

Smartphone Addiction, Daytime Sleepiness and Depression among Undergraduate Medical Students: A Cross-sectional Study in a Medical College of Kolkata, India

Nirmalya Manna, M.D., Shibasish Banerjee, M.D., Ankush Banerjee, M.D., Arup Chakraborty, M.D., Debasis Das, M.D.

Department of Community Medicine, Medical College, Kolkata, India.

ABSTRACT

Objective: Smartphone addiction has become an emerging problem among the youth, especially among medical students in India. It has the potential to hamper their sleep quality as well act as a precipitating factor for depression. This study thus assessed the magnitude of smartphone addiction, excessive daytime sleepiness and depression among undergraduate medical students in Kolkata and elicited its determinants.

Materials and Methods: This cross-sectional study was conducted among 204 undergraduate medical students in a selected medical college of Kolkata from March to June 2023. Smartphone addiction, daytime sleepiness and depression were assessed using the SAS-SV, EPSS and PHQ-9 questionnaires. Logistic regression analysis was undertaken to determine the associated factors of smartphone addiction, while Spearman's correlation coefficient was estimated to find the relationship of smartphone addiction with depression and daytime sleepiness.

Results: Approximately 29.4% participants were addicted to smartphone, 45.5% were suffering from excessive daytime sleepiness. The depression scores on the PHQ-9 scale showed a mean value of 8.15 (± 4.72). Factors significantly associated with smartphone addiction were increasing age (AOR=1.23, 95%CI=1.12-2.21), male gender (AOR=2.12, 95% CI=1.36-3.45) and duration of smart phone usage >6 hours per day (AOR=1.92, 95%CI=1.23-2.45). Smartphone addiction showed positive correlation with both daytime sleepiness ($\rho = 0.5$, p-value<0.05) and depression ($\rho = 0.23$, p-value=0.001)

Conclusion: Utmost care should be taken for promoting good mental health and wellbeing among medical students. Motivation and counselling sessions along with peer support groups can help in combating this addictive behaviour and depressive symptoms.

Keywords: Depression; excessive sleepiness; medical students; smartphone addiction (Siriraj Med J 2023; 75: 800-808)

INTRODUCTION

With the advancement of artificial intelligence and technology over the past decade, smartphones have become an indispensable entity in our daily life. A smartphone is characterized not only by its conventional utilities of communication but also consists of sophisticated software, internet, and multimedia functionality. The Telecom Regulatory Authority of India has reported

the wireless telephone density to be 82.57% as on 31st December 2022.¹ Recent trends in smartphone market analysis predicts a growth of smartphone market size from 1.45 in the year 2023 to 1.78 in 2028² The rapid escalation in India has been boosted by “Digital India” initiative launched by the government to ensure the availability of government's services electronically via smartphone and internet to its citizens.³

Corresponding author: Ankush Banerjee

E-mail: ankush.banerjee20@gmail.com

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ORCID ID: <http://orcid.org/0000-0003-2762-123X>

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Gambling addiction has been classified under “substance-related and addictive disorders.” as per the latest version of Diagnostic and Statistical Manual of Mental Disorders (DSM-5)^{4,5} Smartphone addiction is often characterized by the presence of the following elements: functional impairment, compulsive behavior, withdrawal, and tolerance. These characteristics bear quite similarities with the DSM-5 criteria of substance use and addictive disorders.⁶ Thus, psychologists often opine an irrational overuse of smartphones to be denoted as smartphone addiction which has high propensity in becoming one of the most prevalent forms of addictions.⁷

A major proportion of smartphone users comprises college-going young adults; especially medical students, who utilize their smartphone not only for communication and recreational purposes, but also as an educational tool in their vast medical curriculum. Research work suggests that smartphone has become such a significant part in a student's life that they do not necessarily realize their level of dependence on it.⁸ Smartphone addiction can have adverse effects on the health and well-being of an individual as it can precipitate physical ailments (neck and wrist pain and accidents) as well as behavioral problems (depression).⁹ It can also interfere with academic performances, reduce social interactions, cause negligence in personal life and form an important environmental factor disturbing quality sleep, thus leading to lethargy and excessive sleepiness during daytime working hours. Sleep restoration has shown a strong relationship with better physical, cognitive, and psychological well-being in adults, adolescents, as well as in children. Good quality sleep is thus an essential entity in a student's life as poor sleep quality increases the risk of physical and mental disorders.¹⁰⁻¹²

