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EXPLORING THE RELATIONSHIP BETWEEN INTERNET ADDICTION, SLEEP QUALITY, AND DEPRESSION AMONG MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

Loaiee Faisal Halawani[1], Norah Zafer Alasmari[2], Sundos Ali Alghamdi[3], Ali Saud Alsaud[4], Hatim Ahmed Almaghrabi[5], Rawan Mansour Alqahtani[6], Najd Ali Alshamrani[7], Tareq Khalil Dawood[8], Hassan Abdulrahim Alsahafi[8], Jumana Mazen Derar[9], Yasmeen Yaser Alobaida[10], Khames T. Alzahrani[11]

[1]Senior registrar psychiatrist, Psychiatry department, Armed forced hospital, King Fahad military Hospital, Jeddah, Saudi Arabia.
[2]Preventive medicine consultant, Lifestyle Medicine fellowship, Preventive medicine department, Armed Forced Hospital, Prince Mansoure Military Hospital PMMH, Taif, Saudi Arabia.
[3]Medical student, College of Medicine, Umm Al-Qura university, Makkah, Saudi Arabia.
[4]Medical student, College of Medicine, Qassim University, Qassim, Saudi Arabia.
[5]Medical intern, King Abdulaziz university, Rabigh Campus, Jeddah, Saudi Arabia.
[6]Medical intern, king Saud university, Riyadh, Saudi Arabia.
[7]Clinical Psychology student, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia.
[8]Medical intern, King Abdulaziz University, Jeddah, Saudi Arabia.
[9]General physician, King Abdulaziz hospital, Makkah, Saudi Arabia.
[10]Medical intern, Dar Aluloom University, Riyadh, Saudi Arabia.
[11]BDS, PGD Endo from Stanford University, Saudi Board of Endodontic SR, King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia.

***Corresponding author**: Sundos Ali Alghamdi; **Email**: sanooalghamdi8@gmail.com

Abstract

Introduction: The prevalence of internet addiction, poor sleep quality, and mental health challenges, such as depression, among medical students is an area of growing concern. Studies have revealed high rates of internet addiction, with over 21% of students experiencing severe or moderate addiction. Additionally, smartphone overuse has been strongly linked to anxiety, depression, and poor sleep. The objective of this study is to assess the prevalence of internet addiction, the level of sleep quality, and the presence of depressive symptoms among medical students.

Methodology: This is a cross-sectional observational survey that conducted among medical students in all medical colleges in Saudi Arabia between August 2024 and Nov 2024. The study population includes students from the first year to the interns of medical college. A questionnaire used as a data collecting method. Participants surveyed regarding Quality of sleep using Pittsburgh Sleep Quality Index (PSQI), for depressive symptoms using Depression Anxiety Stress Scale (DASS) and for internet addiction using The Internet Addiction Test (IAT)**.**

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Results: This study involving 417 medical students, we explored the links between internet addiction, sleep quality, and depression. The participants, predominantly young males (58.0%), exhibited concerning mental health trends, with 31.2% experiencing moderate depression and 19.4% severe depression. Sleep quality was poor in 54.9% of respondents, with only 6.5% reporting good sleep quality. Notably, 39.3% went to bed after 1 a.m., contributing to sleep disturbances. Internet addiction was prevalent, with 30% frequently staying online longer than intended, negatively impacting academic performance and personal relationships. Significant relationships were found between depression, sleep quality, and demographic factors like age and year of college.

Conclusion: This cross-sectional study has emphasised the significant prevalence of internet addiction, poor sleep quality, and depression among medical students in Saudi Arabia. The findings underscore the relationships between these factors and the need for interventions to address the unique challenges faced by this population.

Keywords: Internet addiction, Sleep quality, Depression, Medical students.

Introduction:

Internet addiction, or, in another word, phone addiction, has a significant impact on the quality and amount of sleep of medical students, particularly men, and leads to dysfunctional daily lifestyles [1]. It is known as the excessive use of the internet in an uncontrolled, time-consuming manner [2]. One of the most common sleep disorders is insomnia, which is defined as the difficulty to start, maintain, or get enough sleep, along with poor sleep quality that interferes with daytime activities [3]. Nevertheless, compared to the general population, medical students were shown to have higher rates of depression and psychological illness [4].

