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Relationship between Internet Addiction and Sleep Quality among Saudi Medical Students

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Abstract

Adequate sleep is a core human requirement, playing a critical role in maintaining mental and physical health as well as overall life quality. Sleep disruptions are frequently associated with lifestyle factors, including prolonged internet use. Investigating the prevalence of internet gaming disorder among young people in Saudi Arabia and its connection to sleep patterns is therefore essential. This study aimed to explore the relationship between internet addiction and sleep quality among medical college students in Najran, Jazan, and King Khalid universities in southern Saudi Arabia. This study surveyed 338 medical students from southern Saudi Arabia (mean ± SD age = 21.2 ± 3.29 years) using an online questionnaire. The survey incorporated the Internet Addiction Test (IAT) and the Pittsburgh Sleep Quality Index (PSQI). Data analysis utilized chi-square tests, ANOVA, Pearson correlations, and iterative modeling to explore relationships between variables. Among participants, 21% were classified with severe internet addiction, and 31% with moderate addiction. Poor sleep quality was significantly linked to higher levels of internet addiction, explaining 75% of the variance in IAT scores even after accounting for demographic factors. Additional analyses indicated that students spending six or more hours daily online reported worse sleep and higher addiction levels. Male students were more vulnerable to internet addiction than females, and affected students generally showed lower academic performance. These findings highlight the strong interplay between internet addiction and sleep disturbances among medical students and point toward the need for interventions and programs designed to reduce excessive internet use and promote healthier sleep behaviors.

Keywords: Saudi Society, Internet addiction, Medical students, sleep quality

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Introduction

The internet's rapid growth has transformed modern life, offering numerous conveniences and opportunities. However, excessive or uncontrolled internet use has also introduced a range of personal and societal challenges [1]. Among these, internet addiction stands out as a significant concern [2]. The concept was first introduced by Goldberg [3], and over time, terms such as "pathological internet

use," "compulsive internet use," and "problematic internet use" have emerged [4]. Despite these alternatives, "internet addiction" remains the term most widely adopted. Rising awareness among parents, healthcare professionals, and policymakers has fueled numerous studies across all age groups, from children to adults [2, 5–9]. These studies consistently highlight that internet addiction is linked to a variety of physical health issues, including sleep disturbances [8], depression and anxiety [10], alcohol abuse [11], aggression [12], and disruption of circadian rhythms [13]. In addition, it is associated with challenges in academic performance [14], social withdrawal, and occupational difficulties [15], as well as economic consequences, such as financial losses [16]. Among university and medical students, excessive internet use has been shown to interfere with daily activities, often leading to neglect of coursework and assignments [17].

Sleep is a fundamental physiological process, critical for both physical and mental well-being. Adequate sleep supports growth hormone secretion, which is essential for normal development [18]. Conversely, poor sleep quality is linked to numerous adverse outcomes, including headaches, learning difficulties, memory deficits, heightened irritability, and impaired cognitive function [19, 20]. These issues pose risks to students' psychological, physical, and academic health [20, 21]. Additionally, inadequate sleep has been associated with chronic illnesses, such as cardiovascular diseases and diabetes [22]. Research has repeatedly shown a connection between excessive internet use and poor sleep quality [8, 23, 24]. Internet addiction can disrupt circadian rhythms, leading to insomnia and other sleep disturbances. The use of electronic devices before or in bed introduces cognitive, emotional, and physiological stimuli that impair sleep [13]. At the same time, exposure to the bright, short-wavelength light from screens can delay sleep onset and alter sleep cycles [23]. Moreover, heavy internet use has been linked to a reduction in gray matter, which can negatively impact attention, decision-making, and other cognitive abilities [25]. Impaired sleep further undermines memory, learning, and overall academic performance, in addition to affecting broader physical and psychological health [20].

