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ORIGINAL ARTICLE

Smartphone Usage, Sleep and Depression Among the Students' Community Emerging from the Covid-19 Pandemic: A Cross Sectional Study

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Abstract

Introduction: The COVID-19 pandemic has markedly influenced digital behaviour among college students, resulting in increased reliance on smartphones for academic, social, and recreational purposes. This heightened usage has raised concerns regarding its potential impact on sleep quality and mental health, particularly depression. **Aim:** To estimate the prevalence of problematic smartphone use and examine its association with sleep disturbances and depression among college students in the post-COVID-19 period. **Objectives:** To determine the prevalence of smartphone addiction, identify factors contributing to excessive use, and evaluate its relationship with sleep disturbances and depressive symptoms. **Methodology:** A cross-sectional study was conducted among 729 medical students at ACS Medical College & Hospital from October 2022 to March 2023. Data were collected using validated tools: Smartphone Addiction Scale–Short Version (SAS-SV), Pittsburgh Insomnia Rating Scale (PIRS-20), and Patient Health Questionnaire (PHQ-9). Statistical analysis was performed using SPSS software, with a significance level set at $p < 0.05$. **Results:** Smartphone addiction was observed in 24.55% of participants, with a higher prevalence among males (29.18%). Clinical insomnia was reported in 42.7% of students, while 88.6% exhibited varying degrees of depression, including 6.5% with severe depression. Significant positive correlations were found between smartphone addiction and insomnia ($r = 0.533$), smartphone addiction and depression ($r = 0.532$), and depression and insomnia ($r = 0.727$) ($p < 0.001$). Increased daily screen time, predominant use for social media, and longer duration of smartphone ownership were significantly associated with these outcomes. **Conclusion:** Problematic smartphone use is strongly associated with sleep disturbances and depressive symptoms, underscoring the need for awareness, early identification, and targeted interventions among college students.

Keywords: Mental health, Insomnia, Screen time

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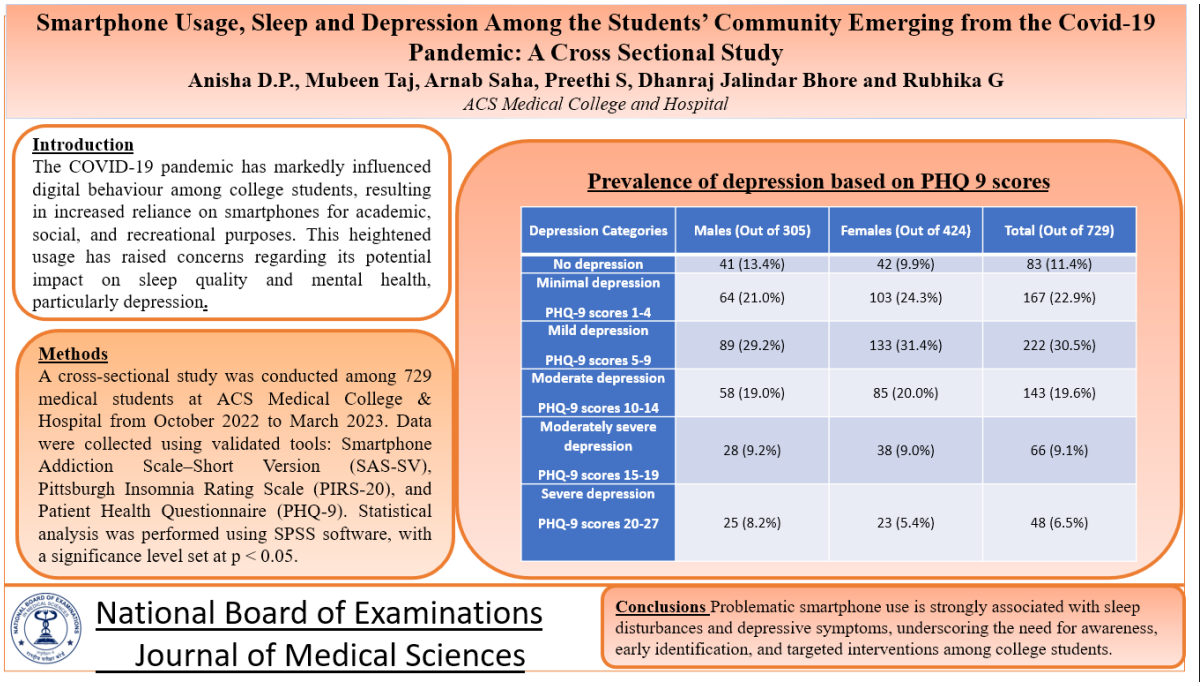
Graphical Abstract