Studies previously done has demonstrated an association between Internet addiction and bad quality sleep alongside a number of mental health-related issues like depression [5]. A multinational meta-analysis revealed that 6% of people globally are victims of internet addiction, with the Middle East ranking highest [6]. Indian medical students and interns participated in a cross-sectional study in 2021 that measured depression symptoms, internet addiction, and sleep quality. According to the findings, the prevalence of internet addiction is 21 [7]. In 2023, a study was carried out in Serbia involving 761 medical students to investigate the connection between depression, inadequate sleep, and excessive smartphone use. 7% of the participants were addicted to smartphones, and using a smartphone for more than four hours a day was strongly associated with anxiety, depression, and poor sleep quality [8]. Research of 338 medical students in the southern part of Saudi Arabia in 2024 sought to ascertain the relationship between internet addiction and sleep quality. The results revealed that 21% of the students had a severe internet addiction, 31% had a moderate addiction, and students who had logged on for six hours or more had a higher severity of internet addiction and were more likely than other students to show signs of poor sleep [9]. A study at King Abdulaziz University in Jeddah pointed out that almost all of the medical students there have smart devices Addiction is considered by WHO as dependence, as the continuous use of something for the sake of relief or stimulation, which often causes cravings when it is absent [10]**.** A potential consequence of such concern is the failure of students to seek adequate care might affect the quality of care provided for patients. Therefore, there is a crucial need for further studies to explore the determinants of depression and burnout, especially in Qassim, KSA, in a newly developing college of medicine with fewer resources. This study aims to assess the prevalence of burnout and depression, risk factors, and relationship among medical students in Unaizah College of Medicine , Qassim, Kingdom of Saudi Arabia [11].

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An analysis of studies conducted in 2018 revealed that smartphone addiction is a global problem, with 9.3% to 48% of people reporting that it negatively affects their sleep, eating habits, energy levels, body weight, exercise, and academic performance [12]. A limited number of studies have been conducted to determine the MP using pattern and its correlation with academic progress and sleep quality, particularly among medical students [13]. Unfortunately, there are few studies that concentrate on medical students' depression brought on by smartphone addiction. Our study was designed to determine the frequency of poor sleep quality and the prevalence of depression in relation to internet addiction in medical students in Saudi Arabia.

Materials and Methods:

Study design and Setting:
Observational cross-sectional survey conducted in Saudi Arabia between Aug 2024 – Nov 2024. This study conducted among medical students in all medical Colleges in Saudi Arabia. The target population of this study is medical students, males and females, from all years, including the internship year. usually between the ages of 18 and 25 from all colleges and universities in the Kingdom of Saudi Arabia. They were recruited through an online questionnaire distributed through social media websites, including WhatsApp.

Sample size:
To determine the bare minimum of responders required to constitute a representative sample for the entire population, sample size calculator was used to calculate the sample size. The sample size that was determined was 384, with an indicator percentage of 0.50, a margin of error of 5%, and a confidence interval (Cl) of 95%.

Method for data collection, instrument and score system:
Medical students were given the questionnaire to complete on a voluntary basis as a study tool. They were educated about the study's objective and an informed consent was obtained. After reviewing pertinent research from other countries [14,15], this instrument was developed. The completed and constructed questionnaire has 4 main categories, The first category contained demographic questions such as gender, age, residential area, year of college and what university they attend. The second category contained depression assessment. The third category was to assess their sleep quality using Pittsburgh Sleep Quality Index score (PSQI), and the final and forth category includes Internet addiction test (IAT).

Pilot test:
The questionnaire was distributed to and filled out by 13 individuals so far. This was done as a preliminary step to assess the simplicity of the questionnaire and the viability of the overall study.

Analyzes and entry method:
The collected data has been entered into the device using the Microsoft Excel (2016) software for Windows. The collected data was then transferred to the Statistical Package for Social Sciences (SPSS) application (version 25) to undergo statistical analysis.

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Results:

Table (1) displays various demographic parameters of the participants with a total number of (417). The study participants, consisting of a total of 417, demonstrate novel features in terms of the age as well as gender distribution. Participants have a mean age of 22.8, SD 2.6, indicating a predominantly young audience. We also note that 32.1% of participants are 24 years or older, meaning there is a sizeable number of younger young adults in this demographic. Gender distribution shows a soccer with a predominant presence of males (58.0%), differing from females (42.0%), and that can be interpreted in terms of possible consequences in later findings on gender. The Western region is the largest geographically represented at 36.9%, while the Southern region has the least represent at 7.7%. Additionally, the data reveals that most participants' status was being single, a whopping 87.1%, a trend that might be observed in other social parts of a younger generation.

Table (1): Sociodemographic characteristics of participants (n=417)

Parameter		***No.***	***Percent (%)***
Age (Mean: 22.8, STD:2.6)	21 or less	103	24.7
	22 years	79	18.9
	23 years	101	24.2
	24 years or more	134	32.1
Gender	Female	175	42.0
	Male	242	58.0
Residential region	Northern region	46	11.0
	Southern region	32	7.7
	Center region	140	33.6
	Eastern region	45	10.8
	Western region	154	36.9
Marital status	Single	363	87.1
	Married	54	12.9
Year of college	1	12	2.9
	2	34	8.2
	3	42	10.1
	4	38	9.1
	5	82	19.7
	6	64	15.3
	Intern	145	34.8

As shown in figure 1, these frequencies include the experience of little or no interest or pleasure from activities in the total sample of 417. 46 respondents, roughly 11% of the sample, replied that they felt this way at least most days. A larger group, made up of 129 people or about 31%, felt this way more than half the days. At the same time, the largest percentage of respondents, approximately 39%, i.e. 161 persons, declared the absence of any interest on various days. On the other hand, 81 respondents, or about 19%, said that they never ran into this sentiment.

