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Internet Addiction and Its Association With Sleep Problems Among Early Adolescents in a Peri-Urban Area

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ABSTRACT

Background: The use of the internet among adolescents increases rapidly, particularly since COVID-19 pandemic, due to the necessity of online learning. Excessive internet use may progress to internet addiction, which has been identified as a risk factor for sleep disturbances. Sleep disorders that occur in adolescents may persist into adulthood, can result in sustained detrimental effects on health, especially in individuals aged 10-12 years, as they are still on critical period of growth and neurodevelopment. Data from Demak show that 30% from 40,000 students from elementary to high school have been addicted to online games, which represents a major subtype of internet addiction.
Objective: To determine the relationship between internet addiction and sleep disorders among adolescents aged 10-12 years.
Methods: : A cross-sectional, analytical observational study was conducted. Data were obtained using the Internet Addiction Diagnostic Questionnaire and the Sleep Disturbance Scale for Children (SDSC) questionnaire, administered to fourth- and fifth-grade students at Bintoro 5 Elementary School in Demak, recruited through purposive sampling. Statistical analysis was performed using chi-square tests and multivariate logistic regression to control the confounding variables such as physical activity, obesity, and co-sleeping.
Results: Among 81 respondents, the prevalence of internet addiction was 35.8% (n=29), and the prevalence of sleep disorders was 61.7% (n=50). Bivariate analysis using chi-square test demonstrated a significant relationship between internet addiction and sleep disorders p = 0.008. After controlling for confounding factors with logistic regression, the result remained statistically significant p = 0.006.
Conclusion: Internet addiction is significantly associated with sleep disorders in adolescents aged 10-12 years, even after controlling for confounding factors.

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1. Introduction

The rapid advancement of technology has increased internet use across age groups, including children in late childhood and early adolescence. During the COVID-19 pandemic, the transition to online learning further intensified daily screen-based activities and reliance on internet-enabled devices.[1] After the implementation of online learning, higher frequency and longer duration of internet use among school-aged children have been increasingly reported, and problematic patterns of use may develop in some individuals.[2] The World Health Organization (WHO) has recognized gaming disorder in the International Classification of Diseases, 11th Revision (ICD-11), which is often discussed in relation to problematic internet use.[3]

Excessive or problematic internet use has been associated with several adverse outcomes, including psychological difficulties, physical health complaints, and sleep-related problems.[4] Sleep problems that have been reported in relation to internet addiction include insomnia symptoms, shorter sleep duration, and poorer overall sleep quality.[5] Several mechanisms have been proposed, such as delayed bedtime due to prolonged device use and increased cognitive or emotional arousal from online activities.[6]

This issue is particularly relevant for children aged 10–12 years, who are in a critical developmental period. *Disturbances during this stage may be linked to persistent problems later in adolescence.[7] When sleep problems and problematic internet use become habitual, they may be associated with daytime sleepiness, reduced concentration, and poorer academic functioning.[8]

Previous studies in Demak have indicated symptoms related to online gaming addiction among students from elementary to high school levels, with approximately 30% of surveyed students showing indications of problematic internet use.[9] Demak was selected as the study setting because it is a peri-urban area, an area transitioning from

rural to urban conditions, where access to digital infrastructure is increasing and may influence internet-use behaviors among school-aged children.[10] In addition, the prevalence of sleep disturbances among children aged 10–12 years has been reported to be 64.6%.[11] This percentage is relatively high considering the potential consequences of poor sleep quality, including memory impairment, behavioral disorders, physiological disturbances, and hormonal imbalances.[12]

Despite the growing concern, evidence focusing specifically on the association between internet addiction and sleep disturbances among children aged 10–12 years in peri-urban settings remains limited. Therefore, this study aims to investigate the association between internet addiction and sleep disturbances among children aged 10–12 years in Demak.

2. Methods

This study employed a cross-sectional design with an observational analytical approach. The research was conducted at SD Negeri Bintoro 5 Demak, an elementary school located in a peri-urban area. Demak was selected as the study setting because peri-urban areas are experiencing increasing access to digital infrastructure, which may influence internet-use behaviors among school-aged children.[10]

The study sample was obtained using a purposive sampling technique. Participants were students aged 10–12 years who met the inclusion and exclusion criteria, resulting in a total of 81 eligible respondents. Because the sample was drawn from a single school using a non-probability sampling method, the findings are intended to reflect this study population and setting. Data on internet addiction were collected from students using the Internet Addiction Diagnostic Questionnaire (Kuesioner Diagnostik Adiksi Internet, KDAI).

Data on sleep disturbances were collected from parents using the Sleep Disturbance Scale for Children (SDSC). Both instruments have been validated and shown to be reliable. However, the use of different informants for the main variables (students for internet addiction and parents for sleep disturbances) may introduce informant-related measurement bias. In addition to the main variables, the study considered potential confounding factors including physical activity, obesity, and co-sleeping practices.