The habitual use of internet-enabled devices, such as smartphones and computers, before bedtime has become increasingly common among students [13, 26, 27]. Several studies have examined sleep patterns among individuals with internet addiction. For instance, one study [28] found that students who spent extensive time on social media or watching television were more likely to suffer from sleep problems and depressive symptoms. Research in Korea demonstrated a strong link between reduced sleep duration and excessive internet use among middle school students [29]. Another study [30] reported that internet addiction, particularly from gaming, was negatively associated with both subjective life satisfaction and objective environmental quality indicators. Furthermore, adolescents and young adults experiencing difficulty falling or staying asleep were found to be at higher risk of developing internet addiction, with significant disruptions in daily routines observed among heavy internet users [8]. This study aimed to explore the relationship between internet addiction and sleep quality among medical college students in Najran, Jazan, and King Khalid universities in southern Saudi Arabia.

Current Study

Saudi Arabia is ranked 17th in the world for internet penetration, with a total population of 34.218 million. Of these, 32.23 million people use the internet, and 25 million actively engage on social media, averaging two hours and fifty minutes of daily usage [31]. Smartphone ownership is widespread, with estimates ranging from 60% to 95%, and nearly 99% of adults own a smartphone [25, 32]. The internet, including social media platforms and mobile applications, plays a significant role in education, healthcare, and entertainment. In educational settings, smartphones allow students to access information and academic resources efficiently [33]. Within healthcare, various applications support medical students, healthcare professionals, and patients in training and educational activities [33, 34]. Saudi Arabia hosts about 36 universities with a combined enrollment exceeding 1.7 million students [8].

Although internet use is increasingly common, research examining internet addiction in Saudi Arabia remains limited. Even fewer studies have explored its relationship with sleep quality among university students, particularly in medical programs [5, 8, 25, 29, 33, 35, 36]. To fill this gap, the present study investigates the prevalence of internet addiction among medical students and its association with sleep quality. Additionally, it examines whether internet addiction can serve as a predictor of sleep quality. It explores variations in addiction levels based on demographic and lifestyle factors, such as gender, GPA, recreational screen time, place of residence, and smoking habits.

Methodology

Participants

This exploratory cross-sectional study targeted undergraduate medical students from Najran, King Khalid, and Jazan universities in southern Saudi Arabia, using simple random sampling. Sample size calculations with G*Power 3.1 [37], assuming an alpha of 0.05 and a power of 0.90, indicated that 332 participants were needed for ANOVA with multiple predictors. To account for

potential non-responses, 374 students were invited to participate. After excluding incomplete and declined surveys, the final dataset included 338 students, surpassing the required sample size. Eligible participants were over 18 years old, enrolled in a four-year medical degree program during the 2022–2023 academic year, fluent in Arabic or English, and willing to participate. **Table 1** details the demographic and academic characteristics of the final sample.

Table 1. Demographic characteristics of the study participants

Demographic characteristics		N	Percentage
Age (mean (SD))		–	21.30 (4.96) years
Sex	Men	178	52.66%
	Women	160	47.33%
Living place	With family	224	66.27%
	University housing	114	33.72%
Smoking	Non smoker	242	71.59%
	Smoker	96	28.40%
Time spent on the internet every day	≤ 3 h	50	14.8%
	4–5 h	162	47.9%
	≥ 6 h	126	37.3%
GPA (performance)	≤ 3.9	111	32.8%
	4-4.4	147	43.5%
	> 4.5	80	23.7%

Data collection

Procedure

Data were obtained through an online survey conducted between April and May 2023. Invitations were sent to randomly selected students from the medical colleges of Najran, Jazan, and King Khalid University in southern Saudi Arabia. Each invitation contained a study information package along with a link to the questionnaire via Google Forms. The information package outlined the study's objectives, explained participant rights—including confidentiality, anonymity, voluntary participation, protection from harm, and the option to withdraw at any stage—and provided instructions for completing the survey [38, 39]. Only participants who provided informed consent after reviewing this package were allowed to proceed. The study protocol received ethical approval from the Deanship of Scientific Research at Najran University (NU/IFC/2/SEHRC/-/19).

Socio-demographic information

Participants reported their gender, living arrangements (with family or in university housing), smoking habits, daily internet usage, and GPA.

