an impact on daytime sleepiness and duration, subjective sleep quality did not significantly worsen depending on the level of nomophobia.

In this context, the positive relationship found in this study may be due to the influence of other factors. Individuals experiencing nomophobia may tend to use their smartphones for activities they perceive as calming, such as listening to music or watching videos, which may be associated with improved sleep quality. This is similar to the study conducted by Rais et al. [41], who designed an application aimed at improving sleep quality.

In their study, the designed application included relaxation features, such as nature sounds and meditation, to help users cope with insomnia and improve their sleep quality. Therefore, students experiencing nomophobia may tend to use their smartphones to access such applications as a form of positive coping strategy, which can contribute to better sleep quality.

The development of applications used on smartphones suggests that technology can be utilized effectively to support mental health and promote good sleep quality. Using smartphones for positive purposes, such as listening to relaxation sounds, can help individuals achieve a calm state.

Based on the findings of this study, there may also be errors in the process of converting responses into a Likert scale. For instance, if the scale is altered, errors in conversion could produce inaccurate data. Another possible explanation is the presence of social desirability bias, which may influence individuals to report good sleep quality in social situations, regardless of their actual conditions.

If respondents are faced with a situation where they are expected to answer honestly, they may still provide more favorable responses even if they are experiencing sleep disturbances. This may affect the data collected and result in a positive correlation between nomophobia and sleep quality that does not reflect the true situation [42].

In terms of sleep quality, correlations were also found between specific aspects of nomophobia and sleep quality. The *losing connectedness* aspect showed the strongest positive correlation with sleep quality. This may also be due to respondents expressing better sleep quality as a form of self-assurance, demonstrating perceived control over their digital environment. In the study by Bostan et al. [43], many respondents reported better sleep quality when they believed that limiting smartphone use was related to improved sleep.

Based on the findings of this study, there are some implications from this study. These findings reaffirm the positive relationship between nomophobia and Problematic Internet Use (PIU), supporting the theory that smartphone dependency can trigger unhealthy internet use behaviors. However, the results showing a positive relationship between nomophobia and sleep quality open up opportunities for expanding theoretical understanding. This could encourage new research exploring the role of positive coping strategies using smartphones (e.g., relaxation app) in improving sleep quality. This study contributes to the literature by presenting the context of Indonesian college students, which is still rarely researched on the issues of nomophobia, PIU, and sleep quality simultaneously.

For education institution, these results demonstrate the need for digital literacy education that focuses not only on reducing screen time, but also on more adaptive smartphone use, for example for relaxation or mental health support. For students, these findings provide insight that smartphones can be a positive tool when used wisely (for example, to listen to relaxing music), but excessive use still carries the risk of increasing PIU. For mobile application developers, this research suggests an opportunity to develop smartphone-based apps that combine relaxation and time management features to improve sleep quality while reducing the risk of PIU.

The author acknowledges several limitations in this study that need to be considered, such as the uneven distribution of the research sample. Although the study involved students from across Indonesia, the data showed that the majority of respondents were from universities in Java. The number of respondents from outside Java was not proportionate to those from within Java.

Additionally, the lack of personal research experience in selecting scales and analyzing results may have influenced the interpretation. A more cautious approach and deeper insights would be beneficial for future research. Nevertheless, this study successfully explored the relationship between nomophobia, problematic internet use, and sleep quality among university students.

Meanwhile, the implications for further research are can add mediating or moderating variables such as digital coping strategies, self-regulation, or duration of smartphone use before bed, and more careful validation of the instrument is needed, including minimizing social bias in filling out the questionnaire. Further studies with longitudinal designs are needed to determine the direction of the causal relationship between nomophobia, PIU, and sleep quality. And the sample for future research should be more geographically distributed so that the results can be generalized to the entire student population in Indonesia.

6 Conclusion

This study produced several findings regarding the relationship between nomophobia, problematic internet use, and sleep quality of students. The first finding is a positive relationship between nomophobia and problematic internet use, this shows that if students with high nomophobia scores then problematic internet use will also be high. Excessive smartphone use in students will involve problematic internet use.

This study found a positive relationship between nomophobia and sleep quality of students, this result contradicts the hypothesis proposed. The conflicting hypothesis shows that there are other factors that may have an influence, such as smartphone use that is used for better and quality sleep, as well as social desirability bias.

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