Unfortunately, medical students are exposed to high levels of stress right from the beginning of their course, and this makes them highly vulnerable to sleep deprivation. Smartphone addiction if present in these students might aggravate this problem and have impact on their sleep quality. Lack of sufficient sleep often leads to undesired consequences like medical errors, job burnout and depression.¹³ In addition, the emergence of the COVID-19 pandemic has shown an increase in the mode of virtual learning which has the potential to initiate a vicious cycle of smartphone addiction, sleep deprivation and mental distress. Moreover, previous studies in Asia have opined smartphone addiction acting as a defense mechanism to compensate for sadness, boredom and other mental health disorders.¹⁴ A previous study among medical students in Thailand have demonstrated 11.1% of participants suffering from depression which highlighted

the relationship between smartphone addiction and depression among medical students.¹⁵ There is dearth of literature in this domain among undergraduate medical students in the city of Kolkata, especially after the emergence of the pandemic. With this backdrop, this study envisaged to assess the magnitude of smartphone addiction, excessive daytime sleepiness, and depression among undergraduate medical students of a medical college in Kolkata and elicit its associated determinants.

MATERIALS AND METHODS

This cross-sectional study was conducted from March to June 2023 among undergraduate medical students of Medical College and Hospital, Kolkata. Data were collected from the study participants from April to May 2023. The study was conducted after taking clearance from Institutional Ethics Committee for Human Research of Medical College and Hospital, Kolkata (Approval ID: MC/KOL/IEC/NON-SPON/1832/04/2023 dated: 05/04/2023). Participants who did not give written informed consent or were absent during the data collection phase were excluded from the study.

Sampling

A previous study conducted by Nowreen N et al⁴ among undergraduate medical students of SKIMS Medical College, Srinagar, India showed the prevalence of smartphone addiction to be 34.4% Considering $P=0.344$ (34.4%), $Z_{1-\alpha}=1.96$, $Q=1-P$ and absolute error of precision (L) to be 8% (0.08), the minimum sample size was estimated using the $(Z_{1-\alpha})^2 PQ/L^2$, which comes to be 135.¹⁶ Since simple random sampling was not done, a design effect of 1.5 was added and the final sample size came to be 204.

Multistage probabilistic sampling technique was used to select the study participants. Students were distributed into 5 groups according to their academic year of study. (1st year, 2nd year, 3rd year, 4th year and internship period). Data regarding total number of students present in each of the academic years was collected from the college registers and line listing was done. At first, the total number of students required from each academic year was calculated according to proportionate allocation as per the sample size. Then after calculating the requisite number of participants from each year, in the 2nd stage, participants from each year were selected through simple random sampling by computer generated random number tables

Data collection, study tools and parameters used

On the day of data collection, the investigators explained the purpose & procedure of the study elaborately

to the participants and written informed consent was taken from them. They were assured of the confidentiality of the data. The study was conducted via face-to-face interview with the study participants with the help of a pre-designed pre-tested self-administered questionnaire. Pre-testing of the questionnaire was done among 30 students of a different medical college who were not included in the study. Reliability of the questionnaire was checked by estimating Cronbach's alpha coefficient while face and content validity of the questionnaire were checked by public health experts. The questionnaire consisted of the following domains:

- a) Socio-demographic characteristics like age in completed years, gender, per-capita monthly family income, place of residence
- b) Smartphone usage characteristics like duration of usage in completed years, average hours used per day, number of apps present in smartphone, purpose of use of smartphones.
- c) Presence of smartphone addiction was assessed by the validated Smartphone Addiction Scale-Short Version (SAS-SV) consisting of 10-items. This 10-item self-report instrument addressed the following 5 content areas: Daily-life disturbance, withdrawal, cyberspace-oriented relationship, overuse, and tolerance. For each item, participants expressed their opinion on a 6-point Likert scale ranging from '1' for 'strongly disagree' to '6' for 'strongly agree'. Total scores range from 6 to 60 with increasing scores indicating increasing addiction. Males were considered to be addicted to smartphones if scores were higher than 31 while females were addicted if scores were higher than 33.^{17,18}
- d) Presence of excessive daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS) consisting of 8-items. Participants could give their response in a 4-point Likert scaling pattern ranging from 'would never nod off' as '0' to 'high chance of nodding off' as 3. Total scores thus range from 0 to 24, higher scores indicating increasing chances of excessive daytime sleepiness. Moreover, if a person scored 11 or more out of 24, he/she was considered as having excessive daytime sleepiness.^{19,20}
- e) Presence of depression among the study participants was assessed by the Patient Health Questionnaire-9 (PHQ-9) which consisted of 9-items. Participants gave their responses in a 4-point Likert scaling pattern ranging from '0' for 'Not at all' to '3' for 'Nearly every day'. Total scores thus ranged from 0 to 27 with higher scores indicating increasing depression. The scores were also categorized as follows: 0-4 as minimal