Internet addiction test

The level of internet addiction was measured using the Internet Addiction Test (IAT), initially developed by Young [40] and adapted into Arabic by Hawi [41]. The IAT contains 20 items scored on a six-point Likert scale ranging from 0 (never) to 5 (always), with total scores spanning 0–100. Participants were classified into four categories: 0–19 = no addiction, 20–39 = low level, 40–69 = moderate level, and 70–100 = severe addiction [42]. The Arabic IAT has shown strong reliability and validity (Cronbach's $\alpha = 0.92$) [41], and in this study, internal consistency was $\alpha = 0.87$.

Sleep quality assessment

Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), initially developed by Buysse *et al.* [43] and adapted into Arabic by Suleiman *et al.* [44]. The PSQI consists of 19 items covering seven components: sleep duration, sleep disturbance, sleep latency, daytime dysfunction, sleep efficiency, overall sleep quality, and use of sleep medications. Each component is scored 0–3, and the sum of the components produces a total score ranging from 0 to 21, where higher scores indicate poorer sleep quality. A total score ≥ 5 was used to indicate poor sleep, while scores below 5 indicated good sleep quality [43]. The Arabic PSQI has demonstrated acceptable reliability (Cronbach's $\alpha = 0.65$) [44]; in this study, the α value was 0.72.

Data analysis

Completed surveys were carefully checked for completeness and internal consistency before analysis. SPSS version 21 was used to perform all statistical procedures. Descriptive statistics summarized categorical variables as frequencies and percentages, and continuous variables as means and standard deviations. Bivariate and multivariate analyses included t-tests, chi-square tests, and ANOVA, following checks for normality and homogeneity. Correlation and logistic regression analyses were conducted to examine associations between internet addiction and sleep quality while adjusting for demographic factors. Statistical significance was set at $P \leq$

0.05. Effect sizes were calculated following Cohen's guidelines, with 0.2, 0.5, and 0.8 representing small, medium, and significant effects, respectively [45].

Results

Prevalence of internet addiction

Table 2 displays the distribution of internet addiction levels among the medical students in the southern region of Saudi Arabia, using the classification system proposed by Widyanto and McMurran [42]. In this sample, 21.0% of students were identified as having severe internet addiction, 31.1% exhibited moderate addiction, 37.0% had low levels of addiction, and 10.9% showed no signs of internet addiction.

Table 2. Prevalence of internet addiction among medical college students

Internet addiction scores	Internet addiction level	Frequency (n = 305)	Percentage
≤ 19	No internet addiction		10.9%
20-39	Low internet addiction	125	37.0%
40-69	Moderate internet addiction	105	31.1%
≥ 70	Severe internet addiction	71	21.0%

Table 3 summarizes the results of a univariate analysis assessing variations in internet addiction levels according to gender, living arrangements, smoking status, daily internet usage, and GPA. The findings revealed statistically significant differences ($P < 0.01$) across all variables, indicating that these demographic and behavioral factors influence internet addiction levels in the sample.

Table 3. ANOVA results examining internet addiction scale scores by sex, living place, time spent on the internet every day, smoking, and GPA among medical college students (Table view)

Source	Type III sum of squares	df	Mean square	F	Sig.	Effect size	Level of effect size
GPA (performance)	7963.073	2	3981.573	21.077	.000	.71	Medium
Sex	951.511	1	951.511	5.037	026	.58	Medium
Living place	1970.727	1	1970.727	10.432	.001	.63	Medium
Time spent on the internet every day	2891.656	2	1445.828	7.654	.001	.60	Medium
smoking	1551.074	1	1551.047	8.211	.004	.58	Medium
Error	52704.825	279	188.906				
Total	842996.000	338					

[a]R^2 = .770, and adjusted R^2 = .720.

To explore these differences in greater detail, the Scheffé post hoc test was applied to examine variations in internet addiction levels according to students' daily internet use and GPA **(Table 4)**.