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Figure (1): Illustrates level of interest in doing things among participants.

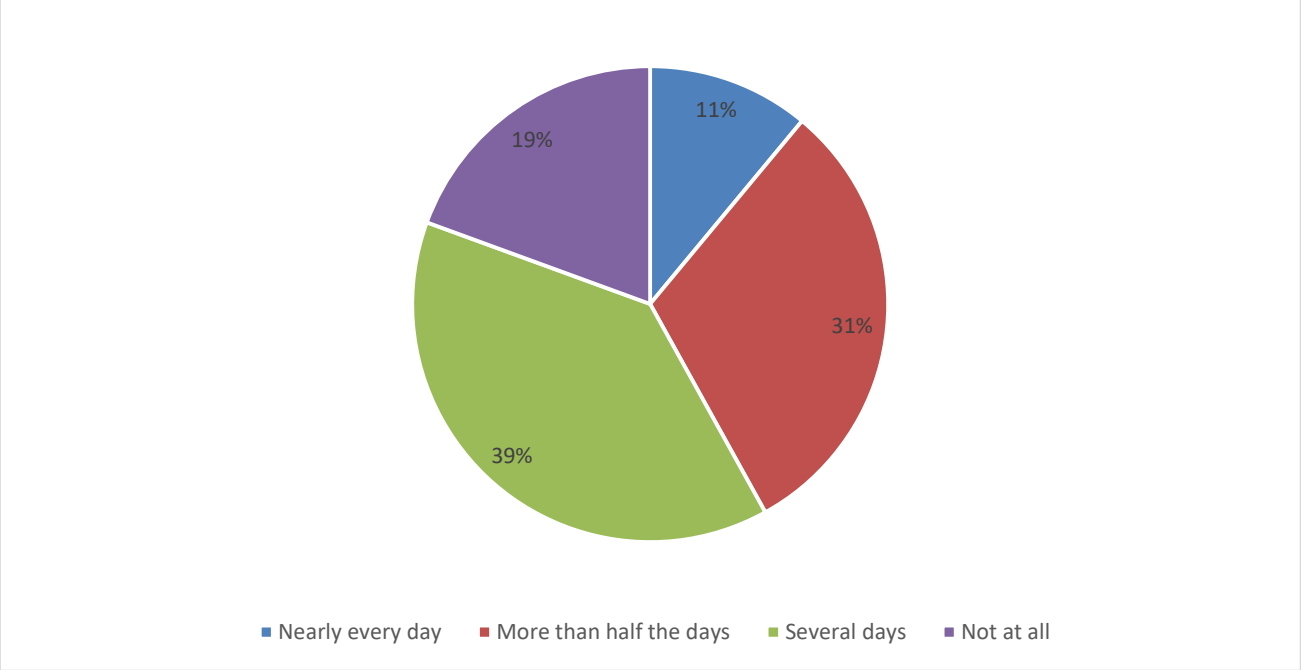

Table 2 presents the critical data revealing the age prevalence of depressive symptoms of the 417 respondents. A third or more felt that it was difficult to concentrate, or that their mind seemed to be going 'on and on,' and a substantial number (30.9% and 38.6%, respectively) indicated these feelings more than half of the days and on several days. This also shows a pervasiveness in some cases with feeling down, depressed, or hopeless multiple days for striking 46.0%. Thirty-one-point four percent indicated sleep disturbances on more than half the days, and 34.1 percent indicated sleep problems on some days, noting potential interrelationships between mood and sleep patterns. Additionally, more than half carried feeling low energy 38.8% more than half the days, and a large portion also reported having self-critical thoughts. Here, although a majority (61.6%) said they did not have suicidal thoughts, the overall picture is one of concerning depressive symptoms.

Table (2): Parameters related to depression Assessment of participants (n=417).

