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Pathways from Parent–Child Relationships to Adolescent Sleep Problems: Examining Problematic Smartphone Use and Nomophobia as Mediators

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Abstract

Although previous research has linked adolescents' sleep problems to excessive smartphone use and associated anxiety about losing device access (nomophobia), there is limited understanding regarding how problematic smartphone use specifically contributes to sleep disturbances among adolescents. This cross-sectional study examined the mediating role of problematic smartphone use and nomophobia in the relationship between parent–child interactions and adolescent sleep problems. The parent–child relationship was measured using reliable and valid self-report questionnaires employing Likert scales, administered in Indonesian. Data were collected from 672 students aged 15–19 years across ten high schools in Yogyakarta, Malang, Jambi, Palembang, Aceh, Lombok, Palangkaraya, Balikpapan, Makassar, and Sumbawa. Path analysis was conducted using Amos 20 to evaluate indirect effects, defined as mediating relationships between variables. Results indicated a significant indirect effect of the father-child relationship on adolescent sleep problems through problematic smartphone use and nomophobia ($\beta = -.033$). However, the mother–child relationship showed no significant indirect effect ($\beta = .016$). Practical implications include promoting parental awareness about their role in adolescents' technology use. Specific practical implications include developing family-based educational workshops emphasizing healthy smartphone habits, creating guidelines for parental mediation of smartphone use, and implementing school-based interventions targeting sleep hygiene among adolescents. Future research could employ longitudinal designs to determine causality, integrate objective sleep assessments like actigraphy, and consider contextual influences such as peer relationships and academic pressures.

Keywords Parent–child relationship · Sleep problem · Nomophobia · Problematic smartphone use · Adolescents

Introduction

Many children and adolescents experience sleep disorders such as insomnia, restless leg syndrome, and sleepwalking (Piroska et al., 2024). Sleep problems are very common in children and adolescents, with approximately 50% experiencing difficulty sleeping (Chaveepojnkamjorn et al., 2021; Rasul et al., 2014). Furthermore, quality sleep is crucial for the physical and mental development of children and adolescents. Poor sleep can lead to unhealthy eating habits and obesity in children and adolescents (Dubey et al., 2019; Mazza et al., 2024). Poor sleep quality can reduce physical performance and cause daytime fatigue (Safarzade & Tohidinik, 2019), directly affecting cognitive performance and academic achievement (Kaur & Bhoday, 2017; Sorrell, 2018). Sleep-deprived children tend to have problems with attention and learning (Buckhalt et al., 2009). Sleep deprivation can lead to issues with emotional regulation, including mood changes and symptoms of depression (Kaur & Bhoday, 2017; Safarzade & Tohidinik, 2019). Poor sleep is also associated with risky behavior and mental health problems (Mazza et al., 2024), leading to cognitive deficits, mood disturbances, and behavioral issues (Brambilla et al., 2017; Greydanus, 2018; Thomas et al., 2015). Other studies have shown that sleep deprivation can result in anxiety symptoms and impair daily functioning (Safarzade & Tohidinik, 2019).

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Sleep-deprived children often experience daytime fatigue, which can disrupt their daily activities (Piroska et al., 2024).

The increased use of digital devices, such as smartphones, tablets, and computers, has been associated with a decline in sleep quality and duration among adolescents (Meltzer & Westin, 2011; Ekinci et al., 2014; Fulfs et al., 2024). Adolescents frequently use electronic devices at night, which can delay sleep onset and reduce overall sleep duration (Hysing et al., 2015). Higher scores on internet addiction scales are correlated with more severe sleep problems, including difficulty falling asleep and frequent nighttime awakenings (Madrid-Valero et al., 2023). Studies have demonstrated a strong relationship between problematic digital technology use and poor sleep quality, even after accounting for genetic and familial factors (Fulfs et al., 2024).

Sleep quality mediates the relationship between device use and mental health issues, indicating that poor sleep resulting from technology use may exacerbate mental health problems (Meltzer & Westin, 2011). Adolescents with higher internet addiction scores experience more sleep problems and poorer sleep quality, which can lead to daytime sleepiness and impaired cognitive functioning (Chaveepojnkamjorn et al., 2021; Madrid-Valero et al., 2023).

