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To Study the Prevalence of Smartphone Use Among Adolescents Aged Between 15-18years and to Examine its Association with Sleep Disturbances and Depression In A Post-Pandemic Context

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ABSTRACT

Background: The COVID-19 pandemic has significantly altered digital behaviors among adolescents, leading to increased smartphone usage. Concerns have emerged regarding the relationship between excessive smartphone use, sleep disturbances, and mental health conditions such as depression.

Objective: To assess the prevalence of problematic smartphone use among adolescents aged 15-18 years and examine its association with sleep disorders and depression in a post-pandemic context.

Methods: A cross-sectional study was conducted with 729 adolescents aged 15-18 years. Participants were assessed using the 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, with significance set at $p < 0.05$.

Results: Smartphone addiction was identified in 24.55% of adolescents, with higher prevalence among males (29.18%). Clinical insomnia was observed in 42.7% of participants, while 88.6% exhibited various levels of depression, with 6.5% experiencing severe depression. Significant positive correlations were found between smartphone addiction and insomnia ($r = 0.533$, $p < 0.001$), smartphone addiction and depression ($r = 0.532$, $p < 0.001$), and depression and insomnia ($r = 0.727$, $p < 0.001$). Extended daily smartphone use, social media engagement, and longer ownership duration were significantly associated with higher rates of addiction, insomnia, and depression.

Conclusion: The study demonstrates a significant association between smartphone addiction, sleep disorders, and depression among adolescents. These findings emphasize the urgent need for awareness campaigns, mental health support, and responsible digital usage programs to mitigate the negative effects of excessive smartphone use in this population.

Keywords*: Smartphone addiction; adolescents; sleep disorders; depression; post-pandemic; digital behavior; mental health.*

INTRODUCTION

The COVID-19 pandemic has fundamentally altered social interactions, educational paradigms, and individual behavioural patterns, particularly among the student population. The transition to remote learning environments necessitated an unprecedented reliance on digital technologies, with smartphones emerging as primary devices for educational and social engagement (1). Smartphone utilisation exhibited a significant upward trajectory during the pandemic compared to pre-pandemic periods, encompassing an intensification of social media engagement as a

compensatory mechanism for diminished face-to-face interactions during quarantine measures. Throughout the pandemic, students at both secondary and tertiary educational institutions were confined to virtual learning environments, and as the Annual Status of Education Report (ASER) 2022 indicates, smartphone accessibility escalated from 67.6% in 2021 to 74.8% in 2022 (3). While mobile devices constitute essential tools for communication, educational purposes, and recreational activities, their excessive utilisation has been increasingly associated with detrimental psychological and physiological consequences, including sleep disturbances and depressive symptomatology (4,5).

Behavioural addiction, conceptualised as compulsive participation in rewarding activities despite adverse consequences, has emerged as a growing concern regarding smartphone usage patterns among students. In contrast to substance-related disorders, behavioural addiction pertains to dependencies on activities such as social networking, gaming, and persistent smartphone engagement, which can significantly impair daily functioning and precipitate considerable psychological distress. Behavioural addictions, analogous to substance use disorders, are characterised by diminished self-control, compulsive urges, and reduced engagement in alternative activities, particularly familial relationships (7). Furthermore, during adolescence and early adulthood, the prefrontal cortical circuits responsible for impulse regulation remain incompletely developed, resulting in heightened vulnerability to addictive behaviours (8). The persistent demand for continuous connectivity frequently exacerbates the compulsive characteristics associated with smartphone addiction, Fear of Missing Out (FoMO), and immediate gratification, rendering it a pervasive concern among young adults in contemporary digital society. Recognising and addressing smartphone addiction within the framework of behavioural pathology is imperative for developing efficacious intervention strategies to enhance student wellbeing and mitigate adverse health outcomes.