Physical activity was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A). Given that PAQ-A was originally developed for older adolescents, its use in children aged 10–12 years should be interpreted cautiously. Co-sleeping was assessed through direct parental responses using a dichotomous (yes/no) question. The collected data were analyzed using the chi-square test for bivariate associations. When chi-square assumptions were not met due to small expected cell counts, Fisher's exact test was applied. Multivariable logistic regression was performed to estimate adjusted associations while controlling for confounding variables.

3. Result

The study was conducted among 4th- and 5th-grade elementary school students aged 10–12 years who met the inclusion and exclusion criteria. A total of 81 participants were included in the analysis. Anthropometric measurements were obtained to determine obesity status. Data on internet addiction were collected from students, while sleep disturbances and co-sleeping practices were reported by parents. Physical activity was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A).

Sample Characteristics

Table 1 summarizes the characteristics of the 81 participants aged 10–12 years and the corresponding parental reports used in the assessment process. Based on the Internet Addiction Diagnostic Questionnaire (KDAI), 35.8% of participants met the criteria for internet addiction. Based on the Sleep Disturbance Scale for Children (SDSC), 61.7% of participants were classified as having sleep disturbances. The distribution of sleep disturbance subtypes is presented in Table 3.

Table 1. Assessment Characteristics

Variable	n N= 81	% (100%)
Gender		
Male	48	59.3
Female	33	40.7
Age		
10 years	20	24.7
11 years	59	72.8
12 years	2	2.5
Internet Addiction (KDAI)		
Yes (≥108)	29	35.8
No (<108)	52	64.2
Sleep Disturbances (SDSC)		
Yes (≥39)	50	61.7
No (<39)	31	38.3
Obesity		
Yes	7	8.6
No	74	91.4
Physical Activity		
High	19	23.5
Moderate	43	53.1
Low	19	23.5
Co-sleeping		
Yes	37	45.7
No	44	54.3

**Data are presented as frequency (n) and percentage (%).*

The Relationship between Internet Addiction and Sleep Disturbances Among Adolescents Aged 10–12 Years

Bivariate analysis showed a statistically significant association between internet addiction and sleep disturbances (p = 0.008). Participants with internet addiction had higher odds of being classified as having sleep disturbances compared with those without internet addiction (OR = 4.80; 95% CI: 1.59–14.51) (Table 2). The distribution of sleep disturbance subtypes according to the SDSC subscales is presented in Table 3.

Table 2. Analysis of the Relationship Between Internet Addiction and Sleep Disturbances

Variable	Sleep Disturbances: Yes n	Yes %	No N	No %	p	OR (95% CI)
Internet addiction						
Yes	24	48	5	16.1	0.008*	4.80
No	26	52	26	83.9		(1.59-14.51)

**Chi-square test; p < 0.05 indicates statistical significance.*

Table 3 presents the distribution of SDSC sleep disturbance subtypes among participants classified as having sleep disturbances (SDSC ≥ 39).

Table 3. Types of Sleep Disturbances

Variable	n	%
Initiating and maintaining sleep disorder	27	33.3
Sleep–wake transition disorders	14	17.3
Excessive somnolence disorder	8	9.9
Sleep hyperhidrosis	1	1.2

**Data are presented as frequency (n) and percentage (%).*

The Relationship Between Physical Activity, Obesity, and Co-sleeping Practices

As shown in Table 4, physical activity was not significantly associated with sleep disturbances (p = 0.472), and co-sleeping practices were also not significantly associated with sleep disturbances (p = 0.446). For obesity, Fisher's exact test was applied because more than 20% of the expected cell counts were less than five; obesity showed a borderline association with sleep disturbances (p = 0.071) and met the criterion (p < 0.25) for inclusion in multivariable analysis.

The Relationship Between Internet Addiction and Obesity with Sleep Disturbances

As shown in Table 5, multivariable logistic regression analysis indicated that internet addiction remained significantly associated with sleep disturbances after adjustment for obesity (p = 0.006; adjusted OR = 4.94; 95% CI: 1.58–15.41). Obesity was not significantly associated with sleep disturbances in the adjusted model (p = 0.086; adjusted OR = 0.20; 95% CI: 0.03–1.25).

Table 4. Association Between Potential Confounders and Sleep Disturbances

Variable	Sleep Disturbance: Yes n	Yes %	No N	No %	p	OR (95% CI)
Physical Activity						
High	11	22	8	25.8	0.472	–
Moderate	25	50	18	58.1		
Low	14	28	5	16.1		
Obesity						
Yes	2	4	5	16.1	0.071	0.22 (0.04–1.20)
No	48	96	26	83.9		
Co-sleeping						
Yes	25	50	12	38.7	0.446	1.58 (0.64–3.94)
No	25	50	19	61.3		

**Fisher's exact test was applied for obesity due to small expected cell counts*

Table 5. Multivariable Logistic Regression Analysis of Factors Associated With Sleep Disturbances

Variable	β	p	OR	95% CI
Internet addiction	1.597	0.006*	4.939	1.583 – 15.411
Obesity	-1.602	0.086	0.202	0.032 – 1.254

**logistic regression analysis; p < 0.05 considered statistically significant*

4. Discussion

This study found that 35.8% of participants aged 10–12 years met the criteria for internet addiction, and 61.7% were classified as having sleep disturbances. These findings suggest that problematic internet use and sleep-related problems are common in this school-based sample from a peri-urban setting. The developmental period of late childhood/early adolescence is characterized by ongoing maturation of executive control and emotion regulation, which may contribute to greater vulnerability to problematic engagement with online activities.[13] However, given the cross-sectional design, the present findings should be interpreted as associations, not causal effects.

