International Journal of Research in Medical Sciences
Haque S et al. Int J Res Med Sci. 2024 Oct;12(10):3737-3746
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20242934

Original Research Article

Effect of smartphone use on sleep and mental health status of Indian medical students: a cross-sectional study

Shiraza Haque[1], Shraddha Singh[1]*, Jagdish Narayan[1], Adarsh Tripathi[2], Manzoor Ahmad[3], Toyaj Kumar[1], Shivam Verma[4]

[1]Department of Physiology, King George's Medical University, Lucknow, Uttar Pradesh, India
[2]Department of Psychiatry, King George's Medical University, Lucknow, Uttar Pradesh, India
[3]Department of General Surgery, TSM, Lucknow, Uttar Pradesh, India
[4]Department of Physiology, Prasad Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Received: 27 July 2024
Revised: 07 September 2024
Accepted: 09 September 2024

***Correspondence:**
Dr. Shraddha Singh,
E-mail: drshraddhasingh@yahoo.com,

ABSTRACT

Background: In today's digital era, technology plays an integral role in daily life, particularly among students facing significant health challenges associated with increased screen time. The increased screen usage has been linked to deteriorating physiological and psychological well-being, contributing to physical inactivity, and a sedentary lifestyle, leading to serious health conditions such as obesity, depression, and disrupted sleep patterns. Medical students are particularly susceptible to these effects due to prolonged screen use, which compromises both their mental and physical health and increases the risk of addiction. This study aims to explore the impact of digital screen time on sleep quality, cardiometabolic health, and mental health conditions such as depression, anxiety, and stress among medical students.
Method: A cross-sectional study was conducted at the Department of Physiology, KGMU, Lucknow, involving 113 medical students. Data collection utilized a structured questionnaire alongside validated instruments: PSQI for sleep quality assessment, DASS21 for psychological distress evaluation, and SAS-SV for smartphone addiction screening.
Results: The findings revealed that participants reported high average smartphone usage (8.84±10.62 years) and screen time (49.98±15.17 hours weekly). Statistical analysis demonstrated significant associations between smartphone dependency ($p<0.0001$), psychological distress ($p<0.0001$), and compromised sleep quality (Global PSQI score: 6.87±3.84) highlighting prevalence of disrupted circadian rhythms and compromised health.
Conclusion: This study highlights the critical need for guidelines on screen usage based on age, lifestyle, and professional demands and regulating screen use early can mitigate its detrimental health consequences, including disturbed sleep and mental health.

Keywords: Screen time, Sleep quality, Mental health, Smartphone addiction.

INTRODUCTION

We are currently living in an era where technology is the most crucial part of everyone's life and we need this to survive, cope, and compete in this juggling world. Thus, playing a pivotal role in every aspect of life irrespective of age, gender, occupation, geographic distribution, etc. with different purposes. If we shift focus to the younger generation, they are seen to be more regularly using electronic media with access to a wide range of digital devices or gadgets that can be used in leisure or for work. Technological advancements are leading children and adolescents to excessive screen time, surpassing the

recommended limit of 2 hours per day, negatively influencing physical activity, fitness, level of adiposity, and hormonal changes.[1] With increasing concerns of physical inactivity and a sedentary lifestyle, associated negative health outcomes can be observed with increased prevalence which include obesity, depression, and disrupted sleep patterns leading to various health conditions, and compromised psychosocial wellbeing.[2-4] Sedentary behaviors involving screen use pose greater health risks than general sedentary activities.[5]

Smartphones, integrated seamlessly into daily life, are used extensively by young adults, with some spending four to eight hours daily performing leisure activities, academic purposes, or office work thereby reducing sleep quality and increasing the undue burden of mental health problems like depression, anxiety, etc.[6] Prolonged exposure to smartphone screens is correlated with adverse health outcomes, including cardiovascular risks, diabetes, and obesity which itself is a risk factor for many health problems.[7,8] There has been increased use of digital devices, particularly mobile phones while performing daily activities like physical activities/exercising, eating, etc, a continuous use of screens has been noticed which can decrease the efficiency of that activity resulting in detrimental outcomes. The COVID-19 pandemic played a highly significant role in exacerbating the habit of screen time use, as quarantine measures led to increased remote working, online education, and socializing, which became an irreplaceable habit since then.[9,10]