The Annual Status of Education Report (ASER) 2023 (9) highlights substantial increases in digital device utilisation, altered learning behaviours, and mental health challenges among Indian students in the post-pandemic landscape. This comprehensive survey documents significant increases in smartphone availability among school-aged individuals, particularly in rural regions, where digital learning tools became essential during COVID-19-induced educational institution closures. The intensified reliance on smartphones has generated concerns regarding screen addiction, reduced physical activity, and sleep disruptions among the student population. ASER 2023 further observes that while digital learning constitutes a valuable supplementary educational resource, excessive smartphone engagement has detrimentally affected students' attentional capacity, social interactions, and psychological wellbeing. Moreover, disparities in digital accessibility persist, as students from socioeconomically disadvantaged backgrounds encounter significant challenges in integrating online educational modalities with traditional pedagogical approaches. In response to these findings, experts emphasise the necessity for comprehensive policies that promote responsible digital engagement, enhance awareness regarding the implications of prolonged screen exposure, and provide adequate mental health support services for students navigating the post-pandemic educational environment in India.

The excessive utilisation of smartphones has been extensively documented as a contributing factor to diminished sleep quality. Empirical investigations indicate that prolonged exposure to blue light emissions from digital screens inhibits melatonin production, thereby delaying sleep onset and reducing total sleep duration (10,11). Furthermore, compulsive engagement with digital content, including social media platforms and gaming applications, has been correlated with delayed bedtimes and increased nocturnal awakenings, thereby exacerbating sleep disturbances. Compromised sleep hygiene has subsequently been associated with increased daytime fatigue, cognitive performance decrements, and emotional dysregulation.

In addition to sleep disturbances, inappropriate smartphone usage patterns have been identified as significant risk factors for mental health disorders, particularly depression and anxiety. Research conducted during and subsequent to the pandemic reveals that excessive screen engagement contributes to social isolation, exposure to cyberbullying phenomena, and elevated stress levels among students (14,15). The Fear of Missing Out (FoMO) syndrome, perpetuated by continuous social media interaction, intensifies anxiety and depressive symptomatology (16). The excessive dependence on mobile devices as coping mechanisms for pandemic-related stressors has resulted in heightened dependency behaviours, perpetuating a cycle of psychological distress and maladaptive coping strategies.

Understanding the enduring consequences of pandemic-induced digital dependence is essential as students reintegrate into traditional educational environments. The post-pandemic period presents a unique opportunity to evaluate modifications in smartphone usage patterns and their sustained impacts on sleep quality and mental health parameters (18). Implementation of digital detoxification measures, sleep hygiene education, and mental health interventions is crucial for promoting healthy lifestyle practices among students. Educational institutions and healthcare providers must collaborate to encourage balanced technology utilisation while ensuring adequate mental health support systems are established. This investigation aims to examine the complex interrelationships between smartphone usage, sleep disturbances, and depression among students in the post-pandemic context. This research endeavours to elucidate

associations that can inform policy recommendations, enhance digital wellbeing initiatives, and contribute to the broader discourse on student mental health in the contemporary digital era.

AIM

This study aims to access the prevalence of problematic smartphone usage among college students and identify the variables associated with excessive use and explore the relationship between smartphone use, sleep disturbances, and depression.

MATERIALS AND METHODS

Study Design and Setting

This investigation employed a cross-sectional research design conducted between July and December 2024 within the Attibele region of Bangalore, India. Participants were identified through systematic random sampling methodology across educational institutions representing diverse socioeconomic backgrounds.

Sample Size Calculation

The requisite sample dimensions were determined utilizing finite population calculations. With an estimated smartphone usage prevalence of 30%, confidence intervals set at 95%, and acceptable error margin of 5%, the computation yielded a baseline requirement of 336 subjects. To account for potential data incompletion and participant withdrawal, researchers expanded the target enrollment to 485 adolescents.