Table 4. Scheffé test comparison of differences in internet addiction based on daily internet usage time and GPA (academic performance)

Variables	(J) Number of children	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Time spent on the internet every day						
≤ 3 h	4–5 h	−9.4477*	2.2235	.00	−14.9197	−3.9756
	≥ 6 h	−27.6425*	2.2972	.00	−33.2960	−21.9891
4–5 h	≤ 3 h	9.4477*	2.2235	.00	3.9756	14.9197
	≥ 6 h	−18.1949*	1.6325	.00	−22.2126	−14.1772
≥ 6 h	≤ 3 h	27.6425*	2.2972	.00	21.9891	33.2960
	4–5 h	18.1949*	1.6325	.00	14.1772	22.2126
GPA (performance)						
≤ 3.9	4-4.4	−10.1541*	1.7282	.00	−14.4073	−5.9009
	> 4.5	−30.8764*	2.01573	.00	−35.8370	−25.9157
4-4.4	≤ 3.9	10.1541*	1.72827	.00	5.9009	14.4073
	> 4.5	−20.7223*	1.90956	.00	−25.4216	−16.0230
> 4.5	≤ 3.9	−30.8764*	2.01573	.00	25.9157	35.8370
	4-4.4	−20.7223*	1.90956	.00	16.0230	25.4216

*The mean difference is significant at the *.05* level.

Table 4 presents clear evidence of significant differences in internet addiction scores among students based on their daily online activity and GPA. Those who spent three hours or less on the internet per day had markedly lower

addiction scores than students who used the internet for four to five hours or more than six hours. In addition, students with a GPA of 3.9 or below showed higher levels of internet addiction compared to those with GPAs between 4.0 and 4.4 or above 4.5, highlighting a potential inverse relationship between internet use and academic achievement.

Table 5 reports t-test analyses examining the influence of living arrangements and smoking on internet addiction. Male students scored higher (M = 51.48, SD = 19.36) than female students (M = 38.57, SD = 18.41). Students not residing with their families demonstrated elevated addiction levels (M = 55.89, SD = 19.19) compared with those living with family members (M = 40.01, SD = 19.69). Similarly, students who smoked exhibited greater internet addiction (M = 56.68, SD = 19.05) than their non-smoking counterparts (M = 40.88, SD = 19.51). Overall, these results suggest that independent living and smoking are associated with increased risk of internet addiction among medical students.

Table 5. t-test analysis of internet addiction based on sex, living place, and smoking

Variables		N	M	SD	t
Sex					
	Men	178	51.48	19.36	5.95*
	Women	160	38.57	18.41	
Living place					
	With family	224	40.01	19.69	7.06*
	University housing	114	55.89	19.19	
Smoking					
	Non smoker	242	40.88	19.51	6.58*
	Smoker	96	56.68	19.05	

*Statistically significant at P < 0.05 level.

Internet addiction and sleep quality

The mean PSQI sleep quality score for the sample was 7.84 (SD = 3.22), with possible scores ranging from 0 to 21. An ANOVA was conducted to compare sleep quality across the different internet addiction groups. Results indicated that participants in the severe internet addiction group had significantly higher PSQI scores, reflecting poorer sleep quality, compared to the other groups. Furthermore, the majority of the participants exhibited poor sleep quality based on the cut-off score of ≥ 5. In particular, the average PSQI scores for both the moderate and severe internet addiction groups exceeded this threshold **(Table 6)**.

Table 6. ANOVA test comparison of internet addiction groups on sleep quality (n = 338)

	Group	f	M	SD	F	P	Post hoc
							Scheffé
(PSQI)	No internet addiction	37	4.13	0.91	239.331	.000	(D) > (C) > (B) > (A)
	Low internet addiction	125	4.98	1.81			
	Moderate internet addiction	105	9.38	2.14			
	Severe internet addiction	71	11.53	1.65			

Note: (A) no internet addiction; (B) low internet addiction; (C) moderate internet addiction; (D) severe.

Correlation analysis using Pearson's method revealed a strong positive association between internet addiction and PSQI sleep quality scores (r = 0.83, P < .001). This indicates that as levels of internet addiction increased, participants' sleep quality deteriorated correspondingly.

To further investigate this relationship, a linear regression analysis was conducted **(Table 7)**, adjusting for five demographic factors. The study showed that sleep quality accounted for 75% of the variance in internet addiction scores (R = 0.869; R^2 = 0.755; Adjusted R^2 = 0.750; F = 67.32, P < .05), demonstrating that poorer sleep quality is a significant predictor of higher internet addiction.