depression, 5-9 as mild depression, 10-14 as moderate, 15-19 as moderately severe and 20-27 as severe depression.²¹

Data analysis

Data were analyzed using Microsoft Excel (v.2019) and SPSS (version 16.0 IBM Corp. USA). Continuous data were denoted as mean ($\pm$ standard deviation) or as median with interquartile range, whereas categorical data were expressed as number with percentages. Kolmogorov-Smirnov and Shapiro-Wilk test were performed to test the normal distribution of the data. Multicollinearity among the variables was excluded by estimating variance inflation factor ($VIF > 10$). Factors associated with smartphone addiction were analyzed using univariate and multivariable binary logistic regression models. Only the biologically plausible significant variables in the univariate analysis (p -value < 0.05 at 95% confidence interval) were included in the final multivariable model. Pearson's or Spearman correlation coefficient (whichever applicable) was estimated to find out the relationship between excessive sleepiness and depression with smartphone addiction among the study participants.

RESULTS

Socio-demographic characteristics of the study participants

Among 204 study participants, the median age was 20 years (IQR=19-21 years). Approximately 72% of the participants were males, 141 (69.1%) resided in urban areas while 148 (72.5%) participants lived in hostel premises of the institute. The median per-capita income of the study participants was ₹12500 (IQR= ₹6250-₹22500). A major proportion (65.2%) of participants belonged to Class I socio-economic status as per modified BG Prasad scale 2022.²² Other socio-demographic characteristics have been described in detail in [Table 1](#).

Smartphone usage characteristics of the study participants

Approximately 38% of the participants have used a smartphone for a duration of 3-5 years, 90 (44.1%) participants utilize their smartphones for 4-6 hours duration per day. Approximately 46% of the participants had 11-20 apps in their smartphones. Other smartphone usage characteristics of the participants have been described in detail in [Table 1](#).

Smartphone addiction, daytime sleepiness, and depression among the study participants

The total scores of the SAS-SV scale had a median value of 27 (IQR=21-34), 60 (29.4%) participants were found to be addicted to their smartphones ([Table 2](#)).

TABLE 1. Socio-demographic and smartphone usage characteristics of the study participants (n=204).

Variables	Categories	Frequency (%)
Gender	Male	147 (72.1)
	Female	57 (27.9)
Type of residence	Urban	141 (69.1)
	Rural	63 (30.9)
Living in hostel premises	Yes	148 (72.5)
	No	56 (27.5)
Socio-economic status (as per modified BG Prasad scale 2022)	Class I	133 (65.2)
	Class II	39 (19.1)
	Class III	12 (5.9)
	Class IV	14 (6.9)
	Class V	6 (2.9)
Duration of smartphone usage (in completed years)	< 3 years	57 (27.9)
	3-5 years	78 (38.2)
	6-8 years	41 (20.1)
	> 8 years	28 (13.7)
Average hours of smartphone usage per day	< 4 hours	57 (27.9)
	4-6 hours	90 (44.1)
	7-9 hours	36 (17.6)
	>9 hours	21 (10.3)
Purpose of smart phone usage*	Educational tool	183 (89.7)
	Playing games	72 (35.3)
	Using social media	140 (68.6)
	Watching movies	99 (48.5)
	Taking photos	112 (54.9)

*multiple response

The daytime sleepiness scale scores showed a median value of 10 (IQR=7.25-13), 45.6% (n=93) participants were found to have excessive daytime sleepiness. The depression scores on the PHQ-9 scale showed a mean value of 8.15 (± 4.72). 53(26%) had moderate levels of depression, 15(7.4%) had moderately severe depression and 5(2.5%) were having severe levels of depression. (Fig 1)