Participation Criteria

Eligibility for study inclusion required:

1. Adolescents between 15-18 years of age
2. Voluntary participation with formal authorization from both educational administrators and parents/guardians

Individuals were deemed ineligible if they:

- Had previously diagnosed psychiatric conditions
- Suffered from ongoing medical illnesses
- Were undergoing pharmacological treatment for mental or physical health disorders

Data Collection Process

Research participants were assembled in limited-size cohorts and provided with procedural orientation before completing self-administered assessment instruments. Demographic information was gathered via structured proforma capturing variables including:

1. Age and gender distribution
2. Family structure classification
3. Educational program enrollment
4. Sibling presence
5. Behavioral tendencies (tobacco consumption, alcohol intake)

Smartphone utilization patterns were documented, specifically:

- Age of initial smartphone acquisition
- Daily utilization duration
- Primary purpose of device engagement

Assessment Instruments

Three validated measurement tools were implemented:

Smartphone Dependency Evaluation The Smartphone Addiction Scale-Short Version, developed by Kwon and colleagues (2013), comprises 10 statements assessed on a 6-point response continuum (ranging from "strongly disagree" to "strongly agree"). Cumulative scores span from 10-60, with elevated totals signifying problematic usage patterns. Gender-specific threshold values (≥31 for males; ≥33 for females) indicate addiction likelihood (20).

Sleep Disturbance Measurement The Pittsburgh Insomnia Rating Scale consists of 20 self-reported items evaluating sleep difficulties experienced during the preceding week. The instrument incorporates 12 distress symptom indicators, 4 sleep parameter metrics, and 4 sleep quality evaluators. Each component utilizes a 4-point rating system (0-3), generating aggregate scores between 0-60, with values ≥20 suggesting clinical insomnia manifestation (21).

Depression Assessment The Patient Health Questionnaire-9 features 9 items corresponding to DSM-IV diagnostic criteria, scored from 0 ("not at all") to 3 ("nearly every day"). Total scores range from 0-27, with higher values indicating increased depression severity (22).

Analytical Approach

Data analysis was performed utilizing the Statistical Package for Social Studies software environment. Relationships between categorical variables were examined through Chi-Square Independence testing. Comparison of mean values between distinct participant groups was accomplished via t-test procedures. Pearson's correlation coefficient calculations quantified relationships between continuous variables. Statistical significance was established at $p<0.05$ for all analytical procedures.

RESULTS

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

S. No.	Variable	Frequency	Percentage
1.	**Age**		
	15-16 years	634	87%
	17-18years	95	13%
2.	**Gender**		
	Female	424	58.2%
	Male	305	41.8%
3.	**Type of family**		
	Extended	28	3.8%
	Joint	165	22.6%
	Nuclear	536	73.5%
4.	**Siblings**		
	Yes	623	85.5%
	No	106	14.5%
5.	**Rank**		
	Oldest Child	277	38.0%
	Middle Child	54	7.4%
	Youngest	292	40.1%
	Single child	106	14.5%

The study included 729 participants, with the majority (87%) aged between 15-16 years and a smaller proportion (13%) aged 17-19 years. Female participants (58.2%) outnumbered males (41.8%). The majority (73.5%) came from nuclear families, while 22.6% lived in joint families, and only 3.8% were from extended families. A large proportion (85.5%) had siblings, with 40.1% being the youngest child, 38.0% the oldest, 14.5% single children, and 7.4% middle children.

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		
	Less than 3 years	201	27.6%
	More than 5 years	342	46.9%
	Does not own	159	21.8%
		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 participants reported using a smartphone, with 96.3% owning only 3.7% not having personal ownership. Nearly half (46.9%) had used a smartphone for less than three years, while 27.6% had owned one for 3-5 years and 21.8% for more than five years. The most common primary use of smartphones was social media (46.6%), followed by making calls (29.4%), online classes (15.0%), OTT platforms (6.9%), and gaming (2.2%). Most participants (65.2%) started using smartphones after 15 years, while 26.6% began between 10-15 years, and 8.2% started before 10 years. Regarding daily usage, 47.1% used their smartphones for 2-5 hours on weekdays, 28.4% for more than five hours, and 24.6% for less than two hours.

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%)

Depression was assessed using PHQ-9 scores. Among the participants, 11.4% reported no depression, while 22.9% had minimal depression, 30.5% had mild depression, and 19.6% experienced moderate depression. More severe forms of depression were also observed, with 9.1% classified as having moderately severe depression and 6.5% experiencing severe depression. Males had a slightly higher prevalence of severe depression (8.2%) compared to females (5.4%).