This heightened screen time is found to be associated with addictive behaviors including alcoholism, tobacco, and drug abuse in adults as well as in other age groups.[11,12] There have been incidences of online gaming during the pandemic affecting both the psychological and physiological health of adolescents and adults, as indulging in gaming for longer durations can make them prone to nutrient deprivation, sleep deprivation, and social life imbalance.[13] There is a notable gap in research focusing on the young adult population (aged between 18-30 years), regarding specific types of screen time use and its impact on well-being, certain studies report associations between screen time and compromised well-being.[12,14] So, it becomes crucial to conduct more research and studies to advocate screen time limits to reduce the ongoing debates over screen time use, gaming disorders, etc, a need to reclassify mental health problems is also necessary to find the conclusion on these ongoing debates.[15,16] The increased prevalence of screen time usage can be seen among medical students at both undergraduate and postgraduate levels like every other field. These students continuously work under pressure, following hectic schedules hardly getting enough time for their health and well-being. This profession is already considered to be one of the most stressful and such long durations of screen time can potentiate poor sleep quality, obesity, and clinical characteristics like blood pressure, blood glucose, etc. These students are on the verge of compromised health both physiological and psychological and the increased screen time can easily exacerbate such negative health impacts. Thus, the current research aims to study the physiological and psychological health effects of screen time use in medical students. The objective of the study is to determine the association of digital screen time use with sleep quality, cardiometabolic health problems (obesity, blood pressure), and mental health conditions like depression, anxiety, and stress.

METHODS

Study design

This was a cross-sectional study.

Study place

The study was conducted at the Department of Physiology, King George's Medical University, Lucknow, U.P, India.

Study period

The study was conducted in a span of 1 year i.e., 2023-2024.

Sample size

113 medical students aged 18-30 years who were smartphone users. Before registering the participants in the study ethical clearance was obtained from the Institutional Ethics Committee, KGMU, Lucknow (Ethical Approval number- 2226/Ethics/2023).

The participants were registered using standard inclusion and exclusion criteria to ensure the homogeneity of the sample.

Inclusion criteria

Medical students aged 18-30 years who were smartphone users.

Exclusion criteria

Those who did not fall into the age group of the study were excluded along with those with major depressive disorder, or panic disorder without co-morbid generalized disorders, or with a history of psychoactive substance abuse or dependence within the past six months.

Sampling technique: simple random sampling

This was a questionnaire-based study in which a structured questionnaire along with 3 standard questionnaires were used. All the participants were registered after obtaining informed consent and the

purpose of the study was explained in a language they can understand. In this study where anthropometric parameters were measured including basal clinical parameters. Sleep quality assessment was done using the Pittsburgh sleep quality index (PSQI), developed by the University of Pittsburgh.[17] Anxiety levels were assessed using the depression, anxiety, and stress scale-21 items (DASS-21), to measure depression, anxiety, and stress.[18,19] Smartphone addiction was evaluated using the smartphone addiction scale-short version (SAS-SV), which demonstrated reliability and validity for assessing smartphone addiction.[20]

Ethical approval

The ethical clearance was obtained from the Institutional Ethics Committee, KGMU, Lucknow (Ethical Approval number- 2226/Ethics/2023).

Statistical analysis

The data collected from the study sample was transferred to Microsoft excel and analysed using statistical software SPSS version 26 (SPSS Inc., Chicago, IL, USA). The continuous variables were evaluated by mean (standard deviation) or range value. The data was analysed using frequency, mean, standard deviation, and statistical tests like Chi-square and Student's t-test were performed. All the analysis was done with a 95% confidence interval, and a p value of <0.05 or 0.001 was considered significant.