Table 7. Linear regression analysis of the association between internet addiction and sleep quality

	Unstandardized coefficient		Standardized coefficient	t		P
Variables	B	Std. error	beta		f	
Sleep quality	0.638	0.225	0.638	18.41	67.32	0.00

Note. Sex, living place, time spent on the internet every day, smoking, and GPA were included as control variables.

Discussion

To our knowledge, this study is the first to examine the relationship between internet addiction and sleep quality

among medical college students in universities located in southern Saudi Arabia. The findings indicated that roughly 21% of participants demonstrated severe internet addiction, while around 31% fell into the moderate category. This implies that nearly half of the students experienced moderate to severe levels of internet addiction, consistent with several prior studies [46–49]. In contrast, some studies have reported lower prevalence rates, such as 18.3% in the UK, 6.6% in Italy [50], and 8.2% in Greece [51]. Cultural differences, variations in diagnostic criteria and assessment tools, and the specific characteristics of survey samples may influence these discrepancies.

It is noteworthy that many studies reporting lower prevalence rates (8%–18%) were conducted before the COVID-19 pandemic. The elevated rates observed in the present study may be partly explained by pandemic-related lockdowns, which required students to rely heavily on the internet for academic purposes. Globally, the pandemic and associated social isolation have been linked to increases in internet and gaming addiction among students. Factors such as heightened stress, reduced access to mental health support, and the substitution of online activities for in-person interactions likely contributed to this rise. Despite the diverse reasons behind these results, the high prevalence of severe (21%) and moderate (31%) internet addiction in this sample underscores the urgent need for further investigation into risk and protective factors affecting young people.

This study also identified several key factors associated with higher levels of internet addiction, including gender, smoking, living arrangements, time spent online, and GPA. The widespread availability of internet access in Saudi Arabia, whether through smartphones or tablets, may contribute to excessive usage. Social media applications such as WhatsApp, Snapchat, and Twitter are particularly popular among students [31]. Additionally, environmental factors like extreme summer heat may encourage prolonged indoor activity, further increasing engagement with digital media [49].

Male students in this study exhibited higher internet addiction scores than female students, likely due to spending more time online and playing digital games—a trend supported by previous research [52, 53], which consistently reports higher rates of internet addiction among young men. The current findings also revealed that 47.9% of students used the internet for 4–5 hours daily, while 37.3% reported using it for more than 6 hours per day. Excessive daily internet use, particularly 6 hours or more, was significantly associated with higher addiction scores. These results are in line with previous research linking prolonged internet use to elevated addiction risk. For instance, one study reported that 40.8% of participants using the internet 5–7 hours per day exhibited severe addiction [54]. At the same time, another found that students using the internet more than 4 hours daily were highly likely to be addicted [46, 55]. These findings underscore the importance of monitoring the amount of time young people spend online, as extended usage is a strong predictor of internet addiction.

In addition, internet addiction may develop due to poor study habits, where online activity replaces academic engagement. This behavior can lead to lower grades, absenteeism, and incomplete mastery of academic material [56]. Excessive internet use can also negatively affect sleep, which in turn reduces students' ability to complete assignments effectively. Consistent with this, our study found that students with higher levels of internet addiction had lower self-reported GPA scores. This observation is supported by prior research: one study found that nearly two-thirds of students experienced academic performance deficits due to excessive internet use, and one-third reported diminished classroom attendance [57]. Similarly, other studies have reported that higher internet addiction correlates with lower GPA [54] and that internet addiction is negatively associated with academic performance among undergraduates [53, 58].

The findings revealed that students who smoked exhibited higher internet addiction scores than non-smokers. Existing literature also supports a link between smoking and internet addiction, suggesting that smokers may be more prone to developing addictive internet behaviors [59]. For example, a study involving 467 Chinese adolescents found that individuals with internet addiction or internet gaming disorder were more likely to engage in risky behaviors such as smoking, truancy, alcohol consumption, and physical altercations [60]. Furthermore, activities such as internet use, gaming, and nicotine consumption can modify neural networks in the brain, potentially leading to long-term effects on cognitive functions, including memory and sleep quality [61]. Research has also indicated that smoking alters sleep patterns, reducing the likelihood of achieving good sleep quality [62]. Consistent with these findings, other studies have shown that individuals reporting poor sleep quality tend to smoke more and engage in frequent internet use [63, 64].