Factors associated with smartphone addiction among the study participants

Multivariable logistic regression analysis showed that increasing age (AOR=1.23, 95%CI=1.12-2.21), male gender (AOR=2.12, 95% CI=1.36-3.45) and duration of smart phone usage >6 hours per day (AOR=1.92, 95%CI=1.23-2.45) were significantly associated with the presence of smartphone addiction among the study participants. The non-significant Hosmer-Lemeshow test (p-value>0.05) indicated goodness of fit of the multivariable model,

while 26-38% of the variance of the outcome variable could be explained by this multivariable model. (Table 3)

Correlation between smartphone addiction with daytime sleepiness and depression scores

Spearman's correlation coefficient (ρ) was estimated to find the relationship of smartphone addiction with daytime sleepiness and depression scores. Smartphone addiction and sleepiness scores showed moderate positive correlation between them which was found to be statistically significant ($\rho=0.5$, p-value <0.001) (Fig 2). However, there was mild significant positive correlation between smartphone addiction and depression scores ($\rho=0.23$, p-value=0.001) (Fig 3).

DISCUSSION

Medical students are the future backbone of the healthcare infrastructure of any country, thus care of their

TABLE 2. Responses of the study participants on the SAS-SV questionnaire (n=204).

Statements	Strongly disagree N (%)	Disagree N (%)	Weakly disagree N (%)	Weakly agree N (%)	Agree N (%)	Strongly agree N (%)
I have missed a planned work due to smartphone use	33 (16.2)	44 (21.6)	20 (9.8)	50 (24.5)	38 (18.6)	19 (9.3)
I am having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	27 (13.2)	61 (29.9)	37 (18.1)	30 (14.7)	28 (13.7)	21 (10.3)
Feeling pain in the wrists or at the back of the neck while using a smartphone	55 (27.0)	68 (33.3)	25 (12.3)	29 (14.2)	20 (9.8)	7 (3.4)
I won't be able to stand not having a smartphone	48 (23.5)	57 (27.9)	25 (12.3)	23 (11.3)	32 (15.7)	19 (9.3)
I feel impatient and fretful when I am not holding my smartphone	66 (32.4)	69 (33.8)	27 (13.2)	26 (12.7)	10 (4.9)	6 (2.9)
I have my smartphone in my mind even when I am not using it	73 (35.8)	64 (31.4)	39 (19.1)	20 (9.8)	4 (2.0)	4 (2.0)
I will never give up using my smartphone even when my daily life is already greatly affected by it.	66 (32.4)	64 (31.4)	26 (12.7)	23 (11.3)	19 (9.3)	6 (2.9)
I constantly check my smartphone so as not to miss conversations between other people on Twitter or Facebook	66 (32.4)	56 (27.5)	26 (12.7)	22 (10.8)	20 (9.8)	14 (6.9)
I use my smartphone longer than I had intended	19 (9.3)	35 (17.2)	14 (6.9)	42 (20.6)	64 (31.4)	30 (14.7)
The people around me tell me that I use my smartphone too much.	36 (17.6)	58 (28.4)	30 (14.7)	28 (13.7)	32 (15.7)	20 (9.8)

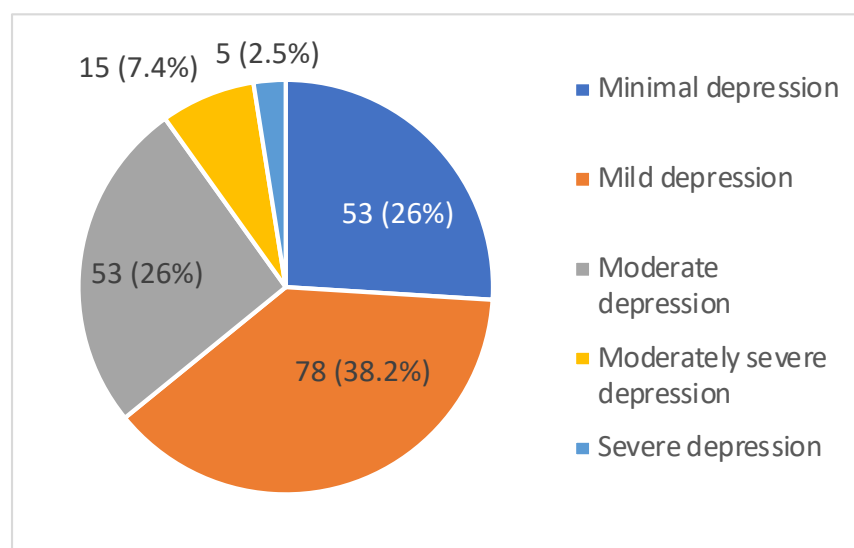
**Fig 1.** Pie Diagram showing pattern of depression among the study participants (n=204).