Problematic Smartphone Uses and Sleep Problems

The increased use of smartphones among children and adolescents, particularly before bedtime, has become a growing phenomenon (Bozkurt et al., 2024; Dibben et al., 2023). Excessive use, especially before sleep, can negatively impact sleep quality. Adolescents who frequently engage in smartphone use before bed often experience difficulty falling asleep or poor sleep quality (Kim et al., 2020), especially when using interactive applications like social media and games (Siebers et al., 2024). Frequent notifications and interactions with smartphones can cause sleep disruptions and increased daytime sleepiness (Strube et al., 2016). This is particularly evident on school days, when the pressure to wake up early causes adolescents who use smartphones late into the night to lose valuable hours of sleep (Schweizer et al., 2016). The blue light emitted from smartphone screens can also delay the production of melatonin, a hormone that helps regulate the sleep cycle, making it more difficult for adolescents who use smartphones before bed to fall asleep (Figueiro & Overington, 2016; Van der Lely et al., 2015). Previous studies have shown a positive correlation between excessive smartphone use and sleep disturbances, further emphasizing the negative impact of technology use before bedtime (Zhu et al., 2024).

Adolescents often keep these devices in their beds or nearby while sleeping (Elsheikh et al., 2023; Strube et al., 2016). Social media and communication apps are the most frequently used before bed (Elsheikh et al., 2023). Adolescents who excessively use smartphones tend to have shorter sleep durations and later bedtimes, leading to a decline in overall sleep quality (Ahn et al., 2017; Bozkurt et al., 2024; Li et al., 2025). Prolonged smartphone use at night is associated with cognitive impairments such as slower reaction times and decreased attention, as well as physical health problems like hypertension and fatigue (Anumol, 2022; de Oliveira et al., 2020). Poor sleep quality due to smartphone use can lead to emotional dysfunction and behavioral problems, which can negatively affect academic performance and overall well-being (Vernon et al., 2015; Xie et al., 2018).

Nomophobia and Sleep Problems

Nomophobia refers to the fear or anxiety experienced by individuals when they are away from their phones (Yildirim & Correia, 2015). Previous research has shown that nomophobia contributes to poor sleep habits. College students with severe nomophobia tend to experience higher levels of daytime sleepiness and shorter sleep duration compared to those with mild or moderate nomophobia. This suggests that the severity of nomophobia directly affects sleep quality (Torpil et al., 2022).

Earlier studies have also found a strong correlation between nomophobia and insomnia (Jahrami et al., 2022). Dissatisfaction with sleep is a common component of both conditions, indicating that individuals with nomophobia are more likely to experience insomnia (Daraj et al., 2023). Other research has shown that nomophobia is associated with a night chronotype, which is linked to increased screen time before bed. This behavior disrupts sleep patterns and contributes to insomnia (Jahrami, 2023).

Nomophobia is often accompanied by anxiety and depression, both of which are known to negatively impact sleep quality. The presence of these psychological factors worsens sleep disturbances (Copaja-Corzo et al., 2022; Sheikh et al., 2024). Furthermore, excessive phone use, particularly for social media and entertainment, is associated with poor sleep quality due to the stimulating effects of screen time and the anxiety related to disconnection (Lin et al., 2021; Mohammadbeigi et al., 2016; Preety et al., 2018).

Parent–Child Relationship and Sleep Problems

The parent–child relationship plays a crucial role in shaping children's behaviors and habits, including sleep patterns and technology use. Factors such as parental bedtime behaviors, tolerance for crying, maternal mood, and parental

stress significantly contribute to children's sleep development (Tikotzky, 2017). Additionally, excessive mobile phone use by parents can interfere with parent–child interactions, a phenomenon known as "technoference," which has been linked to problematic externalizing and internalizing behaviors in children (McDaniel & Radesky, 2018a; Uzundağ et al., 2022).