The results also demonstrated that internet addiction was more prevalent among students living in university housing or away from their families. This observation aligns with the cultural context of Saudi Arabia, where family oversight plays a significant role in regulating internet use. Students living with their families are subject to parental monitoring and are often engaged in household responsibilities alongside their studies, which limits excessive internet use. This is supported by previous research indicating that parents closely monitor their

children's internet usage, reducing the risk of developing internet addiction [65].

Regarding the primary focus of this study—the relationship between internet addiction and sleep quality—both ANOVA and hierarchical regression analyses **(Tables 5 and 6)** confirmed that higher levels of internet addiction were associated with poorer sleep quality. Over half (52%) of students classified with moderate to severe internet addiction reported poor sleep. Even after controlling for sex, smoking, living arrangements, time spent online, and GPA, sleep quality accounted for 75% of the variation in internet addiction scores. These findings underscore the negative impact of internet addiction on sleep, which is often manifested as insufficient sleep, poor sleep quality, and daytime sleepiness [8, 64].

Several factors may explain this relationship. For instance, late-night internet use can directly displace bedtime [66]. Excessive internet activity, including online gaming, is closely tied to lifestyle behaviors that impair sleep [67]. Engaging in stimulating online activities, such as gaming or watching action films, activates the central nervous system and delays the onset of sleep [64, 66]. Internet addiction has also been linked to disruptions in circadian rhythms, which negatively affect sleep timing and duration, resulting in daytime fatigue and decreased performance [63]. Additionally, exposure to blue light from screens suppresses melatonin secretion from the pineal gland, further prolonging sleep latency [66]. Poor sleep among medical students carries additional risks, such as an increased likelihood of errors during clinical training, highlighting the broader consequences of internet addiction on health and academic performance.

While this study contributes valuable information on internet addiction among young adults, several limitations must be acknowledged. First, the findings are based on a relatively small sample of students from health faculties in southern Saudi Arabia, limiting the ability to generalize results to broader populations. Second, the study employed an exploratory, cross-sectional design, which allows for identifying associations between internet addiction and sleep quality but does not establish causal relationships. Third, the reliance on self-reported online surveys introduces potential biases, particularly regarding participants' estimates of time spent online or gaming. Future research should aim to disentangle the effects of individual and combined factors on internet addiction and sleep quality. Prospective studies with larger, more diverse samples, as well as longitudinal and qualitative designs, would help clarify causality and underlying mechanisms.

Conclusions

This study aimed to explore the relationship between internet addiction and sleep quality among medical college students in Najran, Jazan, and King Khalid universities in southern Saudi Arabia. Despite the noted limitations, the findings provide important insights into internet addiction within this population. The results suggest that internet addiction, although distinct from traditional substance dependence, shares similar behavioral and neurobiological characteristics, highlighting its relevance for intervention strategies and public health initiatives. Of particular concern is the observed link between internet addiction and psychological difficulties, including impaired sleep quality [8, 24].

Young adults, especially university students, are critical contributors to society, both economically and socially. Excessive internet use and associated mental health challenges can impede their potential, leading to negative consequences such as academic underperformance, absenteeism, job instability, medical costs, long-term disabilities, and even premature mortality related to stress or suicide. These findings underscore the necessity of targeted interventions to reduce internet addiction in adolescents and young adults.

Preventive strategies could include early educational programs designed to promote digital resilience and responsible internet use. Parents should monitor both the duration and nature of their children's online activities, including gaming. Strengthening psychosocial support networks involving parents, educators, and mental health professionals is also essential, ensuring timely assistance for young people's emotional and social needs. Proactive measures and early interventions are crucial for reducing the detrimental impact of internet addiction, safeguarding mental health, enhancing academic performance, and ultimately fostering a healthier, more productive future for individuals and society.

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