Parameter		***No.***	***Percent (%)***
1. How often have you had little interest or pleasure in doing things?	Nearly every day	46	11.0
	More than half the days	129	30.9
	Several days	161	38.6
	Not at all	81	19.4
2. How often have you been feeling down, depressed, or hopeless?	Nearly every day	37	8.9
	More than half the days	90	21.6
	Several days	192	46.0
	Not at all	98	23.5
3. How often have you had trouble falling/staying asleep, or sleeping	Nearly every day	33	7.9
	More than half the days	131	31.4

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too much?	Several days	142	34.1
	Not at all	111	26.6
4. How often have you been feeling tired or having little energy?	Nearly every day	50	12.0
	More than half the days	162	38.8
	Several days	140	33.6
	Not at all	65	15.6
5. How often have you had poor appetite or struggle with overeating?	Nearly every day	53	12.7
	More than half the days	66	15.8
	Several days	146	35.0
	Not at all	152	36.5
6. How often have you been feeling bad about yourself or that you are a failure or have let yourself or others down?	Nearly every day	51	12.2
	More than half the days	84	20.1
	Several days	115	27.6
	Not at all	167	40.0
7. How often have you had trouble concentrating on things (reading the newspaper, watching tv...)?	Nearly every day	39	9.4
	More than half the days	92	22.1
	Several days	155	37.2
	Not at all	131	31.4
8. How often have you been moving or speaking slowly that other people would have noticed. Or being unusually fidgety or restless?	Nearly every day	32	7.7
	More than half the days	61	14.6
	Several days	103	24.7
	Not at all	221	53.0
9. How often have you had thoughts that you would be better off dead, or hurting yourself?	Nearly every day	34	8.2
	More than half the days	48	11.5
	Several days	78	18.7
	Not at all	257	61.6

As shown in figure (2), analysis of bedtime habits data of the whole sample of 417 respondents reveals important information about nocturnal behaviour. A large 39.2% (of 164 individuals) even went to bed after 1 AM, indicating a general tendency towards late night routines. Immediately thereafter come those who usually retire between 11 PM and 1 AM, 38.1 percent (159 respondents). On the other hand, an even smaller slice of the population goes to bed early, with only 16.2 percent (67 people) falling asleep between 9 PM and 11 PM, and 6.5 percent (27 respondents) doing so even earlier — before 9 PM.

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Figure (2): Illustrates the time participants go to bed at night.

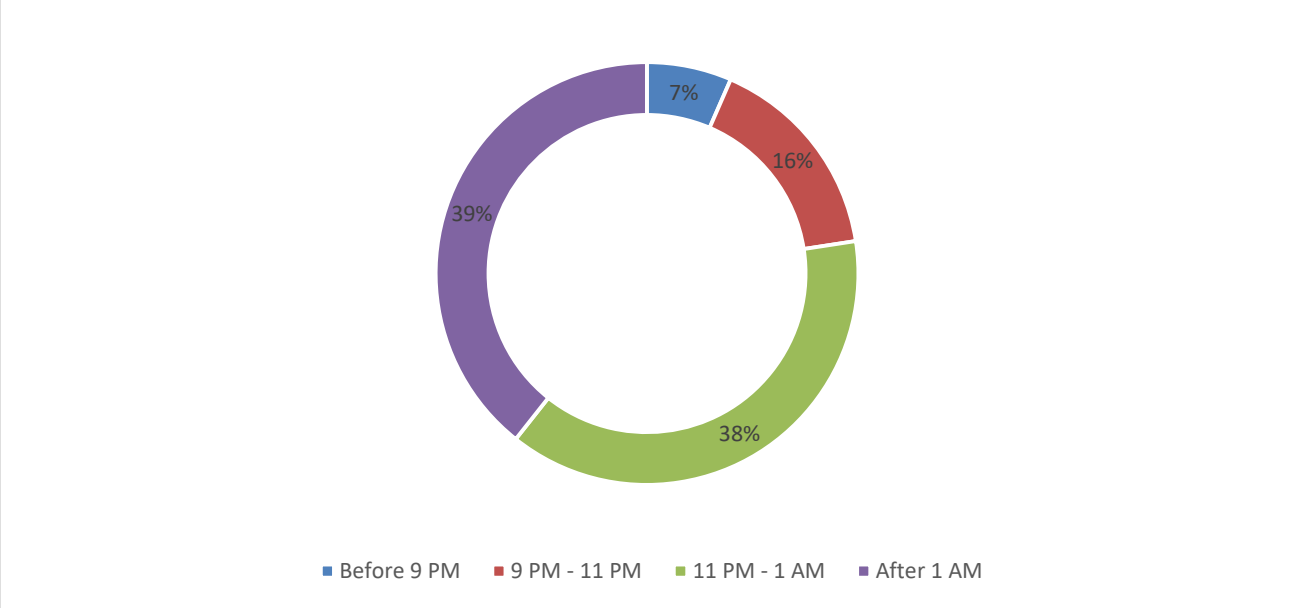

Table 3 presents a broad picture of sleep quality for approximately 417 participants, with many parameters around sleep habits and experiences. Most notably, a remarkably high proportion of respondents — 39.3 percent — said that they don't go to bed until 1 a.m. or later, which sounds like it might explain the sleep habits we're seeing here; 45.3 percent said they generally get less than six hours sleep per night. Also, the time it takes to sleep falls is inconsistent, with 28.8 percent taking between 15 and 30 minutes (indicating a moderate difficulty in initiating sleep in most people). Finally, the prevalence of sleep disturbances deserves notice, with 36 percent reporting trouble sleeping once or twice a week, with bathroom trips (30.5 percent) and bad dreams (28.1 percent) as their chief causes. Despite these difficulties a majority (55.9%) considered their overall sleep quality as fairly good, suggesting a possible resistance of the participants to suboptimal sleep conditions.