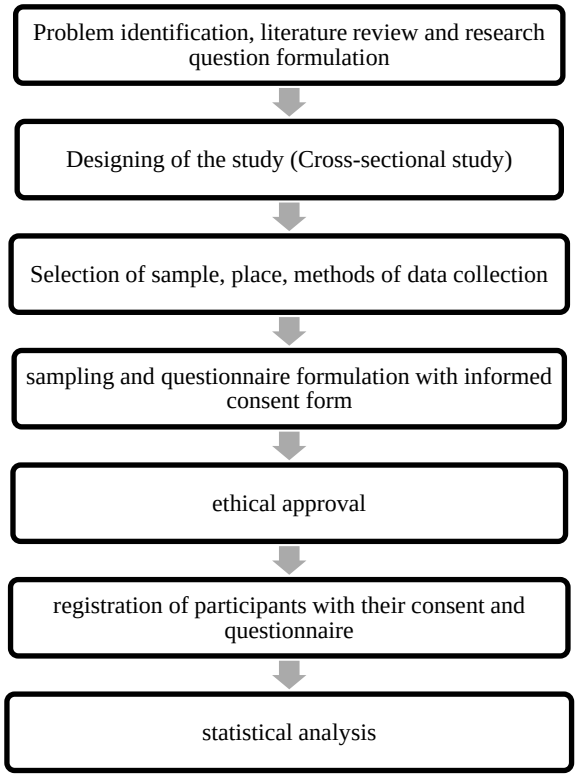

Figure 1: Methodology.

RESULTS

This cross-sectional study was conducted at the Department of Physiology, KGMU, Lucknow. After obtaining ethical clearance and informed consent, 113 young adults (age group more than 18 years and less than 30 years) who were smartphone users were included in the study.

Table 1: Demographic observations of the study participants (Total participants, N=113).

Parameter	Observation (%)
Age	18-25 Years- 72.57 26-30 Years- 27.43
Gender	Male- 46.02 Female- 53.98
Education status	Intermediate-81.42 Graduate-7.96 Postgraduation-10.62
Tobacco use	Yes-5.31 No-94.69
Taking medication	No-91.89 Yes-8.11
Prevalence of comorbidity	Yes-10.62 No-89.38

Table 2: Anthropometric and clinical observations (N=113).

Characteristics	Observations
Height	155.13±15.66 cm *
Weight	61.79±11.81 Kg *
BMI	23.77±2.64 kg/m2 *
BMI	Underweight-20.35% Normal-52.21% Overweight-15.04% Obese-12.39%
Waist circumference	43.67±22.22 cm *
Hip circumference	57.50±26.01 cm *
Blood pressure (SBP/DBP)	119.38±9.87/77.69±8.03 mmHg *
Heart rate	77.31±4.32 beats per minute *

Where, *Mean±Standard Deviation, significant at level p<0.05.

Demographic distribution

The mean age distribution of the study participants was 23.86±1.28 years, with maximum participants aged 18-25 years i.e., 72.97%. The female participants outnumbered the male (53.98% vs 46.02%). The majority were those who had not completed their medical degree graduate degree. Most of the participants, comprising 94.69%, reported no tobacco use. Conversely, a smaller proportion, accounting for 5.31%, indicated they used tobacco. Out of all the enrolled patients, only 10.62% exhibited a comorbidity, while 94.59% did not display any comorbidity. Among all the enrolled patients, 8.11%

were reported taking medication, while the majority (91.89%) did not (Table 1).

Table 3: Smartphone-related parameters and observations (N=113).

Smartphone related parameter	Observations
Duration of smartphone use (Years)	8.84±10.62*
Total one-week screentime (Hours)	49.98±15.17*
Purpose of smartphone usage	Online-69.91% Gaming-15.93% social media-78.76% Movie-51.33% Others-32.74%
Night-time screen use(8PM-8AM)	Yes-81.42% No-18.58%
Self-reported adverse effects	Energy level-23.89% Headache-78.76% Decrease Concentration-38.05% Eye pain- 92.04%

Where *Mean±Standard Deviation, significant at level p<0.05.

Anthropometric measurements

The mean height of the participants was 155.13±15.66 cm. The mean weight was 61.79±11.81 kg. The mean body mass index (BMI) was 23.77±2.64 kg/m2. Most participants fell into the normal BMI category, comprising 52.21%, following this, there were participants categorized as underweight (20.35%) and overweight (15.04%) (Figure 1).

A smaller proportion fell into the Obese category, constituting 12.39%. The mean waist circumference was 43.67±22.22 cm, and the hip circumference was 57.50±26.01 cm (Table 2). The mean blood pressure (SBP/DBP) was observed to be 119.38±9.87/77.69±8.03 mmHg and the mean value for heart rate was 77.31±4.32 beats per minute (Table 2).