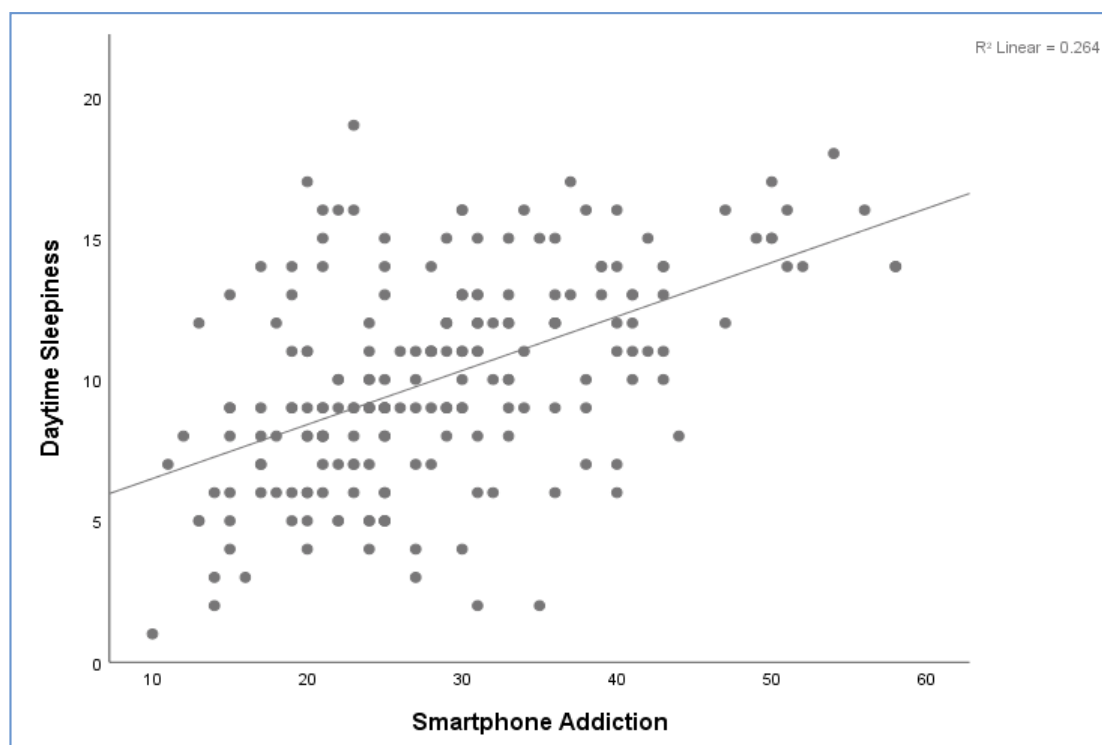
TABLE 3. Factors associated with presence of smartphone addiction among the study participants: Univariate and multivariable binary logistic regression analysis (n=204).