High parental stress often leads to increased technology use, which then disrupts parent–child interactions and negatively affects children's cognitive and socio-emotional development (McDaniel & Radesky, 2018b; Uzundağ et al., 2022). Transactional models suggest that difficult child behavior can elevate parental stress, prompting parents to turn to technology more frequently as an escape, further worsening parent–child interactions (McDaniel & Radesky, 2018b).

Excessive smartphone use by parents is also associated with reduced parental responsiveness, which can hinder children's cognitive and socio-emotional development (Carson & Kuzik, 2021; Vanden Abeele et al., 2020). Parental involvement in regulating technology use is essential for fostering healthy behavioral and habit development in children. Reducing technological interference in parent–child interactions and promoting digital awareness among parents can help strengthen the parent–child bond and support healthy child development (Toran et al., 2024; Zurcher et al., 2020).

The different effects of father-child and mother–child relationships on smartphone use, nomophobia, and sleep quality are based on the distinct roles that fathers and mothers play in child development. Research indicates that mother–child relationships have a more direct and lasting impact on a child's sleep quality. For instance, a study found that higher-quality mother–child interactions predicted longer sleep duration nearly 6 years later, while father-child interactions did not exhibit the same effect (Cimon-Paquet et al., 2019). Similarly, children's emotional security with their parents influenced their sleep quality, with stronger associations observed in the mother–child bond compared to the father-child bond (Keller & El-Sheikh, 2011). Moreover, while fathers' involvement in child sleep management is important, their role is often less direct than that of mothers, resulting in a comparatively weaker influence on sleep patterns (Coles et al., 2021).

When it comes to smartphone use, research suggests that mother–child interactions play a crucial role in moderating smartphone dependency. A study on employed mothers found that a positive work-family balance led to better mother–child interactions, which in turn reduced children's excessive smartphone use (Hong & Jang, 2023). Conversely, when mothers frequently used smartphones, it disrupted their responsiveness to their children, leading to increased reliance on digital devices for attention and engagement (Konrad et al., 2021). This highlights the importance of maternal involvement in shaping children's smartphone habits.

Nomophobia, or the fear of being without a smartphone, has also been linked to parental influence. Children of parents who are highly dependent on smartphones are more likely to develop smartphone dependency themselves. This effect is mediated by parenting styles, as both positive and negative parenting approaches influence a child's likelihood of experiencing nomophobia (Yoon et al., 2021). Because mothers tend to spend more time with their children, their smartphone use patterns and parenting behaviors have a greater impact on the child's screen time habits. Additionally, studies show that nomophobia is associated with poor sleep quality, excessive daytime sleepiness, and smartphone addiction. Specifically, limiting smartphone use to less than 30 min before bedtime improves sleep quality, emphasizing the role of parental control in bedtime phone usage (Erten et al., 2022; Kurnia et al., 2021).

In conclusion, previous studies indicate that mother–child relationships exert a stronger influence on sleep quality, smartphone use, and nomophobia than father-child relationships. Mothers' greater involvement in caregiving and emotional regulation contributes to more direct effects on their children's sleep and smartphone habits. While fathers also play an important role, their influence tends to be more indirect, contributing to children's emotional security rather than immediate behavioral patterns. These findings suggest that interventions targeting smartphone dependency and sleep disturbances should emphasize improving mother–child interactions while also encouraging fathers to be more engaged in emotional and behavioral regulation.

The Gap of Study

Previous research has separately explored the influence of parent–child relationships on adolescent psychological outcomes (Carson & Kuzik, 2021; Wong et al., 2024) and the relationship between smartphone usage or nomophobia and sleep quality (Coles et al., 2021; Hong & Jang, 2023). However, there remains limited understanding of how these factors interrelate in an integrated theoretical framework, particularly regarding the potential mediating roles of problematic smartphone behaviors. Moreover, existing studies rarely distinguish between the specific influences of fathers and mothers, often treating parental roles interchangeably, despite evidence suggesting distinct parental influences on adolescent behaviors and outcomes (Toran et al., 2024; Zurcher et al., 2020).