Introduction

The COVID-19 pandemic has significantly altered social, academic, and personal lives, with students being the most affected. This change, with the shift to online classes, saw the number of people using digital gadgets, specifically smartphones, increase significantly [1]. Smartphone usage increased significantly during the pandemic compared to pre-pandemic usage, including the increased use of social media platforms to address the lack of face-to-face interaction during the lockdown [2]. School and college students were restricted from face-to-face classes during the pandemic, with the ASER Report 2022 indicating that the number of people using smartphones increased from 67.6% to 74.8% between 2021 and 2022 [3]. While smartphones serve as vital tools for communication, education, and entertainment, excessive usage has been increasingly associated with negative psychological and physiological effects, including sleep disturbances and depressive symptoms [4,5].

Behavioral addiction can also be seen in the way in which an individual can spend hours on a single activity, as well as in the way in which an individual can function in life, the driving force to continue to participate in the activity, cravings for the activity, inattention to other sources of pleasure and an inability to stop the behavior. A major step forward for the DSM-5 was to formally recognize Gambling Disorder as the first behavioral addiction under the category of Substance-Related and Addictive Disorders [6]. Internet Gaming Disorder has also been recognized in Section III of the DSM-5 the research appendix indicating that this disorder warrants more research to support its inclusion as a behavioral disorder in future editions of the manual once research evidence supports its inclusion. The prefrontal cortex of the brain, which controls planning, decision-making, and impulse control, continues to develop

throughout adolescence and young adulthood; therefore, there are more risks for addictive behaviors to occur during these periods of development [7]. The constant connectedness of smartphones creates FoMO Fear of Missing Out addiction as well as instant gratification, making this a very prevalent problem among young adults who are growing up in a highly technological society. Smartphone addiction being recognized as a behavioral disorder is imperative to create effective interventions to enhance the lives of students [8].

The Annual Status of Education Report (ASER) 2023 (9) highlights significant trends in digital device usage, learning patterns, and mental health concerns among Indian students post-pandemic. However, smartphone overuse among young students has also posed problems such as sleeplessness, physical inactivity, and addiction in many cases. According to the ASER 2023 report, excessive use of smartphones has not only affected the students' concentration but also caused disturbances in their social life and well-being in general. In addition, there are still discrepancies in the availability of digital education opportunities for students with different socio-economic backgrounds, as some of them are unable to combine digital learning and regular lessons. Based on these observations, scholars stress the importance of formulating relevant educational policies aimed at responsible smartphone usage and addressing mental issues associated with increased exposure to screens.

According to the research conducted by experts, prolonged smartphone usage negatively affects sleep due to several reasons. First, as it was mentioned earlier, extended exposure to light emitted by smartphones leads to melatonin deficiency, thus making it harder for people to fall asleep [10,11]. Secondly, obsessive behavior, when a person spends hours engaging with social networks or playing video games, may lead to bedtime delays and nocturnal arousals [12]. On the other hand, poor sleep hygiene has, in its turn, been linked to higher daytime fatigue, cognitive impairment, and emotional instabilities [13].

Apart from disrupting the sleep process, another significant danger to the well-being of an individual caused by excessive mobile phone usage is social isolation, cyberbullying, and academic stress experienced by students as demonstrated by studies undertaken during the period of the pandemic. FoMO is a result of a constant urge to be connected with social media and can cause both anxiety and depression. Lastly, using smartphones to cope with pandemic-related stress may create dependency, leading to vicious cycles of mental issues.

The importance of knowing how the long-term effect of digital dependency brought by pandemic affects people should be considered once students return to regular classrooms. This post-pandemic period serves as an excellent chance for evaluating shifts in the use of smartphones, including any consequences on the quality of sleep and mental well-being [18]. The adoption of measures that would encourage digital detoxification, education about the importance of maintaining proper sleep, and taking care of one’s mental well-being could significantly contribute to a healthier life of students [19]. This study aims to explore the intricate relationship between smartphone

usage, sleep disturbances, and depression among students in the post-pandemic context. By analyzing these interconnections, the research seeks to provide valuable insights that can inform policy recommendations, enhance digital well-being initiatives, and contribute to the broader discourse on student mental health in the digital age.

Aim

To assess the prevalence of problematic smartphone use among college students and examine its association with sleep disturbances and depression in the post-COVID-19 period.