Smartphone use

The average duration of smartphone use and total screen time over one week were 8.84±10.62 years and 49.98±15.17 hours, respectively. These findings underscore the importance of promoting awareness and implementing strategies for managing screen usage to maintain a healthy balance and alleviate possible negative consequences (Table 3).

The most prevalent purpose observed was social media, with 89 participants (78.76%) utilizing smartphones for this activity. Following this, the online study was reported by 79 individuals (69.91%) as their primary use. Additionally, movies, gaming, and other purposes were also recorded (Table 3). Most participants (81.08%) reported using screens from 8 PM to 8 AM, while 18.92% stated that they did not use screens at night. The most prevalent adverse effect was Eye Pain, reported by 91.89% of the participants, followed by Headache, reported by 78.38%. Additionally, decreased concentration and energy levels were also reported in subsequent patients (Table 3).

SAS-SV (Smartphone Addiction Scale-Short Version)

The majority strongly disagreed or disagreed with missing planned work due to smartphone use (35.40% and 7.96%, respectively), while significant percentages agreed or strongly agreed with constantly checking their smartphones not to miss conversations (23.89% and 13.27%, respectively).

Additionally, the total SAS-SV score was 24.162±10.541, and statistical analysis revealed a significant association between responses and smartphone dependency ($p<0.0001$*) (Table 4).

DASS21 (Depression Anxiety and Stress Scale 21)

The total DASS21 score was 11.946±9.63, and statistical analysis indicated a significant relationship between responses and psychological distress ($p<0.0001$), indicating a moderate level of emotional distress within the surveyed group. Several respondents reported experiencing symptoms such as difficulty, dryness of mouth, and inability to experience positive feelings.

Additionally, many participants noted feelings of agitation, panic, and worthlessness. Most participants reported that they found it hard to wind down (43.36% to some degree, 32.74% to a considerable degree), while fewer reported feeling scared without reason (23.89% to some degree, 10.62% to a substantial degree) (Table 5,6).

PSQI (Pittsburgh Sleep quality Index)

Most patients (62.16%) scored above 5, indicating a higher prevalence of poor sleep quality, while 37.84% scored 5 or below, suggesting relatively better sleep quality. The average Global PQSI score was 6.87±3.84, further reflecting the overall moderate level of sleep disturbances among the surveyed individuals (Table 7).

Associations

Distribution of stress levels across BMI categories

The distribution of stress levels among participants categorized by BMI showed that 26.09% experienced normal stress among underweight individuals, while 55.56% of normal-weight individuals reported mild stress. Conversely, within the obese category, 42.86% experienced severe stress. Overall, the data provides insights into the relationship between BMI and stress levels among the participants.

Stress level and mean blood pressure

Individuals with normal stress levels (0-14) had a mean SBP of 120.58±10.47 mmHg and a mean DBP of 80.34±8.21 mmHg. As stress levels increased, so did the mean blood pressure readings, with those experiencing very severe stress (≥34) exhibiting the highest mean SBP (135.98±18.07 mmHg) and mean DBP (92.24±15.69 mmHg).

Overall, the data indicates a positive association between stress levels and mean blood pressure, with higher stress categories associating with elevated mean systolic and diastolic blood pressure values.

Table 4: Perception of smartphone dependency among participants (smartphone addiction scale-short version (SAS-SV)).