Addressing this gap, the current study integrates parent–child interactions with smartphone-related behaviors (problematic smartphone use and nomophobia) to provide a more comprehensive understanding of their collective

impact on adolescent sleep quality. By examining these relationships within one unified model, this research underscores the unique and differential roles of fathers and mothers. The findings aim to inform targeted parental interventions and contribute to a nuanced understanding of how distinct parental roles can influence adolescents' technology-related health behaviors and outcomes.

Method

Participants

This cross-sectional study involved 672 participants recruited from ten high schools across ten cities in Indonesia: Yogyakarta, Malang, Jambi, Palembang, Aceh, Lombok, Palangkaraya, Balikpapan, Makassar, and Sumbawa. Purposive sampling was used, with the inclusion criterion being enrollment as a high school student. All students voluntarily consented to participate without coercion. Prior to data collection, approvals were obtained from the respective school authorities and affiliated universities. Data collection occurred directly at schools from July to August 2024, where researchers distributed questionnaires to classrooms. Before completing the questionnaires, students received a clear explanation about the study's purpose, instructions for responding, their voluntary participation, and data confidentiality. Participants were also provided an opportunity to ask questions for clarification. As a token of appreciation, each participant received a pen upon completion of the survey.

Measurement

All scales used in this study were adapted following the guidelines outlined in the International Test Commission (ITC) manual (ITC, 2017). The scales were translated by a professional translator fluent in both languages and knowledgeable in the relevant field, with assistance from an expert to ensure scientific and cultural appropriateness. A group discussion was then conducted with two experts in psychology to evaluate the translation, identify cultural differences, and make necessary revisions. Subsequently, a back-translation process was carried out, where a different translator translated the instrument back into English to assess its consistency with the original version. Aiken's V was used to evaluate the validity of all scales, while Cronbach's alpha and McDonald's ω were employed to assess their reliability.

Parent–Child Relationship

To assess the quality of the parent–child relationship, this study used the Inventory of Parent and Peer Attachment (IPPA) developed by Armsden and Greenberg (1987). This instrument examines how adolescents perceive emotional and cognitive aspects that both support and challenge their interactions with their parents. Specifically, it measures the extent to which parents are perceived as providing psychological security. The assessment focuses on three main areas: trust (e.g., "I trust my parents"), quality of communication (e.g., "I value my father's advice on personal matters"), and feelings of anger or alienation (e.g., "My father respects my feelings"). The IPPA is a self-administered questionnaire using a 5-point Likert scale, ranging from "almost never true" to "almost always true." The original version contains 25 items related to parental attachment, but only 10 were retained after reliability testing. Scores are calculated by reversing responses to negatively worded items and summing the values for each section. The overall Cronbach's alpha for this scale is 0.940 and McDonald's $\omega = 0.941$, with individual item correlations ranging from 0.652 to 0.812. The IPPA was selected due to its strong psychometric properties, ease of administration, and established validity in measuring parent-adolescent relationships. Alternative methods for assessing parent–child relationships include observational techniques, structured interviews, and multi-informant assessments, but these approaches were less feasible in the current research context due to resource and time constraints.

Nomophobia (MNPQ)

To assess nomophobia, the researchers employed the Nomophobia Questionnaire (NMP-Q) (Yildirim & Correia, 2015). From the NMP-Q, eight items were selected, each demonstrating item-total correlations above 0.30. For the purposes of this study, the scale was adapted through a forward and backward translation process conducted by two bilingual experts. The final nomophobia scale encompassed four dimensions: difficulty in communication (e.g., "I feel anxious without my phone because it limits my ability to connect with family and friends"), loss of social connection (e.g., "I feel uncomfortable without my phone because I cannot keep up with social media"), limited access to information (e.g., "I feel anxious when I cannot check the news without my phone"), and discomfort (e.g., "I feel uneasy if I run out of mobile data"). Participants rated their agreement with each statement on a 4-point Likert scale, ranging from "Definitely true" to "Definitely not true." The overall Cronbach's alpha for this scale was 0.811, and McDonald's $\omega = 0.817$, with item correlations ranging from 0.452 to 0.632. The NMP-Q was chosen due to its specific relevance, established reliability, and ability to measure distinct nomophobia dimensions effectively compared to other general anxiety measures.