Objectives

1. To determine the prevalence of smartphone addiction among college students.
2. To identify factors associated with excessive smartphone use among college students.
3. To evaluate the relationship between smartphone addiction, sleep disturbances and depression

Methodology

In this cross-sectional study, consenting college students of ACS medical College and Hospital which has 5 faculties on one campus (Faculty of Medicine, Nursing, Pharmacy, Physiotherapy and Allied health sciences) were assessed for problematic smartphone use, sleep and depression between the period of october 2022 to march 2023.The study was approved by the Ethical Committee [IEC Approval No:590/2022/IEC/ACSMCH] at ACS Medical College and Hospital for further proceedings.

Sample size

729 college students were recruited for the study and this was a time bound study

Inclusion criteria

The study included all the students of the Private University who were willing to participate in the study and sign the informed consent.

Exclusion criteria

Students with pre-existing mental illness or chronic medical illness those who were taking medications for any mental or physical health conditions were excluded from the study.

Study Procedure

The study participants were gathered in small groups and given a brief introduction, after which they filled out the necessary questionnaires. A sociodemographic proforma was used to collect details about the participants, such as age, gender, type of family, course enrolled in, presence of siblings, and lifestyle habits (smoking, oral tobacco use, alcohol use). Additionally, smartphone-related variables were recorded, including age at first smartphone use, number of hours used, and the main purpose of smartphone use. The Smartphone Addiction Scale-Short Version (SAS-SV) was used to assess smartphone addiction, the Pittsburgh Insomnia Rating Scale (PIRS-20) was used to evaluate the severity of insomnia, and the Patient Health Questionnaire (PHQ-9) was used to assess depression.

The SAS-SV (Kwon et al., 2013) is a 10-item scale assessing smartphone addiction using a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree).

Scores range from 10 to 60, with higher scores indicating problematic use. Cut-off scores of ≥31 for males and ≥33 for females indicate addiction [20].

The PIRS-20 is a 20-item self-report questionnaire assessing insomnia severity over the past week. It includes 12 items on distress symptoms, 4 on sleep parameters, and 4 on sleep quality. Each item is rated on a 4-point scale (0–3), with total scores ranging from 0 to 60. A score ≥20 indicates clinical insomnia [21].

The PHQ-9 is 9-item depression screening tool scoring DSM-IV criteria from 0 (not at all) to 3 (nearly every day). Scores range from 0 to 27, with higher scores indicating greater depression severity [22].

Statistical Analysis

Data collected in the study was analyzed using SPSS software version 11. For establishing the association between two categories, the Chi-square independence test was employed. A t-test was performed to establish the comparison between means of two groups, while Pearson correlation coefficient was used to establish the statistical relationship between two variables. P-value less than 0.05 was considered statistically significant (Table 1).

Results

Table 1. Distribution of sociodemographic variables among the study participants (N=729)

S. No.	Variable	Category	n (%)
1	Age	18–21 years	634 (87.0)
		22–25 years	95 (13.0)
2	Gender	Female	424 (58.2)
		Male	305 (41.8)
3	Course	MBBS	470 (64.5)
		Nursing	147 (20.2)
		Pharmacy	39 (5.3)
		Physiotherapy	73 (10.0)
4	Type of family	Extended	28 (3.8)
		Joint	165 (22.6)
		Nuclear	536 (73.5)

5	Siblings	Yes No	623 (85.5) 106 (14.5)
6	Birth order (Rank)	Oldest child Middle child Youngest child Single child	277 (38.0) 54 (7.4) 292 (40.1) 106 (14.5)

There were a total of 729 subjects involved in the research, with the majority of the subjects being in the age group of 18-21 years (87%) while others (13%) belonged to the age group of 22-25 years. The female respondents were more (58.2%) as compared to the male respondents (41.8%). With respect to the educational background of the respondents, MBBS was the leading education background for the respondents, accounting for (64.5%), followed by nursing (20.2%), physiotherapy (10.0%) and pharmacy (5.3%) (Table 2).