Q. no	SAS-SV score		Strongly disagree	Disagree	Weakly disagree	Weakly agree	Agree	Strongly agree
1	Missing planned work due to smartphone use	N	40	9	10	24	21	9
		%	35.40%	7.96%	8.85%	21.24%	18.58%	7.96%
2	Having a hard time concentrating	N	49	24	12	13	15	0
		%	43.36%	21.24%	10.62%	11.50%	13.27%	0.00%
3	Feeling pain in the wrists or at the back of the neck while using a smartphone	N	52	24	21	7	9	0
		%	46.02%	21.24%	18.58%	6.19%	7.96%	0.00%
4	Will not be able to stand not having a smartphone	N	58	24	6	10	9	6
		%	51.33%	21.24%	5.31%	8.85%	7.96%	5.31%
5	Feeling impatient and fretful when i am not holding my smartphone	N	61	21	9	13	6	3
		%	53.98%	18.58%	7.96%	11.50%	5.31%	2.65%
6	Having my smartphone in my mind even when i am not using it	N	64	21	10	15	3	0
		%	56.64%	18.58%	8.85%	13.27%	2.65%	0.00%
7	I will never give up using my smartphone even when my daily life is already greatly affected by it	N	58	34	12	3	6	0
		%	51.33%	30.09%	10.62%	2.65%	5.31%	0.00%
8	Constantly checking my smartphone so as not to miss conversations between other people on WhatsApp, Facebook, or WeChat	N	34	25	3	27	15	9
		%	30.09%	22.12%	2.65%	23.89%	13.27%	7.96%
9	Using my smartphone longer than i had intended	N	25	12	9	12	46	9
		%	22.12%	10.62%	7.96%	10.62%	40.71%	7.96%
10	The people around me tell me that i use my smartphone too much	N	28	34	18	12	18	3
		%	24.78%	30.09%	15.93%	10.62%	15.93%	2.65%

Total SAS-SV SCORE, 24.162±10.541, p<0.0001*

Table 5: Assessment of psychological distress among participants (depression anxiety and stress scale 21 (DASS21)).

Q. no.	DASS21		Did not apply to me at all	Applied to me to some degree, or some of the time	Applied to me to a considerable degree or a good part of	Applied to me very much or most of the time
1	I Found it hard to wind down	N	49	37	12	15
		%	43.36%	32.74%	10.62%	13.27%
2	I was aware of dryness of mouth	N	52	34	18	9
		%	46.02%	30.09%	15.93%	7.96%
3	I couldn't seem to experience any positive feeling at all	N	55	43	12	3
		%	48.67%	38.05%	10.62%	2.65%
4	I experienced breathing difficulty	N	95	6	9	3
		%	84.07%	5.31%	7.96%	2.65%
5	I found it difficult to work up the	N	61	27	21	4
		%	53.98%	23.89%	18.58%	3.54%
6	I tended to over-react to situations	N	46	49	12	6
		%	40.71%	43.36%	10.62%	5.31%
7	I experienced trembling	N	82	24	6	1

Continued.

Q. no.	DASS21		Did not apply to me at all	Applied to me to some degree, or some of the time	Applied to me to a considerable degree or a good part of	Applied to me very much or most of the time
		%	72.57%	21.24%	5.31%	0.88%
8	I felt that I was using a lot of nervous energy	N	61	37	9	6
		%	53.98%	32.74%	7.96%	5.31%
9	I was worried about situations in which I might panic and make a fool of myself	N	55	43	9	6
		%	48.67%	38.05%	7.96%	5.31%
10	I felt that I had nothing to look forward to	N	89	18	6	0
		%	78.76%	15.93%	5.31%	0.00%
11	I found myself getting agitated	N	52	46	12	3
		%	46.02%	40.71%	10.62%	2.65%
12	I found it difficult to relax	N	55	43	12	3
		%	48.67%	38.05%	10.62%	2.65%
13	I felt down-hearted and blue	N	61	43	6	3
		%	53.98%	38.05%	5.31%	2.65%
14	I was intolerant of anything that kept me from getting on with what I was doing	N	61	43	6	3
		%	53.98%	38.05%	5.31%	2.65%
15	I felt I was close to panic	N	76	27	9	1
		%	67.26%	23.89%	7.96%	0.88%
16	I was unable to become enthusiastic about anything	N	73	24	9	7
		%	64.60%	21.24%	7.96%	6.19%
17	I felt I was not worth much as a person	N	92	9	9	3
		%	81.42%	7.96%	7.96%	2.65%
18	I felt that I was rather touchy	N	76	24	12	1
		%	67.26%	21.24%	10.62%	0.88%
19	I was aware of the action of my heart in the absence of physical exertion	N	76	24	12	1
		%	67.26%	21.24%	10.62%	0.88%
20	I felt scared without any good reason	N	70	27	12	4
		%	61.95%	23.89%	10.62%	3.54%
21	I felt that life was meaningless	N	73	31	9	0
		%	64.60%	27.43%	7.96%	0.00%

Total DASS21=11.946±9.63, X=243.0, p<0.0001*

Table 6: Distribution of severity levels according to DASS21.