Problematic Smartphone Use

To assess problematic smartphone use among participants, researchers developed a questionnaire measuring the intensity of smartphone usage. This questionnaire included two primary factors: frequency of phone use (e.g., "I use my phone every day") and time spent using the phone (e.g., "I use my phone for 12 h a day"). Participants rated each statement on a 4-point scale ranging from 1 (never) to 4 (always). The item-total correlation ranged from 0.496 to 0.731, with Cronbach's alpha reliability of 0.808 and McDonald's $\omega =$ 0.816. This scale was selected for its simplicity, relevance, and clear differentiation of problematic usage behaviors, providing more direct measurements compared to other complex or general addiction scales.

Sleep Problems

This study assessed sleep-related issues using the Global Sleep Assessment Questionnaire (GSAQ) (Roth et al., 2002). Scores were calculated for various sleep disorders, such as primary insomnia (I), insomnia related to mental conditions (IME), obstructive sleep apnea (OSA), periodic limb movement (PLM), and parasomnia (P). Participants rated each item on a 4-point scale, selecting from the following options: never, occasionally, usually, or always. The overall reliability of the scale was indicated by Cronbach's alpha of 0.806 and McDonald's $\omega =$ 0.807, with item-total correlations ranging from 0.396 to 0.572. The GSAQ was chosen due to its comprehensiveness, established validity in various populations, and clear differentiation among common sleep disorders, offering advantages over simpler or less comprehensive sleep measures.

Data Analysis

Path analysis using structural equation modeling (SEM) was employed to test the theoretical model of this research, allowing for the examination of direct and indirect relationships between variables. This method was chosen due to its ability to analyze complex causal relationships while accounting for measurement errors. Prior to hypothesis testing, assumption tests were conducted to assess data normality, multicollinearity, and model fit to ensure the appropriateness of SEM for the analysis. Data analysis was carried out using Jamovi 2.2 and Amos 20 software, which facilitated model estimation, goodness-of-fit evaluation, and hypothesis testing.

Research Ethics

This study was approved by the Research Ethics Committee of Ahmad Dahlan University, under the Ethics Number 012206071 KEP UAD. Additionally, the researchers obtained permission for data collection from the university authorities. All participants voluntarily consented to participate and signed written consent forms. Their privacy and anonymity were ensured throughout the study.

Results

This study involved 672 high school students from ten cities in Indonesia, among them, 397 participants, or 59.1%, identified as male, while the remaining 275 participants, accounting for 40.9%, identified as female. The largest age group represented is 17-year-old respondents, comprising 50.1% of the total sample, or 337 individuals. This is followed by 16-year-old respondents, who make up 32.3% of the sample, with 217 individuals. Respondents aged 18 account for 13.5% of the group, totaling 91 individuals. The smallest age groups are 19-year-olds and 15-year-olds, representing 2.8% and 1.2% of respondents, respectively, with 19 and 8 individuals. Table 1 presents the age distribution of respondents.

The first variable, father-child relationship, had scores ranging from a minimum of 12 to a maximum of 50, with a mean score of 38.68 and a standard deviation (SD) of 8.66, indicating variability in responses. The mother–child relationship variable displayed a slightly higher mean score of 40.62, with scores ranging from a minimum of 13 to a maximum of 53, and an SD of 7.26, reflecting slightly lower variability compared to the father-child relationship.

The study also assessed nomophobia (the fear of being without a smartphone), with scores ranging from 8 to 32, a mean score of 21.14, and an SD of 4.76, indicating moderate variability in participants' levels of nomophobia. Smartphone usage scores ranged between 8 and 33, with a mean of 21.97 and an SD of 4.80, showing variability similar to nomophobia scores. Lastly, the sleep problems variable had scores ranging from 9 to 36, with a mean of 19.03 and an SD of 5.21, reflecting moderate variability in sleep habits among participants.