Table 2. Distribution of usage of smartphone among the study participants (N=729)

S. No.	Variable	Frequency	Percentage
1.	**Usage of Smartphone**		
	Yes	729	100%
2.	**Own a smartphone**		
	Yes	702	96.3%
	No	27	3.7%
3.	**Years of owning a smartphone**		
	3-5 years	201	27.6%
	Less than 3 years	342	46.9%
	More than 5 years	159	21.8%
	Does not own	27	3.7%
4.	**Chief use**		

	Gaming	16	2.2%
	Making calls	214	29.4%
	Online classes	109	15.0%
	OTT platforms	50	6.9%
	Social Media	340	46.6%
5.	**Age at first use**		
	10-15 years	194	26.6%
	Less than 10 years	60	8.2%
	More than 15 years	475	65.2%
6.	**Hours of use on weekday**		
	2 to 5 hours	343	47.1
	Less than 2 hours	179	24.6
	More than 5 hours	207	28.4

All respondents have used smartphones, with 96.3% having one but only 3.7% lacking a personal smartphone. Almost half of them (46.9%) have used smartphones for less than three years, while 27.6% and 21.8% used the devices for 3 to 5 years and more than five years, respectively. The most prevalent activity done by means of smartphones is social media (46.6%), then call usage (29.4%), online learning (15.0%), over-the-top services (OTT) (6.9%), and games (2.2%). Almost all respondents (65.2%) started using smartphones for more than 15 years, while 26.6% and 8.2% started using them from 10 to 15 years and less than 10 years, respectively (Table 3).

Table 3. Prevalence of depression based on PHQ 9 scores.

Depression Categories	**Males (Out of 305)**	**Females (Out of 424)**	**Total (Out of 729)**
No depression	41 (13.4%)	42 (9.9%)	83 (11.4%)
Minimal depression PHQ-9 scores 1-4	64 (21.0%)	103 (24.3%)	167 (22.9%)
Mild depression PHQ-9 scores 5-9	89 (29.2%)	133 (31.4%)	222 (30.5%)
Moderate depression PHQ-9 scores 10-14	58 (19.0%)	85 (20.0%)	143 (19.6%)
Moderately severe depression PHQ-9 scores 15-19	28 (9.2%)	38 (9.0%)	66 (9.1%)
Severe depression PHQ-9 scores 20-27	25 (8.2%)	23 (5.4%)	48 (6.5%)

The depression score for the subjects was measured based on the PHQ-9 scale. The subjects who had no depression accounted for 11.4%, while those with minimal depression, mild depression, and moderate depression were 22.9%, 30.5%, and 19.6%, respectively. Some subjects had more severe cases of depression, and these comprised 9.1% of moderately severe depression and 6.5% of severe depression cases (Table 4).

Table 4. Prevalence of smartphone addiction

Variable	**Frequency**	**Percentage (%)**	**95% C. I**
Males (Out of 305) SAS-SV score >/= 31	89	29.18%	24.14 – 34.63
Females (Out of 424) SAS-SV scores >/= 33	90	21.23%	17.43 – 25.43
Total (Out of 729)	179	24.55%	21.47 – 27.85

The study found that 24.55% of participants met the criteria for smartphone addiction based on SAS-SV scores. Males had a higher addiction rate (29.18%) compared to females (21.23%) (Table 5)

Table 5. Prevalence of clinical insomnia based on PIRS scores

Insomnia categories	Males (Out of 305)	Females (Out of 424)	Total (Out of 729)
No insomnia	170 (55.7%)	248 (58.5%)	418 (57.3%)
Clinical Insomnia PIRS scores >/=20	135 (44.3%)	176 (41.6%)	311 (42.7%)

Clinical insomnia was present in 42.7% of participants, with males (44.3%) showing a slightly higher prevalence than females (41.6%). The remaining 57.3% of participants did not report significant insomnia symptoms (Table 6).

Table 6. Association between PIRS scores and SAS SV scores

Sample size	Variable	Mean	Standard Deviation	Correlation Coefficient (r)	p - Value
729	SAS SV Score	23.86	11.88	1	<0.001*
729	PIRS Score	17.83	13.39	0.533	

* Statistically significant

A statistically significant association ($r = 0.533$, $p < 0.001$) was found between smartphone addiction (SAS-SV scores) and insomnia (PIRS scores) (Table 7).

Table 7. Correlation between PHQ 9 scores and SAS SV scores

Sample size	Variable	Mean	Standard Deviation	Correlation Coefficient (r)	p - Value
729	SAS SV Score	23.86	11.88	1	<0.001*
729	PHQ 9 score	8.10	6.42	0.532	

* Statistically significant

Smartphone addiction was also statistically significantly associated with depression, with a correlation coefficient of r = 0.532 ($p < 0.001$) (Table 8)

Table 8. Correlation between PHQ 9 scores and PIRS scores

Sample size	Variable	Mean	Standard Deviation	Correlation Coefficient (r)	p - Value
729	PHQ 9 score	8.10	6.42	1	<0.001*
729	PIRS Score	17.83	13.39	0.727	

* Statistically significant

A statistically significant association ($r = 0.727$, $p < 0.001$) was found between depression (PHQ-9 scores) and insomnia (PIRS scores) (Table 9).