Table (3): participants' sleep quality (n=417).

Parameter		***No.***	***Percent (%)***
1. What time have you usually gone to bed at night?	Before 9 PM	27	6.5
	9 PM - 11 PM	67	16.1
	11 PM - 1 AM	159	38.1
	After 1 AM	164	39.3
2. How long has it usually takes you to fall asleep?	Less than 15 minutes	92	22.1
	15-30 minutes	120	28.8
	31-60 minutes	108	25.9
	More than 60 minutes	97	23.3
3. What time have you usually gotten up?	Before 6 AM	91	21.8
	6 AM - 8 AM	184	44.1

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	8 AM - 10 AM	81	19.4
	After 10 AM	61	14.6
4. How many hours of actual sleep do you get at night?	Less than 5 hours	55	13.2
	5-6 hours	189	45.3
	7-8 hours	149	35.7
	More than 8 hours	24	5.8
5. How often have you had trouble sleeping due to difficulty falling/staying asleep?	Less than once a week	108	25.9
	Once or twice a week	150	36.0
	Three or more times a week	45	10.8
	Not during the past month	114	27.3
6. How often have you had trouble waking up in the night due to one of the following? *	Bad dreams	117	28.1
	Pain	49	11.8
	Bathroom trips	127	30.5
	Breathing issues	36	8.6
	Feeling too cold/hot	115	27.6
	Loud coughing or snoring	23	5.5
	None during the past month	149	35.7
7. How often have you had trouble staying awake during daily activities?	Less than once a week	114	27.3
	Once or twice a week	103	24.7
	Three or more times a week	40	9.6
	Not during the past month	160	38.4
8. How often have you taken sleep aid medicine (prescribed or over the counter)?	Less than once a week	43	10.3
	Once or twice a week	33	7.9
	Three or more times a week	17	4.1
	Not during the past month	324	77.7
9. How would you rate your sleep quality overall?	Very bad	18	4.3
	Very good	53	12.7
	Fairly bad	113	27.1
	Fairly good	233	55.9

Results may overlap

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Table 4 shows a complete data on internet addiction and shows some of the patterns of this behaviour among 417 participants, and thus the features should be given careful consideration. Around 30 percent of respondents said they often find themselves staying online longer than intended, 27.6 percent of respondents admitted to often engaging in the same behaviour, which suggests that for many people, internet usage is associated with a struggle with the regulation of themselves. Furthermore, the fact that 34.1 percent frequently gave priority to online activities over their household chores, may imply that internet use could hinder the daily life and obligations. The findings also show an alarming trend regarding personal relationships in which 19.4 percent of respondents commonly chose online excitement over closeness with a partner, and the character implications of such an action are emotionally as well as relationally concerning. Additionally, the excessive use of internet has a negative effect on academic performance, with 28.5 percent of respondents frequently finding their grades are negatively affected by the internet.

Table (4): participants' Internet addiction (n=417).

Parameter		***No.***	***Percent (%)***
How often do you find that you stay online longer than you intended?	Always	99	23.7
	Frequently	115	27.6
	Occasionally	62	14.9
	Often	125	30.0
	Rarely	16	3.8
How often do you neglect household chores to spend more time online?	Always	36	8.6
	Frequently	142	34.1
	Occasionally	135	32.4
	Often	72	17.3
	Rarely	32	7.7
How often do you prefer the excitement of the internet to intimacy with your partner?	Always	20	4.8
	Frequently	81	19.4
	Occasionally	65	15.6
	Often	47	11.3
	Rarely	63	15.1
	I don't have a partner	141	33.8
How often do you form new relationships with fellow online users?	Always	12	2.9
	Frequently	50	12.0
	Occasionally	82	19.7
	Often	27	6.5
	Rarely	246	59.0
How often do your grades or schoolwork suffer because of the amount of time you spend online?	Always	25	6.0
	Frequently	119	28.5
	Occasionally	125	30.0
	Often	68	16.3
	Rarely	80	19.2
How often do you check your email or social media accounts before something else that you need to do?	Always	55	13.2
	Frequently	104	24.9