Table 2 presents the correlation matrix among variables involving sleep problems, father-child relationship, mother–child relationship, nomophobia, and smartphone usage. The correlation results indicate a significant

Table 1 Distribution of respondents' age ($N = 672$)

Age	Frequency	Percent
15 years	8	1.2
16 years	217	32.3
17 years	337	50.1
18 years	91	13.5
19 years	19	2.8

Table 2 Correlation matrix between variables

	1	2	3	4
Sleep problem	1.000			
Father-child	− 0.215**	1.000		
Mother–child	− 0.147**	0.334**	1.000	
Nomophobia	0.266**	− 0.135**	− 0.015	1.000
Smartphone use	0.177**	0.000	0.083*	0.412**

Note: *$p < 0.05$, **$p < 0.01$

negative relationship between sleep problems and the father-child relationship ($r = -0.215$, $p < 0.01$) as well as the mother–child relationship ($r = -0.147$, $p < 0.01$). This suggests that poorer relationships with either the father or mother tend to be associated with increased sleep problems. Furthermore, there is a significant positive relationship between sleep problems and nomophobia ($r = 0.266$, $p < 0.01$), indicating that higher levels of nomophobia are associated with more sleep problems.

The relationships among other variables show that the father-child relationship and mother–child relationship are positively correlated ($r = 0.334$, $p < 0.01$), suggesting that a good relationship with one parent is likely to be accompanied by a good relationship with the other parent. Meanwhile, nomophobia is significantly positively correlated with smartphone usage ($r = 0.412$, $p < 0.01$), indicating that individuals experiencing higher levels of nomophobia are more likely to use their smartphones more frequently. The correlation between the mother–child relationship and smartphone usage is also significant, though weaker ($r = 0.083$, $p < 0.05$), suggesting that this relationship influences smartphone usage to a lesser extent.

Table 3 and Fig. 1 present the regression weight results from the path analysis examining the relationships among father-child relationship, mother–child relationship,

Table 3 The result of weighted regression

Dependent variables		Independent variables	Estimate	S.E	C.R	*p*
Nomo	< ---	Father	− 0.075	0.021	− 3.604	0.000
Nomo	< ---	Mother	0.019	0.023	0.842	0.400
Smartphone	< ---	Father	0.015	0.019	0.807	0.420
Smartphone	< ---	Mother	0.044	0.021	2.127	0.033
Smartphone	< ---	Nomo	0.409	0.035	11.805	0.000
Sleep	< ---	Nomo	0.224	0.045	5.023	0.000
Sleep	< ---	Smartphone	0.116	0.045	2.568	0.010
Sleep	< ---	Father	− 0.089	0.022	− 3.985	0.000
Sleep	< ---	Mother	− 0.063	0.024	− 2.613	0.000