Table 9. Correlation between hours of use on a weekday and PHQ 9 scores (N=729)

Hours of use	No Dep	Minimal Depression	Mild Depression	Mod Dep	Mod severe Dep	Severe Dep	X^2 (df), p
< 2 hours	42(50.6%)	59(35.3%)	33 (14.9%)	23(16.1%)	8(12.1%)	14(29.2%)	85.73
2 – 5 hrs	31(37.4%)	80(47.9%)	122(54.9%)	68(47.5%)	29(43.9%)	13(27.1%)	(10)
> 5 hours	10(12%)	28(16.8%)	67((30.2%)	52(36.4%)	29(43.9%)	21(43.7%)	<0.001*
Total	83	167	222	143	66	48	

*Statistically significant.

Participants who used their smartphones for more than five hours per day had higher rates of moderate to severe depression compared to those who used them for shorter durations. Minimal and mild depression were more common in participants using smartphones for 2-5 hours per day, while those using smartphones for less than two hours had the lowest depression levels. Hours of use on weekdays was also statistically significantly associated to PHQ-9 scores. ($p<0.001$) (Table 10).

Table 10. Association between chief use of the smartphone and PHQ 9 scores (N=729)

Chief use	No Dep	Minimal Depression	Mild Depression	Mod Dep	Mod severe Dep	Severe Dep	X^2 (df), p
Social media	29(34.9%)	66(39.5%)	108 (48.6%)	72(50.3%)	36(54.5%)	29(60.4%)	34.136 (20) 0.025*
Gaming	2(2.4%)	2(1.2%)	6(2.7%)	2(1.4%)	3(4.5%)	1(2.1%)	
Making calls	31(37.3%)	61(36.5%)	64((28.8%)	37(25.9%)	12(18.2%)	9(18.7%)	
Online classes	16(19.3%)	33(19.8%)	24(10.8%)	22(15.4%)	8(12.1%)	6(12.5%)	
OTT platforms	5(6%)	5(3%)	20(9%)	10(7%)	7(10.6%)	3(6.2%)	
Total	83	167	222	143	66	48	

* Statistically significant

Participants who primarily used smartphones for social media had the highest depression rates, while those who used them for gaming had the lowest. Making calls, online classes, and OTT platform usage also contributed to varying levels of depression, with social media showing the strongest association. There was a statistically significant association between the chief use of smartphones and PHQ-9 scores. (p=0.025) (Table 11).

Table 11. Association between years of owning a smartphone and PHQ 9 scores (N=729)

Years of owning	No Dep	Minimal Depression	Mild Depression	Mod Dep	Mod severe Dep	Severe Dep	X^2 (df), p
No phone owned	5(6%)	7(4.2%)	7 (3.1%)	5(3.5%)	2(3%)	1(20.8%)	31.488 (15) 0.008*
Less than 3 years	49(59%)	96(57.5%)	88(39.6%)	60(4.2%)	29(44%)	20(41.7%)	
3 to 5 years	18(21.7%)	37(22.1%)	71((32%)	49(34.3%)	15(22.7%)	11(23%)	
More than 5 years	11(13.2%)	27(16.2%)	56(25.2%)	29(20.3%)	20(30.3%)	16(33.3%)	
Total	83	167	222	143	66	48	

* Statistically significant

A statistically significant association was found between the duration of smartphone ownership and depressive symptoms, as measured by PHQ-9 scores (p = 0.008). People who owned the smartphones for less than three years and more than five years displayed moderate to severe depression than those who had used the smartphone for three to five years. It is worth noting that people who did not own a smartphone also exhibited depressive conditions (Table 12).