DASS21	Severity levels	%
DASS21 (depression)	Normal (0-9)	41.59
	Mild (10-13)	24.21
	Moderate (14-200)	21.24
	Severe (21-27)	7.96
	Very severe (≥28)	7.96
DASS21 (anxiety)	Normal (0-7)	40.71
	Mild (8-9)	0.00
	Moderate (10-14)	27.43
	Severe (15-19)	10.62
	Very severe (≥20)	21.24
DASS21 (stress)	Normal (0-14)	40.71
	Mild (15-18)	23.89
	Moderate (19-25)	19.47
	Severe 926-33)	12.39
	Very severe (≥34)	2.65

Table 7: Pittsburgh sleep quality index (PSQI) scores of the study participants.

S.no.	Questions	Categories	%
1.	What time have you usually gone to bed at night?	10:00 PM-11:59 PM	40.71
		12:00 AM-1:59 AM	51.33

Continued.

S.no.	Questions	Categories	%
		2:00 AM-3:59 AM	7.96
2.	How long (in minutes) has it usually takes you to fall asleep each night?	6-15	56.64
		16-25	15.93
		26-36	27.43
3.	What time have you usually gotten up in the morning?	5-6	5.31
		6-7	27.43
		7-8	67.26
4.	How many hours of actual sleep did you get at night?	2-4	5.31
		5-7	53.98
		8-10	40.71
5.	During the past month, how often have you taken medicine to help you sleep ("prescribed or 'over the counter")	Not during the past month	2.65
		Less than once a week	84.07
		Once or twice a week	7.96
		Three or more times a week	5.31
6.	During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	Not during the past month	69.91
		Less than once a week	18.58
		Once or twice a week	7.96
		Three or more times a week	2.65
7.	During the past month, how much of as problem has it been for you to keep up enough enthusiasm to get things done?	No problem at al	35.40
		Only a very slight	51.33
		Somewhat of a problem	7.96
		A very long problem	5.31
8.	During the past month, how would you rate your sleep quality overall?	Very good	23.89
		Fairly good	46.02
		Fairly bad	47.79
		Very Bad	7.96

	During the past month, how often have you had trouble sleeping because of you?	**Not during the past months**	**Less than once a week**	**Once or twice a week**	**Three or more times a week**
9.	Cannot get to sleep within 30 min	51.33%	27.43%	13.27%	7.96%
	Wake up on the middle of the night or early morning	61.95%	13.27%	10.62%	14.16%
	Have to get up to use the bathroom	61.95%	23.89%	7.96%	6.19%
	Cannot or snore loudly	92.04%	2.65%	2.65%	2.65%
	Cough or snore loudly	78.76%	13.27%	2.65%	5.31%
	Feel too cool	76.11%	18.58%	5.31%	0.00%
	Feel too hot	69.91%	23.89%	0.00%	6.19%
	Have bad dreams	61.95%	21.24%	13.27%	3.54%
	Have pain	59.29%	27.43%	5.31%	7.96%
10.	Frequency of sleep disturbances among participants	**Not during the past months**	**Less than once a week**	**Once or twice a week**	**Three or more times a week**
	Loud snoring	38.05%	7.96%	40.71%	13.27%
	Long pauses between breaths while asleep	78.76%	13.27%	2.65%	5.31%
	Legs twitching or jerking while you sleep	92.04%	2.65%	5.31%	0.00%
	Episodes of disorientation or confusion during sleep	63.725	11.50%	18.58%	0.00%
	Other restlessness while you sleep	81.42%	18.58%	0.00%	0.00%

p value X=106.5, p<0.0001*, p value= X=177.0, p<0.0001*

DISCUSSION

The exposures to screens, including smartphones, computers, and televisions are seen to be increasing rapidly, and these prolonged exposures are putting a burden on society with various adverse health outcomes. The effects on physiological and psychological health have been widely observed in young adults in recent years. This research was conducted at the Department of Physiology, KGMU, Lucknow, involving a cross-sectional analysis of 113 individuals in the young adult category (aged 18-30 years) who regularly used smartphones.