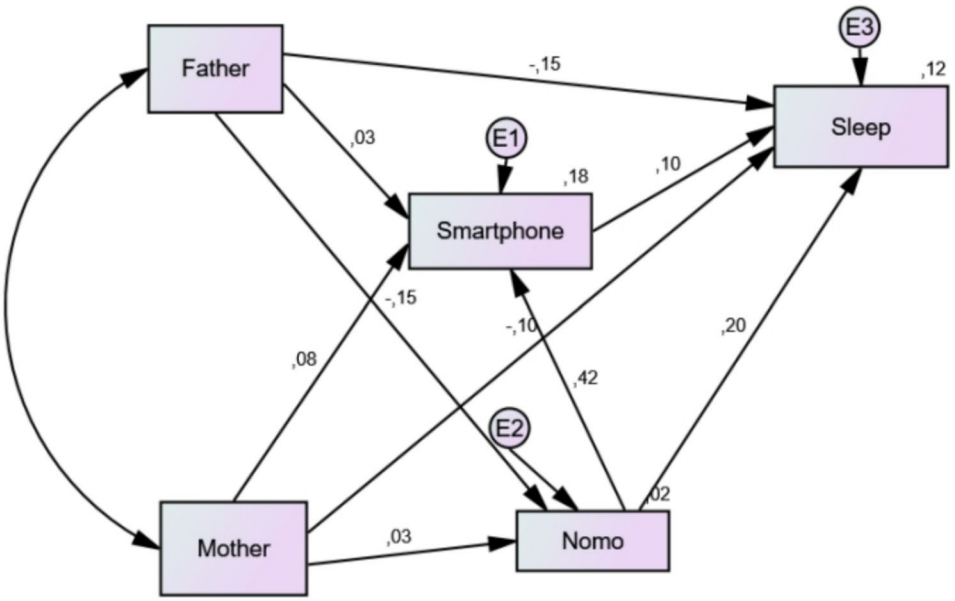

Fig. 1 Results of the path analysis of the theoretical research model

nomophobia, smartphone use, and sleep problems. First, the findings indicate that the father-child relationship has a significant influence on nomophobia (Estimate = − 0.075, C.R. = − 3.604, $p < 0.001$). This influence is negative, meaning that a poorer father-child relationship is associated with higher levels of nomophobia in the child. In contrast, the mother–child relationship does not significantly affect nomophobia (Estimate = 0.019, C.R. = 0.842, $p = 0.400$), suggesting that the quality of the mother–child relationship is not directly related to nomophobia levels.

Second, smartphone use is significantly influenced by nomophobia (Estimate = 0.409, C.R. = 11.805, $p < 0.001$), indicating that individuals with higher levels of nomophobia tend to use smartphones more frequently. The mother–child relationship also has a significant effect on smartphone use (Estimate = 0.044, C.R. = 2.127, $p = 0.033$), though with a smaller effect size. However, the father-child relationship does not have a significant impact on smartphone use (Estimate = 0.015, C.R. = 0.807, $p = 0.420$).

Lastly, with regard to sleep problems, nomophobia has a significant positive influence (Estimate = 0.224, C.R. = 5.023, $p < 0.001$), suggesting that individuals with higher levels of nomophobia are more likely to experience sleep issues. Smartphone use also significantly impacts sleep problems (Estimate = 0.116, C.R. = 2.568, $p = 0.010$). Moreover, both the father-child relationship (Estimate = − 0.089, C.R. = − 3.985, $p < 0.001$) and the mother–child relationship (Estimate = − 0.063, C.R. = − 2.613, $p = 0.009$) have significant negative effects on sleep problems, indicating that poorer relationships with parents are associated with a greater likelihood of experiencing sleep problems.

Table 4 presents the testing of the indirect effects of the theoretical model using the bootstrapping method. The results indicate a significant indirect effect of the father-child relationship on smartphone use ($\beta = -0.061$) and sleep problems ($\beta = -0.033$). This suggests that the father-child relationship indirectly influences children's sleep problems through nomophobia or smartphone use. In contrast, the mother–child relationship does not have a significant indirect effect on sleep problems ($\beta = 0.016$) or smartphone use ($\beta = 0.014$), implying that the mother's influence on these variables is smaller or undetected within this model.

Additionally, the indirect effect of nomophobia on sleep problems is also significant ($\beta = 0.043$), indicating that nomophobia indirectly affects sleep problems through smartphone use. This is consistent with previous findings showing that nomophobia is directly related to smartphone use, and smartphone use impacts sleep problems. These results strengthen the hypothesis that smartphone use serves as a crucial mediator in the relationship between nomophobia and sleep problems.

Table 4 The result of the standardized indirect effect

	Mother	Father	Nomophobia
Nomophobia	.000	.000	.000
Smartphone	.014	− .061*	.000
Sleep problem	.016	− .033*	.043*

Significantly greater ($p < .05$). Note: *$p < .05$

Discussion

This study aimed to examine a theoretical model of how parent–child relationships influence sleep problems, mediated by nomophobia and problematic smartphone use. The findings confirmed that father-child relationships, mother–child relationships, nomophobia, smartphone use, and sleep problems align with previous research. Notably, the father-child relationship had a significant negative impact on nomophobia, suggesting that weaker father-child bonds are linked to higher nomophobia levels. This aligns with findings from Itahashi et al. (2020), who emphasized the father-child relationship's role in children's psychological development, including internalizing behavioral problems. Interestingly, the mother–child relationship did not significantly influence nomophobia but did have a substantial impact on smartphone use, supporting research that suggests mothers play a more active role in regulating children's technology use (Inoue et al., 2022).