Table 12. Association between chief use of smartphone and SAS-SV scores (N=729)

Chief use	**Addiction**	**No Addiction**	**Total**	**X^2 (df), p**
Social media	111(62%)	229(41.6%)	340	
Gaming	10(5.6%)	6(1.1%)	16	
Making calls	25(13.9%)	189(34.4%)	214	45.919 (4)
Online classes	20(11.2%)	89(16.2%)	109	<0 .001*
OTT platforms	13(7.3%)	37(6.7%)	50	
Total	179	550	729	

* Statistically significant

A significant statistical relationship (p<0.001) between the main reason for using smartphones and the degree of smartphone addiction (SAS-SV results) was detected. The highest levels of smartphone addiction were identified in respondents that use smartphones mostly for social media purposes (62%), as well as for gaming/OTT content. On the other hand, smartphone addiction is relatively low for respondents that use smartphones for phone calling purposes or for attending online classes (Table 13).

Table 13. Association between years of owning a smartphone & SAS-SV scores (N=729)

Years of owning	**Addiction**	**No Addiction**	**Total**	**X^2 (df), p**
No phone owned	8(4.5%)	19(3.4%)	27	10.029 (3)
Less than 3				

years 3 to 5 years	66(36.9%)	276(50.2%)	342	0.018*
More than 5 years	56(31.3%)	145(26.4%)	201	
	49(27.4%)	110(20%)	159	
Total	179	550	222	

* Statistically significant

A statistically significant association (p = 0.018) was seen between years of smartphone ownership and smartphone addiction. Higher addiction rates were observed among individuals who had owned smartphones for less than 3 years and 3–5 years, compared to those who had used them for more than 5 years or did not own a smartphone (Table 14).

Table 14. Association between hours of use of smartphone on a weekday and SAS-SV scores (N=729)

Hours of use	**Addiction**	**No Addiction**	**Total**	**X^2 (df), p**
Less than 2 hours	20(11.2%)	159(28.9%)	179	
2 – 5 hours	73(40.8%)	270(49.1%)	343	51.544 (2) <0 .001*
More than 5 hours	86(48%)	121(22%)	207	
Total	179	550	729	

* Statistically significant

Weekday smartphone usage duration was significantly associated with smartphone addiction (p < 0.001). Participants who used smartphones for more than 5 hours daily were found to have the highest prevalence of addiction (48%) (Table 15).

Table 15. Association between substance use and SAS-SV scores

Substance use	**Addiction**	**No Addiction**	**Total**	**X^2 (df), p**
Alcohol	4 (2.2%)	8 (1.4%)	12	
Oral tobacco	0 (0%)	1 (0.01%)	1	
Smoking	6(3.3%)	4(0.7%)	10	
Smoking, alcohol use	6(3.3%)	5(0.9%)	11	22.095 (5)
Smoking, oral tobacco, alcohol use	4(2.2%)	1(0.2%)	5	<0 .001*
None of the above	159(88.8%)	531(96.5%)	690	
Total	179	550	729	

* Statistically significant

A statistically significant association was seen between substance use and smartphone addiction ($p < 0.001$). While most addicted individuals did not report substance use, the prevalence of addiction was higher among those who consumed substances such as alcohol or smoked (Table 16).

Table 16. Association between type of family and PIRS scores

Type of family	**No insomnia**	**Clinical Insomnia**	**Total**	**X^2 (df), p**
Nuclear	302 (72.2%)	234(75.2%)	536	
Extended	8 (1.9%)	20 (6.4%)	28	14.133 (2)
Joint	108(25.8%)	57(18.3%)	165	<0 .001*
Total	418	311	729	

* - Statistically significant

A statistically significant relationship ($p < 0.001$) was seen between family structure and clinical insomnia (PIRS scores). Clinical insomnia was more frequently observed in participants from nuclear families, followed by those from joint and extended families (Table 17).

Table 17. Association between Years of owning a smartphone and PIRS scores

Years of owning a smartphone	**No insomnia**	**Clinical Insomnia**	**Total**	**X^2 (df), p**
No phone owned	17 (4%)	10(3.2%)	27	
Less than 3 years	212 (50.7%)	130 (41.8%)	342	
3 to 5 years	120(28.7%)	81(26%)	201	16.466 (3) <0 .001*
More than 5 years	69(16.5%)	90(28.9%)	159	
Total	418	311	729	

* Statistically significant

A significant association ($p < 0.001$) was seen between years of smartphone ownership and insomnia. Clinical insomnia was more prevalent in participants who had owned smartphones for less than 3 years or more than 5 years (Table 18).