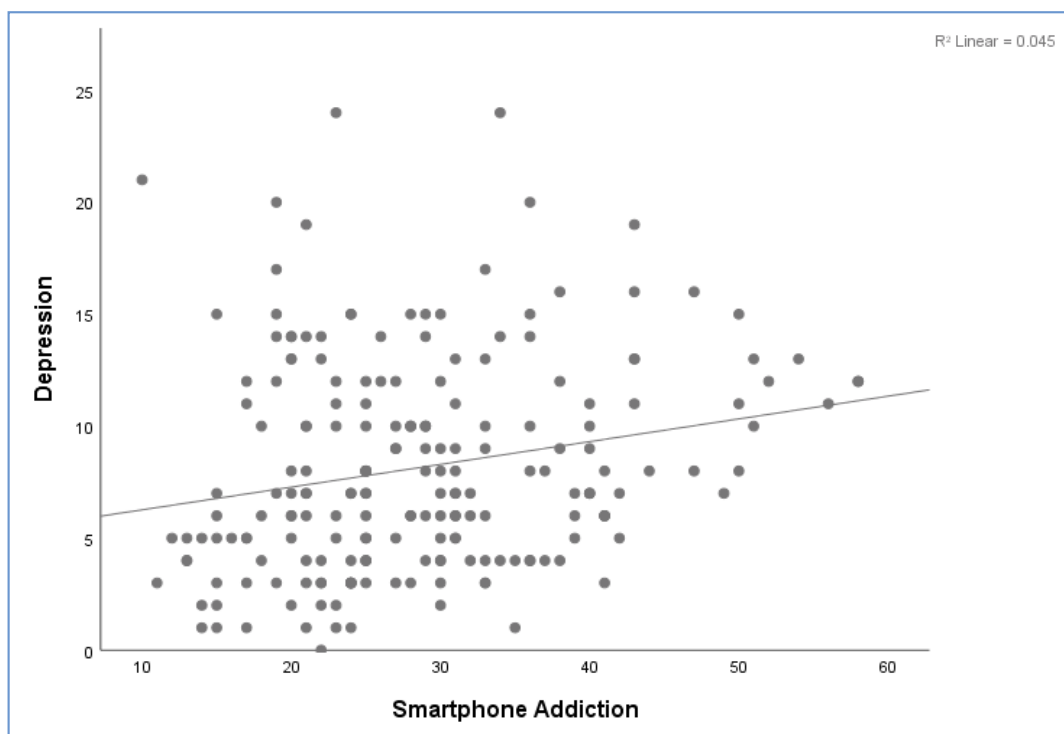
Variables	Categories	OR (95% CI)	P-value	AOR (95% CI)	P-value
Increasing age*		1.46 (1.23-2.45)	<0.001	1.23 (1.12-2.21)	0.012
Gender	Male	2.63 (1.95-4.23)	<0.001	2.12 (1.36-3.45)	0.023
	Female	1 (Ref)		1 (Ref)	
Residence	Urban	1.23 (0.88-1.63)	0.231	--	--
	Rural	1(Ref)		--	
Socio-economic status (as per modified BG Prasad scale 2022)	Class I	2.12 (1.21-3.14)	0.005	1.82 (0.92-2.41)	0.091
	Below Class I	1 (Ref)		1 (Ref)	
Duration of smartphone usage in years	≤5 years	2.1 (1.32-2.82)	0.001	1.56 (0.8-2.11)	0.102
	> 5 years	1 (Ref)		1 (Ref)	
Hours of smartphone usage per day	≤6 hours	1 (Ref)	<0.001	1 (Ref)	0.012
	> 6 hours	2.65 (1.92-3.65)		1.92 (1.23-2.45)	

*continuous variables

OR=Odds Ratio, CI=Confidence interval

Hosmer-Lemeshow test of significance = 0.12

Cox and Snell R²=0.26 and Nagelkerke's R²=0.38 $\rho=0.5$, p-value<0.001**Fig 2.** Scatter plot showing correlation between smartphone addiction and daytime sleepiness among the study participants [n=204].



$\rho=0.233$, $p\text{-value}=0.001$

Fig 3. Scatter plot showing relationship between smartphone addiction and depression among the study participants [n=204].

mental health and wellbeing is of utmost importance. This study made a unique attempt in the state of West Bengal by determining the levels of smartphone addiction, daytime sleepiness, and depression among undergraduate medical students of a selected medical college in Kolkata. Moreover, a novel aspect was explored by determining the relationship between smartphone addiction with daytime sleepiness and depression among the study participants. Almost one-third of participants were found to have smartphone addiction which is quite alarming and shows the increasing levels of dependency on internet, technology, and artificial intelligence in the current scenario.