The results further demonstrated that nomophobia negatively affects sleep quality. Individuals experiencing higher levels of nomophobia tend to have more sleep disturbances, consistent with prior research linking nomophobia to anxiety and insomnia (Daraj et al., 2023; Dibben et al., 2023). Additionally, excessive smartphone use before bed exacerbates sleep problems. Both nomophobia and smartphone use were found to significantly contribute to sleep problems, echoing findings from Lollies et al. (2022), who reported that excessive technology use negatively affects children's sleep quality. Furthermore, both father-child and mother–child relationships had a significant negative impact on sleep problems, reinforcing previous studies that highlight the detrimental effects of disharmonious parenting on children's sleep quality, particularly among those with high anxiety (Chevalier et al., 2021).

This study also identified an indirect influence of the father-child relationship on smartphone use and sleep problems, mediated by nomophobia. A weaker father-child relationship led to higher nomophobia levels, which subsequently increased smartphone use and worsened sleep quality (Moreno-Guerrero et al., 2020). Conversely, the mother–child relationship did not show a significant indirect effect on smartphone use or sleep problems, suggesting that its influence on these variables may be less pronounced

than that of the father-child relationship. Additionally, the findings confirmed that nomophobia indirectly affects sleep problems through increased smartphone use, supporting previous research that has linked nomophobia to excessive smartphone use and subsequent sleep disturbances, including insomnia (Çelik & Alan, 2023; Daraj et al., 2023). These results highlight the importance of family relationships in managing children's technology use and sleep health, with an emphasis on improving father-child relationships as a potential strategy for mitigating nomophobia, problematic smartphone use, and sleep problems.

Several limitations of this study must be acknowledged. First, the correlational design does not allow for causal conclusions between the examined variables. Second, the reliance on self-report measures for parent–child relationships, problematic smartphone use, nomophobia, and sleep problems introduces the potential for subjective bias. Third, external factors such as socioeconomic conditions, cultural influences, and family environments were not comprehensively accounted for, which may have affected the results. Moreover, the study's findings may not be generalizable across different age groups or cultural backgrounds. Lastly, biological factors contributing to sleep problems were not controlled for in this study's model, which may be an important consideration for future research.

Conclusion

Based on the correlation analysis, it can be concluded that strong family relationships, particularly with both fathers and mothers, are associated with fewer sleep problems, suggesting that closer parental bonds may contribute to better sleep quality. Conversely, nomophobia and smartphone use show a positive correlation with sleep problems, indicating that individuals who rely more heavily on smartphones tend to experience greater sleep disturbances. While these findings align with previous research, further studies are needed to explore causal mechanisms and potential moderating factors.

Future research should consider longitudinal studies to better understand the long-term effects of parent–child relationships and smartphone dependency on sleep patterns. Additionally, intervention strategies, such as parental guidance on digital literacy, structured technology use policies in schools, and awareness programs on healthy sleep habits, could be explored to mitigate the impact of nomophobia and excessive smartphone use on sleep quality. Examining cultural and socioeconomic variations in these relationships would also help broaden the applicability of these findings.

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Author Contribution All the authors contributed equally to the study's conceptualization, interpretation of the data, and review and editing of the manuscript. T.S. performed the statistical analyses; wrote the methods, results, and conclusions; and finalized the manuscript. N.E.S. wrote the introduction. D.P.A. and H.S. wrote the discussion. All authors have read and agreed to the published version of the manuscript.

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Data Availability Data are publicly available from Zenodo at https://zenodo.org/records/13831484.

Declarations

Ethical Approval The study followed the guidelines of the Declaration of Helsinki and was approved by The Research Ethics Committee of Universitas Ahmad Dahlan Indonesia, which approved this study's ethical approval on 13 March 2024 (Ethics Number: 012402036 KEP UAD). The researchers also obtained a data collection permit from the school and university administration.

Informed Consent All the informants agreed to participate in this study and signed a voluntary informed consent statement. The anonymity and confidentiality of all participants were guaranteed.

Conflict of Interest The authors declare no competing interests.

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