Table 18. Association between hours of use on a weekday and PIRS scores

Hours of use	**No insomnia**	**Clinical Insomnia**	**Total**	**X^2 (df), p**
Less than 2 hours	128 (30.6%)	51(16.4%)	179	
2 to 5 hours	207 (49.5%)	136 (43.7%)	343	41.121 (2) <0 .001*
More than 5 hours	83(19.8%)	124(39.9%)	207	
Total	418	311	729	

* - Statistically significant

A strong association ($p < 0.001$) was observed between hours of smartphone use on weekdays and clinical insomnia. The highest prevalence of clinical insomnia (39.9%) was reported among those who used smartphones for more than 5 hours daily (Table 18).

Table-19: Association between chief use of smartphone and PIRS scores

Chief use	**No insomnia**	**Clinical insomnia**	**Total**	**X^2 (df), p**
Social media	179(42.8%)	161(51.8%)	340	
Gaming	8(1.9%)	8(2.6%)	16	
Making calls	149(35.6%)	65(20.9%)	214	24.274 (4)
Online classes	63(15.1%)	46(14.7%)	109	<0 .001*
OTT platforms	19(4.5%)	31(10%)	50	
Total	418	311	729	

* Statistically significant

A statistically significant association ($p < 0.001$) between the primary use of smartphones and insomnia. Participants using smartphones mainly for social media or OTT content were found to have the highest rates of clinical insomnia, whereas those using them for calls or academic activities reported comparatively lower rates (Table 20).

Table 20. Association between substance use and PIRS scores

Substance use	**No insomnia**	**Clinical insomnia**	**Total**	**X^2 (df), p**
Alcohol	8 (1.9%)	4 (1.3%)	12	
Oral tobacco	1 (0.2%)	0 (0%)	1	
Smoking	2(0.5%)	8(2.6%)	10	
Smoking, alcohol use	3(0.7%)	8(2.6%)	11	14.106 (5)
Smoking, oral tobacco, alcohol use	1(0.2%)	4(1.3%)	5	0 .015*
None of the above	403(96.4%)	287(92.3%)	690	
Total	418	311	729	

* Statistically significant

A statistically significant relationship ($p = 0.015$) was found between substance use and clinical insomnia. Higher rates of insomnia were reported among participants who used substances such as alcohol, tobacco, or smoked, as compared to those who did not use any substances.

Discussion

This study investigates the prevalence of problematic smartphone use among college students and its associations with sleep disturbances and depression in the context of a post-pandemic world. The findings highlight an escalating concern: excessive smartphone use is not just a behavioural trend but a pressing public health issue with profound psychological implications.

Prevalence and Patterns of Smartphone Use

It was established that 24.55% of respondents had problems with smartphone addiction, with males having a significantly higher percentage of 29.18% than females with 21.23%. This result can be explained by the results of other studies, which show that males use their smartphones more actively when it comes to games and watching videos. As a result, they become addicted to their smartphones more often than women (Kuss & Griffiths, 2015) [23]. This situation can be affected not only by cultural aspects but also by different coping strategies used by people under stress.

The major function of smartphone use was social media, which accounted for 46.6% of the uses, followed by calling, which contributed 29.4%, and online learning, which contributed 15%. It is noteworthy that people preferred using their smartphones for social media, which has been found to be connected with compulsion, instant gratification, and fear of missing out (FoMO). Such phenomena were linked to problematic smartphone use and poor mental health (Elhai et al., 2016; Przybylski et al., 2013) [14-16]. Therefore, the identified trends require a comprehensive examination of the effects of social media use.

It is important to note that smartphone addiction was more prevalent among users who had used smartphones for less than three years and more than five years. In the first case, such users might not have gained sufficient control over themselves and could not use their phones responsibly. On the contrary, users who had used their phones for more than five years might have developed some maladaptive patterns in the process. The observed trend correlates with the findings of Andreassen et al. (2012) about digital behavioural reinforcement [24].

Smartphone Use and Depression

It is noteworthy that depression among participants occurred at different levels; 11.4% did not have any depressive symptoms, while 6.5% suffered from severe depression. There is a statistically significant positive correlation between smartphone addiction and depression ($r = 0.532$, $p < 0.001$), which reveals the mutual effect of high smartphone usage and poor mental well-being. Prolonged engagement in online spaces may increase social isolation, cyberbullying experiences, and distorted social comparison. These factors are widely recognized for their

contribution to depressive symptoms (Twenge et al., 2017) [25].

The results of our study showed that a significant correlation exists between long-term smartphone use, mostly more than five hours a day, and moderate-to-severe depression ($p < 0.001$). This correlation is consistent with the findings of the research studies by Thomée et al. (2011) [26] and Lin et al. (2016) [27].