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	Occasionally	86	20.6
	Often	109	26.1
	Rarely	63	15.1
How often does your job performance or productivity suffer because of the internet?	Always	32	7.7
	Frequently	120	28.8
	Occasionally	111	26.6
	Often	71	17.0
	Rarely	83	19.9
How often do you become defensive or secretive when anyone asks you about your internet use?	Always	26	6.2
	Frequently	76	18.2
	Occasionally	101	24.2
	Often	55	13.2
	Rarely	159	38.1
How often do you block out disturbing thoughts about your life with soothing thoughts of the internet?	Always	93	22.3
	Frequently	78	18.7
	Occasionally	108	25.9
	Often	80	19.2
	Rarely	58	13.9
How often do you find yourself anticipating when you will go online again?	Always	60	14.4
	Frequently	129	30.9
	Occasionally	102	24.5
	Often	81	19.4
	Rarely	45	10.8
How often do you fear that life without the internet would be boring, empty, and joyless?	Always	67	16.1
	Frequently	80	19.2
	Occasionally	119	28.5
	Often	70	16.8
	Rarely	81	19.4
How often do you snap, yell, or act annoyed if someone bothers you while you are online?	Always	34	8.2
	Frequently	92	22.1
	Occasionally	130	31.2
	Often	40	9.6
	Rarely	121	29.0
How often do you lose sleep due to late-night internet use?	Always	45	10.8
	Frequently	96	23.0
	Occasionally	99	23.7
	Often	104	24.9
	Rarely	73	17.5
How often do you feel preoccupied with the internet when you are offline, or fantasize about being online?	Always	22	5.3
	Frequently	92	22.1
	Occasionally	127	30.5
	Often	37	8.9
	Rarely	139	33.3

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As shown in Table 5 the aggregated data from a sample of 417 individuals are distributed into three categories of depression severity, from low (0 to 14), medium (15 to 20), and high (21 to 27). The results show that 49.4% of sample falls in the 'No to Mild Depression' category, close to half of the sample. Of 31.2 percent, the authors observe moderate depression, which indicates a large proportion experiencing clinically significant symptoms of depression. 19.4% of people have severe depression which means that there's a critical segment that might need to intervene urgently.

Table (5): Shows PHQ-9 score results.

	Frequency	**Percent**
No to Mild depression	206	49.4
Moderate depression	130	31.2
Severe depression	81	19.4
Total	417	100.0

Table 6 reflects data for a sample of 417 participants on the Pittsburgh Sleep Quality Index (PSQI) findings indicating concerns regarding sleep quality. Good sleep quality occurs in only 6.5 percent of the population. Conversely, 38.6% of respondents report moderate sleep quality, while 54.9% report poor sleep quality.

Table (6): Shows Pittsburgh Sleep Quality Index (PSQI) score results.

	Frequency	**Percent**
Good sleep	27	6.5
Moderate sleep	161	38.6
Poor sleep quality	229	54.9
Total	417	100.0

As shown in table (7), One of the majorities, 60.9 %, who moderately use the internet show that their internet habits interfere with daily life, but it is not severe enough to affect their daily lives significantly. On the other hand, in the sample there are 26.4% with severe internet usage, which constitute a significant percentage also potentially at risk on negative consequences related to the term addiction. It's reported only 12.7 per cent have mild internet usage, indicating a minority that's mildly disrupted by internet usage.

Table (7): Shows Internet Addiction Test (IAT) score results.

	Frequency	**Percent**
Severe internet usage	110	26.4
Moderate internet usage	254	60.9
Mild internet usage	53	12.7
Total	417	100.0

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Table (8) shows that depression assessment has statistically significant relation to age (P value=0.0001), residential area (P value=0.007), and year of college (P value=0.0001). It also shows statistically insignificant relation to marital status.

Table (8): Relation between depression assessment and sociodemographic characteristics.

Parameters		***Depression level***		***Total (N=417)***	***P value****
		Moderate to severe depression	**No to Mild depression**		
Gender	Female	97	78	175	0.093
		46.0%	37.9%	42.0%	
	Male	114	128	242	
		54.0%	62.1%	58.0%	
Age	21 or less	53	50	103	0.0001
		25.1%	24.3%	24.7%	
	22 years	40	39	79	
		19.0%	18.9%	18.9%	
	23 years	32	69	101	
		15.2%	33.5%	24.2%	
	24 years or more	86	48	134	
		40.8%	23.3%	32.1%	
Residential area	Northern region	24	22	46	0.007
		11.4%	10.7%	11.0%	
	Southern region	16	16	32	
		7.6%	7.8%	7.7%	
	Center region	54	86	140	
		25.6%	41.7%	33.6%	
	Eastern region	29	16	45	
		13.7%	7.8%	10.8%	
	Western region	88	66	154	
		41.7%	32.0%	36.9%	
Marital status	Single	177	186	363	0.051
		83.9%	90.3%	87.1%	
	Married	34	20	54	
		16.1%	9.7%	12.9%	
Year of college	1	10	2	12	0.0001
		4.7%	1.0%	2.9%	
	2	22	12	34	
		10.4%	5.8%	8.2%	
	3	16	26	42	
		7.6%	12.6%	10.1%	
	4	10	28	38	
		4.7%	13.6%	9.1%	
	5	38	44	82	
		18.0%	21.4%	19.7%	