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: 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: 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: Association 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: Association 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: Association 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: 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
Gaming	2(2.4%)	2(1.2%)	6(2.7%)	2(1.4%)	3(4.5%)	1(2.1%)	(20)
Making calls	31(37.3%)	61(36.5%)	64((28.8%)	37(25.9%)	12(18.2%)	9(18.7%)	0.025*
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	

Percentages have been calculated column-wise

* - 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: 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
Less than 3 years	49(59%)	96(57.5%)	88(39.6%)	60(4.2%)	29(44%)	20(41.7%)	(15)
3 to 5 years	18(21.7%)	37(22.1%)	71((32%)	49(34.3%)	15(22.7%)	11(23%)	0.008*
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). Participants who had owned smartphones for less than 3 years and more than 5 years were found to exhibit higher levels of moderate to severe depression compared to those who had used smartphones for 3–5 years. Interestingly, even individuals without smartphones reported depressive symptoms, indicating that other factors might have contributed to their mental health status.

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	45.919 (4)
Making calls	25(13.9%)	189(34.4%)	214	<0 .001*
Online classes	20(11.2%)	89(16.2%)	109	
OTT platforms	13(7.3%)	37(6.7%)	50	
Total	179	550	729	

* - Statistically significant

A statistically significant association (p < 0.001) was observed between the primary purpose of smartphone use and levels of smartphone addiction (SAS-SV scores). Smartphone addiction was found to be most prevalent among participants who primarily used smartphones for social media (62%), followed by those using them for gaming or OTT content. In contrast, lower levels of addiction were reported among those using smartphones mainly for phone calls or attending online classes.

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
Less than 3 years 3 to 5 years	66(36.9%)	276(50.2%)	342	(3)
More than 5 years	56(31.3%)	145(26.4%)	201	0.018*
	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: 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: 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) <0 .001*
Joint	108(25.8%)	57(18.3%)	165	
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 16: 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	16.466 (3)
3 to 5 years	120(28.7%)	81(26%)	201	<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 17: 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: 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	24.274 (4)
Making calls	149(35.6%)	65(20.9%)	214	<0 .001*
Online classes	63(15.1%)	46(14.7%)	109	
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.

DISCUSSION

This investigation examines problematic smartphone utilization prevalence among adolescents aged 15-18 years, exploring its relationship with sleep difficulties and depressive symptoms in post-pandemic circumstances. Our findings indicate that excessive digital device engagement represents not merely a behavioral phenomenon but rather a significant public health concern with substantial psychological ramifications.

Prevalence and Utilization Patterns

Our analysis revealed that 24.55% of participants demonstrated smartphone addiction criteria fulfillment, with males exhibiting markedly higher prevalence (29.18%) compared to their female counterparts (21.23%). These observations align with earlier investigations suggesting male adolescents' greater engagement in high-arousal smartphone activities, particularly gaming and multimedia consumption, potentially contributing to elevated addiction rates (Kuss & Griffiths, 2015)(23). This gender-based disparity may additionally reflect sociocultural influences and divergent stress-management mechanisms across genders.

Social media engagement constituted the predominant smartphone utilization purpose (46.6%), followed by communication (29.4%) and educational applications (15%). The pronounced preference for social media platforms warrants particular attention, as such engagement frequently correlates with compulsive usage behaviors, instant gratification seeking, and Fear of Missing Out (FoMO) phenomena. These behavioral patterns have demonstrated associations with problematic smartphone utilization and adverse mental health outcomes (Elhai et al., 2016; Przybylski et al., 2013)(14)(16). This trend necessitates comprehensive examination regarding social media engagement's impact on holistic wellbeing.