In bivariate analysis, internet addiction was significantly associated with sleep disturbances (p = 0.008; OR = 4.80; 95% CI: 1.59–14.51). This result is consistent with previous studies reporting that higher internet use among school-aged children and adolescents is linked to poorer sleep outcomes, including shorter sleep duration and difficulties initiating sleep.[5] Such associations may be explained by prolonged evening internet use that delays bedtime and increases cognitive or emotional arousal, thereby interfering with sleep onset and continuity. Internet use is also closely linked to gadget use; exposure to device-emitted light may suppress melatonin production and contribute to sleep problems.[18,19]

These findings are in line with reports that increased internet use among children aged 10–18 years is associated with reduced sleep duration, and that sleep problems related

to such patterns may persist into later life stages. [15] Importantly, this study relied on student-reported internet addiction and parent-reported sleep disturbances, which may introduce informant-related measurement differences that could affect observed associations.

Regarding sleep disturbance subtypes, difficulties initiating and maintaining sleep were the most frequently reported category among participants classified as having sleep disturbances. This result aligns with previous research reporting that sleep problems are common among elementary school–aged children, largely due to sedentary behaviors and early engagement in screen-based activities.[16] Similar findings were observed in a 2022 study conducted in Denpasar among 4th–6th grade students, which involved a larger number of participants than the present study.[17]

This study also examined obesity, physical activity, and co-sleeping practices as potential confounders. Obesity showed a borderline association with sleep disturbances in bivariate analysis ($p = 0.071$; OR = 0.22; 95% CI: 0.04–1.20), and because chi-square assumptions were not met due to small expected cell counts, Fisher's exact test was applied for this comparison. Obesity was not significant in the adjusted model ($p = 0.086$), whereas internet addiction remained significantly associated with sleep disturbances ($p = 0.006$; adjusted OR = 4.939; 95% CI: 1.583–15.411). Although obesity can be associated with obstructive sleep apnea mechanisms that disrupt sleep quality,[20] the small number of obese participants in this study may have limited statistical power to detect a significant association. Adequate physical activity is also considered important for sleep quality,[21] and co-sleeping practices may contribute to sleep disturbances through a disruptive sleep environment.[22] However, neither physical activity nor co-sleeping showed significant associations with sleep disturbances in this study.

Several limitations should be noted. First, the study used purposive sampling from a single elementary school, which limits generalizability beyond this setting. Second, the cross-sectional design precludes conclusions about temporality or causality between internet addiction and sleep disturbances. Third, the main variables were reported by different informants (students vs parents), raising the possibility of informant-related measurement bias. Finally, physical activity was assessed using PAQ-A, given that PAQ-A was developed for older adolescents, its application in children aged 10–12 years should be interpreted cautiously. Future studies using probability sampling across multiple schools, age-appropriate physical activity instruments, and longitudinal designs would be valuable to clarify temporal relationships and reduce measurement limitations.

Overall, the present findings indicate a statistically significant association between internet addiction and sleep disturbances among children aged 10–12 years in this peri-urban school-based sample, highlighting the importance of monitoring internet use and sleep health in late childhood/early adolescence.

5. Conclusion

Based on the findings of this study, internet addiction was significantly associated with sleep disturbances among children aged 10–12 years in this school-based peri-urban sample in Demak Regency. In contrast, physical activity and co-sleeping practices were not significantly associated with sleep disturbances, and obesity showed a borderline association in bivariate analysis but was not significant in the adjusted model. Overall, these findings highlight a notable association between internet addiction and sleep disturbances during late childhood/early adolescence; however, due to the cross-sectional design, causal inferences cannot be made.

Further research is recommended using longitudinal designs to clarify temporal relationships between internet addiction and sleep disturbances. Future studies should involve larger, multi-school samples with probability sampling to improve generalizability and should use age-appropriate instruments for physical activity assessment. In addition, future work may explore dose–response patterns (severity of internet addiction and sleep outcomes) and include other relevant confounders that may contribute to sleep disturbances.

Ethical Approval

This study received ethical clearance from the Health Research Ethics Commission (KEPK), Faculty of Medicine UNDIP, under approval No. 059/EC/KEPK/FK-UNDIP/III/2025.

Conflicts of Interest

The authors declare no conflicts of interest related to this study.

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Author Contributions

Conceptualization, AAM, FAR, M; methodology, AAM, FAR, M; validation, FAR, M; data analysis, AAM; investigation, AAM, FAR, M; resources, AAM; data curation, AAM; original draft preparation, AAM; review and editing, AAM, FAR, M, WSA; supervision, FAR, M, WSA; funding acquisition, AAM.

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