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	6	20	44	64	
		9.5%	21.4%	15.3%	
	Intern	95	50	145	
		45.0%	24.3%	34.8%	

P value was considered significant if ≤ 0.05.

Table (9) shows that sleep quality has statistically significant relation to age (P value=0.0001), and year of college (P value=0.0001). It also shows statistically insignificant relation to marital status and residential area.

Table (9): Pittsburgh Sleep Quality Index in association with sociodemographic characteristics.

Parameters		***Pittsburgh Sleep Quality Index (PSQI)***		***Total (N=417)***	***P value****
		Good to moderate sleep	**Poor sleep quality**		
Gender	Female	82	93	175	0.536
		43.6%	40.6%	42.0%	
	Male	106	136	242	
		56.4%	59.4%	58.0%	
Age	21 or less	54	49	103	0.0001
		28.7%	21.4%	24.7%	
	22 years	17	62	79	
		9.0%	27.1%	18.9%	
	23 years	47	54	101	
		25.0%	23.6%	24.2%	
	24 years or more	70	64	134	
		37.2%	27.9%	32.1%	
Residential area	Northern region	24	22	46	0.096
		12.8%	9.6%	11.0%	
	Southern region	16	16	32	
		8.5%	7.0%	7.7%	
	Center region	70	70	140	
		37.2%	30.6%	33.6%	
	Eastern region	13	32	45	
		6.9%	14.0%	10.8%	
	Western region	65	89	154	
		34.6%	38.9%	36.9%	
Marital status	Single	168	195	363	0.203
		89.4%	85.2%	87.1%	
	Married	20	34	54	
		10.6%	14.8%	12.9%	
Year of college	1	8	4	12	0.0001
		4.3%	1.7%	2.9%	
	2	24	10	34	
		12.8%	4.4%	8.2%	

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	3	14	28	42	
		7.4%	12.2%	10.1%	
	4	12	26	38	
		6.4%	11.4%	9.1%	
	5	26	56	82	
		13.8%	24.5%	19.7%	
	6	32	32	64	
		17.0%	14.0%	15.3%	
	Intern	72	73	145	
		38.3%	31.9%	34.8%	

P value was considered significant if ≤ 0.05.

Table (10) shows that internet addiction test has statistically significant relation to gender (P value=0.047), marital status (P value=0.039), and year of college (P value=0.0001). It also shows statistically insignificant relation to age and residential area.

Table (10): Internet addiction test in association with sociodemographic characteristics.

Parameters		***Internet Addiction Test (IAT)***		***Total (N=417)***	***P value****
		Moderate to mild usage	**Severe internet usage**		
Gender	Female	120	55	175	0.047
		39.1%	50.0%	42.0%	
	Male	187	55	242	
		60.9%	50.0%	58.0%	
Age	21 or less	83	20	103	0.117
		27.0%	18.2%	24.7%	
	22 years	57	22	79	
		18.6%	20.0%	18.9%	
	23 years	77	24	101	
		25.1%	21.8%	24.2%	
	24 years or more	90	44	134	
		29.3%	40.0%	32.1%	
Residential area	Northern region	38	8	46	0.122
		12.4%	7.3%	11.0%	
	Southern region	26	6	32	
		8.5%	5.5%	7.7%	
	Center region	104	36	140	
		33.9%	32.7%	33.6%	
	Eastern region	27	18	45	
		8.8%	16.4%	10.8%	
	Western region	112	42	154	
		36.5%	38.2%	36.9%	
Marital status	Single	261	102	363	0.039
		85.0%	92.7%	87.1%	

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	Married	46	8	54	
		15.0%	7.3%	12.9%	
Year of college	1	4	8	12	0.0001
		1.3%	7.3%	2.9%	
	2	24	10	34	
		7.8%	9.1%	8.2%	
	3	42	0	42	
		13.7%	0.0%	10.1%	
	4	34	4	38	
		11.1%	3.6%	9.1%	
	5	63	19	82	
		20.5%	17.3%	19.7%	
	6	44	20	64	
		14.3%	18.2%	15.3%	
	Intern	96	49	145	
		31.3%	44.5%	34.8%	

P value was considered significant if ≤ 0.05.