The observation that smartphone addiction demonstrates greater prevalence among individuals reporting either less than three years or exceeding five years of usage suggests a potential U-shaped risk distribution. Novice users may experience self-regulation challenges essential for responsible digital engagement. Conversely, long-term users potentially develop entrenched maladaptive behavioral patterns. This distribution corresponds with previous research examining digital behavioral reinforcement mechanisms (Andreassen et al., 2012)(24), highlighting smartphone utilization complexity across varying user experience durations.

Smartphone Utilization and Depressive Symptomatology

Depressive symptoms manifested across participants with varying severity, with merely 11.4% reporting absence of symptoms while 6.5% experienced severe depression. A statistically significant positive correlation ($r = 0.532$, $p < 0.001$) between smartphone addiction and depression underscores the bidirectional relationship between excessive digital engagement and psychological health deterioration. Prolonged exposure to online environments potentially exacerbates social isolation perceptions, increases cyberbullying vulnerability, and promotes unrealistic social comparisons—factors extensively documented as depression contributors (Twenge et al., 2017)(25). This highlights the urgent necessity for addressing digital behavioral patterns' impact on psychological wellbeing.

Our findings demonstrated significant correlation between extensive smartphone utilization—particularly exceeding five daily hours—and moderate-to-severe depression ($p < 0.001$). This observation corresponds with investigations by

Thomée et al. (2011)(26) and Lin et al. (2016)(27), indicating excessive screen exposure potentially disrupts emotional regulation processes and intensifies psychological distress, particularly among young adults.

Notably, participants primarily utilizing smartphones for social media engagement reported highest depression levels. This observation aligns with Bányai et al.'s (2017)(28) research establishing robust connections between problematic social media utilization and depressive symptomatology. Contrastingly, individuals primarily engaging with smartphones for communication or educational purposes demonstrated comparatively reduced depressive symptoms. This suggests activity nature substantially influences psychological wellbeing outcomes.

Smartphone Utilization and Sleep Disruption

Clinical insomnia prevalence reached 42.7% among study participants. A significant positive correlation emerged between insomnia and smartphone addiction ($r = 0.533$, $p < 0.001$). This finding corresponds with numerous investigations indicating smartphone utilization, particularly preceding bedtime, disrupts circadian rhythms and inhibits melatonin production through blue light exposure. Such disruptions potentially result in delayed sleep onset and diminished sleep quality (Carter et al., 2016; Exelmans & Van den Bulck, 2016)(11)(29).

Furthermore, a stronger correlation was observed between depression and insomnia ($r = 0.727$, $p < 0.001$), reinforcing the well-established clinical association between these conditions. Students exhibiting both elevated smartphone addiction levels and compromised sleep quality demonstrated significantly increased likelihood of experiencing depressive symptoms. This suggests a detrimental interconnection among smartphone addiction, sleep disturbance, and depression, emphasizing urgent clinical intervention necessity (Alfonsi et al., 2020)(30).

Additionally, participants utilizing smartphones exceeding five daily hours exhibited highest insomnia incidence, with 39.9% reporting sleep disturbances. This finding aligns with Li et al.'s (2017)(31) research identifying dose-dependent relationships between screen exposure duration and sleep quality. Social media and over-the-top (OTT) content consumption emerged as primary insomnia contributors. This may reflect inherently stimulating and addictive characteristics within these media formats, as highlighted by Demirci et al. (2015)(32).

Sociodemographic and Lifestyle Associations

Our investigation revealed significant associations between family structure and insomnia manifestation ($p < 0.001$), with nuclear family participants reporting elevated clinical insomnia levels. This trend potentially indicates diminished social support networks or reduced parental oversight, factors demonstrated to significantly moderate stress responses and influence screen utilization patterns (Chang et al., 2019)(33).

CONCLUSION

This investigation presents compelling evidence regarding interconnections between smartphone addiction, depression, and insomnia among adolescents aged 15-18 years. As digital technologies increasingly permeate academic and social environments, implementing preventive strategies and establishing supportive infrastructures becomes essential for promoting adolescent wellbeing. Recognizing excessive smartphone utilization as a modifiable risk factor potentially enables significant alleviation of mental health burdens and sleep disorders among young populations.

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