It is worth mentioning that participants who used their smartphones for social media activities had a greater chance to suffer from depression. The results align with those of previous research conducted by Bányai et al. (2017) [28], where it was shown that social media addiction was positively associated with depression. In turn, people who mostly used smartphones for calling someone and education did not have high scores concerning depression.

Smartphone Use and Sleep Disturbances

The prevalence of clinical insomnia in this study was found to be 42.7%. The significance level of the positive correlation established between insomnia and smartphone addiction was $r = 0.533$ ($p < 0.001$). These results corroborate many previous findings on the negative effect of smartphones on circadian rhythms and melatonin production as a result of blue light emitted by the devices, causing problems with sleep (Carter et al., 2016; Exelmans & Van den Bulck, 2016) [11,29].

Furthermore, a higher level of correlation was detected between depression and insomnia, which is characterized by a correlation coefficient $r = 0.727$ ($p < 0.001$). The strong correlation reflects the well-established clinical connection between the two variables. Importantly, it was found that students who were addicted to using their smartphones and had low-quality sleep were much more prone to experiencing depression than those not having such features. The harmful triad of smartphone addiction, insomnia, and depression emphasizes the necessity for clinical intervention (Alfonsi et al., 2020) [30].

Additionally, those who were using the smartphones for over five hours per day had the highest levels of insomnia cases recorded, with an astonishing rate of 39.9% who suffered from sleeplessness. This is consistent with the findings of Li et al. (2017) [31] that established a dose-response association between screen usage and poor quality of sleep. Social media and OTT content turned out to be the main sources leading to insomnia among the students. This could be linked to the stimulant effect associated with such types of media, as suggested by Demirci et al. (2015) [32].

Sociodemographic and Lifestyle Associations

Results indicated a statistically significant relationship between family background and insomnia, with higher rates of clinical insomnia being reported by those raised in nuclear families ($p<0.001$). It can be presumed that students from such families had less social support or no family supervision at all, which has proven its critical importance when helping people cope with stressors and regulating the use of screens (Chang et al., 2019) [10].

Furthermore, substance use was identified as an indicator of both smartphone addiction and insomnia, implying co-occurrence of several pathological behaviour traits among the

students. Although causation cannot be established on the basis of these results, they correspond with literature claiming that stress management techniques involving substance abuse and high screen usage can be present in one's lifestyle simultaneously (Walsh et al., 2020) [33].

Firstly, one of the key strengths of this research is that it takes a holistic approach in determining the linkages between smartphone addiction, sleep disorders, and depression in a broad sample of college students who lived through the pandemic. The employment of reliable and proven scales, such as the Smartphone Addiction Scale–Short Version (SAS-SV), Pittsburgh Insomnia Rating Scale (PIRS-20), and Patient Health Questionnaire (PHQ-9), allows for obtaining more reliable data. In addition, the study provides useful information about behavioral patterns and how various smartphone-related activities affect health, and it also highlights some sociodemographic factors that put young people at a higher risk of developing digital health issues.

Limitations

There are several limitations in this study. Firstly, since it uses a cross-sectional approach, causal relationship cannot be established. It also makes the research difficult to identify whether there is a cause-and-effect relationship between the use of smartphone and its psychological consequences. Another potential bias might occur from self-reporting, which means that the accuracy of the responses provided by the subjects may be questionable due to their possible tendency to remember inaccurately and to give socially desirable answers. Moreover, the study involved only participants from one private university, which makes it harder to generalize findings to the other contexts. There is also no control over the confounding variables in this research.

Conclusion

This research makes a clear indication on the relationship between smartphone addiction, depression, and insomnia among university students. Given the fact that digital gadgets have been assuming a more prominent position in both educational and social settings, it is imperative to come up with preventive strategies that promote the well-being of students. Since the misuse of smartphones constitutes a changeable factor, there are many chances of preventing such health problems among youth.

Conflict of interest:

The authors declare that there is no conflict of interest regarding the publication of this study.

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Ethical Approval

The study was approved by the Institutional Ethics Committee of A.C.S. medical college and Hospital, and was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki. IEC Approval No:590/2022/IEC/ACSMCH.

Informed Consent

Informed consent was obtained from all participants prior to data collection.

Authors contribution

ADP, AS, PS, RG were involved in the conceptualization, design, and execution of the study, data collection, and statistical analysis. MT as the research guide, provided guidance in study design, supervised the research process, and critically revised the manuscript for intellectual content. All authors have read and approved the final version of the manuscript.

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