A study was conducted in a medical college of Durgapur, West Bengal by Choudhury S et al where 19.4% of males and 11.1% of females were found to be addicted to smartphones.²³ Another study among nursing students in Nadia, West Bengal by Ghosh T et al found approximately 50% of their participants having smartphone addiction.²⁴ A study conducted by Senthuraman AR et al among undergraduate students pursuing medical education in Andaman and Nicobar Islands found an alarming proportion of 85.4% of students to be addicted to their smartphones.²⁵ However, in contrast, the current study utilized the validated SAS-SV questionnaire for assessing addiction to smartphones and determined 29.4% of medical students having smartphone addiction.

Age was found to be a significant predictor of smartphone addiction as older participants were found to have high risk of smartphone addiction as compared to their younger counterparts. Age and year of academic year of medical curriculum were found to be multicollinear, hence academic year was excluded from the multivariable regression model to reduce confounding. Students in final years of the MBBS curriculum generally comprise the older age group of the participants. There is increased burden of subjects in the final years which often requires increased amount of studying not only from textbooks but also from the internet. Moreover, students in final years and internship periods often concentrate on preparing for postgraduate entrance examinations which often compels them to spend large hours on their smartphones. This predisposes them to develop dependency on these devices. However, discordant findings were found from a study conducted in Jammu and Kashmir, India by Nowreen N et al where younger participants were found to have increasing smartphone addiction.⁴

Male gender emerged as an important factor associated with the presence of smartphone addiction among the study participants. Concordant findings were found in a study conducted by Chatterjee S et al among medical students of a north Indian medical college where approximately 46% males were found to be addicted to their smartphones in comparison to 33% of females.²⁶

Another predictor for the presence of smartphone addiction was also elicited in the current study in the form of hours of smartphone usage per day. The study conducted by Choudhury S et al in West Bengal also demonstrated total hours of smartphone usage to be associated with presence of smartphone dependence among medical students.²³

Depression among medical students has gained increasing importance nowadays which often gets precipitated by the burden of the vast medical curriculum. A systematic review and metanalysis by Dutta G et al demonstrated the pooled prevalence of depression among undergraduate medical students in India to be 50%.²⁷ However, the current study detected approximately 74% of the participants suffering from some amount of depression ranging from mild to severe levels. Similar findings were reported in a study conducted by Santander-Hernandez FM et al in Peru among medical students during the COVID-19 pandemic where 78.4% students were suffering from depression. They also demonstrated addictive smartphone usage to be significantly associated with the presence of depressive symptoms among medical students.²⁸ Concordance was also detected in the current study as smartphone addiction was found to have positive relationship with the presence of depression among the study participants.

Smartphone addiction often compels students to spend long hours on their devices due to which they often remain awake for long hours during night-time. This hampers their sleep quality which often precipitates lethargy and sleepiness during daytime working hours. The current study also assessed for the presence of excessive daytime sleepiness among the study participants by which 45.6% were found to have excessive daytime sleepiness. A study conducted by Dagneu B et al among medical students in Ethiopia showed slightly less proportion (31%) of excessive daytime sleepiness among the participants as compared to the current study.²⁰ Mild positive correlation between smartphone addiction and daytime sleepiness was found in the current study. The study conducted in Jammu and Kashmir, India by Nowreen N et al showed concordant findings where positive correlation was found between smartphone addiction and sleep quality.⁴

Limitations

Since this study was cross-sectional in nature, establishment of causality between the different factors and the outcome variable could not be achieved. Moreover, as this was a single institution-based study, the results might not be generalizable to the community, thus compromising the external validity of the results. Some of the responses were recall-based, hence bias might be possible.

Conclusion and recommendations

A significant proportion of participants were found to have smartphone addiction which nowadays has become an important public health issue. Sleep quality often gets hampered leading to excessive lethargy and sleepiness during working hours. Nearly half of the participants were found to be suffering from excessive daytime sleepiness which is quite alarming. Thus, medical students need to be motivated and counselled regarding the adverse effects of smartphone over usage. Dissemination of appropriate information through faculty and peer groups will also help in the long run. Peer group support systems can help in reducing the burden of depression and addictive smartphone usage which in turn will help in promoting good mental health and wellbeing among them. Further research through qualitative exploration in multicentric settings is needed on this domain which can help in improve the mental health and well being of the future Indian medical fraternity.

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Conflict of interest

The authors declare no conflict of interests

Data availability statement

All the data supporting the results reported in the current study are available upon reasonable request to the corresponding author.

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