Participants were provided with a self-administered questionnaire encompassing various sociodemographic factors, including age, gender, education status, self-reported family financial status, and perceived study workload. Additionally, the questionnaire collected data on height, weight, BMI, blood pressure, health rate, and sleep quality. Most of the participants had a normal BMI followed by being undernourished and very few were obese, which can be understood as compromised physiological health, skipping meals, or not proper utilization of the consumed food or it can be said that they were living a sedentary lifestyle.

The average weekly duration of smartphone uses and total screentime was observed to be 8.84±10.62 years and 49.98±15.17 hours, respectively. In Switzerland, 33.0% of young people were reported to use smartphones for 1-2 hours per day, aligning with a Chinese study where 38.2% of students were found to use smartphones for 2-4 hours daily.[17,21,22] This study showed an increased trend related to smartphone use parameters among the students. Social media was the predominant purpose for smartphone usage (78.76%) while another study highlighted that over 30% of adolescents engaged in smartphones and social interactions through these social media platforms.[23] Moreover, more than two-thirds of adolescents spend 6 or more hours per day on screens, and over a third spend 46 minutes or more using devices before bedtime while lying in bed. Most study participants (81.08%) reported screen use from 8 PM to 8 AM. Timings and duration of smartphone/screen use are as important as other health factors, as these can potentiate disruptions of various systems working inside the body.

The most common observed adverse effect due to prolonged screen use were eye pain, headaches, decreased concentration and energy levels, negative effects on productivity attributed to fatigue, and daytime sleepiness. Johnson et al, in their study discovered that 20% of adolescents experienced introspection while using screens, felt restless, moody, and anxious in the absence of smartphones, and used these devices to escape problems or alleviate irritability with reported symptoms of depression and signs of screen addiction.[24] In another study among students in Gwalior City, India, moderate to severe internet addiction was observed while in another survey of students from schools in Haryana, 30.3% of students were found to be addicted to screens.[25,26] Various other studies also suggested signs of addiction either related to the internet or video games with sleeping less than 5 hours per night and also experiencing psychological distress, which are parallel to those of this study causing disruption of various normal cycles of the body crucial for daily functions.[23,27]

The collective DASS21 score averaged 11.946±9.63, signifying a notable degree of psychological distress among participants. Numerous studies highlighted a positive correlation between screen time and depressive symptoms, along with anxiety in conjunction with shorter sleep duration due to increased screen time usage that can be attributed to types of screens emitting different varieties of lights particularly screen use during night hours.[28-31] A majority of participants (40.71%) had normal anxiety scores (0-7), while 27.43% exhibited moderate anxiety (10-14), additionally, 10.62% reported severe anxiety (15-19), and 21.24% experienced very severe anxiety (≥20), showcasing varying degrees of anxiety within the surveyed group. Individuals with a daily total screen time of more than four hours were more prone to symptoms of anxiety disorders such as social phobia, panic disorder, generalized anxiety disorder, etc. and adolescents with more than 7 hours of screen time engagement were more than twice diagnosed with depression or anxiety and would need professional assistance.[32]

Poor sleep quality is defined as a global PSQI score greater than 5, with a sensitivity of 89.6% and specificity of 86.5%. Consistent with this, a significant number from our study cohort exhibited poor sleep quality, accounting for 53.98% presuming a high prevalence of poor sleep quality. A study conducted in 2015 among medical students in Karachi, Pakistan reported 39.5% of them were suffering from poor sleep quality while another study revealed that 59.03% of the participants from various educational institutions in 2018 were associated with poor sleep quality.[33]

The surge in screen time usage increased to many folds during the COVID-19 pandemic. Studies also suggested that augmented screen usage before bedtime is associated with a significant increase in sleep onset latency between the two separate intervals i.e. March 2020 and April 2020.[34] Souza et al, also determined that screen usage during the pandemic was predictive of obtaining less than or equal to 7 hours of sleep per night, making participants sleep deprived, and the same was observed by Salfi et al, during quarantine in Italy while those who reduced or maintained their screen use before bed had no significant change in their total sleep duration per night.[35-37]

This study highlighted the relationship between screen time and the physiological and psychological health of Indian medical students. The distribution of stress levels

among the recruited participants categorized by BMI showed that there were varied levels of stress in these students irrespective of their BMI but, those who were obese had severe stress levels, and mild stress to severe stress was predominantly observed in the participants. This showed that there is a relationship between BMI and Stress levels, giving insights into compromised physiological and psychological health related to screen use.