Discussion:

This cross-sectional study sought to establish the multiple interdepencies between internet addiction, sleep quality and depression among medical students in Saudi Arabia. The information gained in the study is useful for understanding the frequency and relationships of these important problems in the group of medical students. Consequently, based on demographics, results indicated the population was relatively youthful, comprising of 22.8 years on average, mostly male (58%), and single (87.1%). This concurs with literature that has described medical students as a populations at risk; especially in their initial years of training; to develop issues with Internet use, sleep patterns and mental health [18, 19].

The findings concerning the presence of depressive symptoms among the participants were shocking; 35% of participants reported that they have problems with concentration and 35% of participants reported that they have always been sad; 46% of participants have depressive feelings for multiple days. The current study supports literature reviews that reveal higher depression and psychological illness prevalence among medical students than among the general population [20, 21]. Recently, two cross-sectional surveys carried out in medical students of India and Nepal also revealed a similar prevalence of depressive symptoms as noted in the present study.

There were also many sleep disturbances reported; 31.4% of the participants said they had sleep disturbances more than half the days. This is surmising with what other researchers have found and have postulated that there is a profound correlation between internet addiction and the quality of sleep among medical students [24, 25]. A study conducted on 34 countries of the world to establish the prevalence of Internet addiction, revealed that 6% of the world's population is addicted to internet with middle eastern countries coming out top [26]. In line with these results, our cross-sectional study revealed that ~30% of participants reported frequently being unable to log off the Internet and 34.1% found it difficult to attend to household chores in order to remain online, suggesting a high proportion of students with problematic Internet use.

The number of 'No to Mild Depression' (49.4%), moderate (31.2%), and severe (19.4%) depression were noted for participants categories. These findings are similar to one in Iran which has found that

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56.8 of medical students had poor sleep quality and internet addictions, and also finding a relationship between internet addiction and sleep quality disorder [27]. A similar study in Bangladesh noted large associations between dissatisfaction with sleep time and depression, and internet use greater than five hours per day and depression [28].

Further reinforcing the problem of sleep quality, the results of the analysis of Pittsburgh Sleep Quality Index (PSQI) showed that 6.5 percent had good and the shocking 54.9 percent had poor sleep quality. These findings are in keeping with previous research documenting the harmful effect of internet abuse on both sleep duration and sleep quality [29, 30]. In an example, in Korea, a person with Internet addiction was 1.7 times more likely to have poor sleep quality as compared to those with normal internet usage [31].

The study also found strong ($P < 0.0001$) statistical significance between depression severity and variables including age, residential area and year of college. The relationships with age and year of college were similar in magnitude and significant for sleep quality, while internet addiction was significant with gender, marital status, and year of college. This meets existing literature which has consistently shown the complexity of these factors and their effectiveness on wellbeing of medical students [32, 33].

A study in China revealed that the negative effect of internet addiction on the sleep quality was even more negative on female students [34]. Moreover, in Nepal, a study showed that poor sleep quality was associated with increased internet use, and that interventions to improve sleep quality among internet addicted individuals may also reduce the pathway to depressive symptoms [35].

The study presents the limitations. Since it is of a cross-sectional design it cannot draw any causations out of the variables. Furthermore, the data was self-reported, which can be subject to recall and also social desire bias. The temporal and causal relationships between medical students' internet addiction, sleep quality and depression cannot be elucidated in the present study, and future longitudinal studies are needed.

While such limitations exist, the study presents in a unique manner details of internet addiction, sleep quality and depression in the population of medical students. This supported the idea that there is an urgent need to develop complementary targeted interventions and support systems in educational institutions to deal with the interconnected issues. Healthy sleep habits can be promoted such as sleep hygiene education and cognitive behavioral therapy for insomnia in order to mitigate the negative impact of internet addiction on sleep quality and mental health [36, 37]. Such programs, however, as those aimed at encouraging healthy internet use, time management skills and stress management techniques, may be helpful in helping these medical students cope with the challenges arising both from their academic and personal lives [38, 39].

Additionally, medical schools could integration of mental health services and counseling with medical schools could help provide essential help to students suffering from things like depression, anxiety, and other mental health issues. Early intervention for these conditions might prevent an increase in symptoms and their detrimental effect on academics and overall, wellbeing [40, 41].

Conclusion:

In conclusion, this cross-sectional study has highlighted the significant prevalence of internet addiction, poor sleep quality, and depression among medical students in Saudi Arabia. The findings underscore the complex interrelationships between these factors and the need for comprehensive, multifaceted interventions to address the unique challenges faced by this population. By prioritizing the mental health and well-being of medical students, educational institutions can foster a supportive environment that enables these future healthcare professionals to thrive both academically and personally.

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Ethical approval:

After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

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Conflict of interests:

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

Data and materials availability:

All data associated with this study are present in the paper.

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