Hence, it becomes of utmost importance to use these findings and make certain modifications in interventions to reduce the impacts of excessive screen use or exposure. Both physical and psychological manifestations of prolonged use of screens like eye strain, headaches, sleep deprivation, nourishment, anxiety, depression, etc. should be screened at an early stage, and recommendations on balanced screen use are the need of the hour. We must emphasize these changes to be made at higher levels, as our results highlighted the impact of screen use on the health of this medically aware section of the students.

The limitations of the study were that the sample size was relatively small, of 113 participants might not be applicable to the whole of the population within this age group, limiting the generalizability of the findings. The study did not comprehensively assess confounding factors like physical activity, diet, etc. which could influence the findings. There might be bias in selection as the participants included were from a single institution and a potential to recall bias by the participants while reporting information. This highlighted the need to conduct a longitudinal study on a relatively larger study population with an extended period to get more generalized results including other factors also.

CONCLUSION

We concluded that recruited medical students were not able to keep themselves away from the negative health consequences due to prolonged screen usage and addiction to digital devices, thereby leading to sleep cycle disruptions, metabolic health disruptions, and mental health problems along with behavioral and cognitive problems, therefore, we assume that students from other backgrounds are at more severe risk.

We determined the health effects of excessive screen use on Indian medical students and the results can be used to conduct future research and to take desired actions to limit the adverse effects and maintain a positive relationship of humans with technology. With a broader context, strong recommendations and validation of screen time use in different age groups according to their work schedule and necessity and their health status should be made and implemented at the lowest levels to reduce these risks and prevent many health conditions at an initial stage.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Henderson M, Benedetti A, Barnett TA, Mathieu ME, Deladoëy J, Gray-Donald K. Influence of adiposity, physical activity, fitness, and screen time on insulin dynamics over 2 years in children. JAMA Pediatrics. 2016;170(3):227-35.
2. Reid CYL, Radesky J, Christakis D, Moreno MA, Cross C, Hill D, et al. Children and adolescents and digital media. Pediatrics. 2016;138:5.
3. Magee CA, Lee JK, Vella SA. Bidirectional relationships between sleep duration and screen time in early childhood. JAMA Pediatrics. 2014;168(5):465-70.
4. Lauricella AR, Wartella E, Rideout VJ. Young children's screen time: The complex role of parent and child factors. Journal of Applied Developmental Psychology. 2015;36:11-7.
5. Lemola S, Perkinson-Gloor N, Brand S, Dewald-Kaufmann JF, Grob A. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. Journal of youth and adolescence. 2015;44(2):405-18.
6. Lissak G. Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. Environ Res. 2018;164:149-57.
7. Staiano AE, Martin CK, Champagne CM, Rood JC, Katzmarzyk PT. Sedentary time, physical activity, and adiposity in a longitudinal cohort of nonobese young adults. The American Journal of Clinical Nutrition. 2018;108(5):946-52.
8. Lunden I. 6.1 b smartphone users globally by 2020, overtaking basic fixed phone subscriptions. Tech Crunch. 2015;2:34
9. Kolovos S, Jimenez MAC, Pinedo VR, Cassidy S, Zavala GA. Association of sleep, screen time and physical activity with overweight and obesity in Mexico. Eat. Weight Disord. 2019:1-11.
10. Ghekiere A, Van CJ, Vandendriessche A, Inchley J, Gaspar de MM, Borraccino A, et al. Trends in sleeping difficulties among European adolescents: Are these associated with physical inactivity and excessive screen time? Int J Pub Heal. 2019;64:487-98.
11. Panahi S, Tremblay A. Sedentariness and health: is sedentary behavior more than just physical inactivity? Frontiers in public health. 2018;6:389159.
12. Barkley JE, Lepp A. Mobile phone use among college students is a sedentary leisure behaviour which may interfere with exercise. Computers in Human Behavior. 2016;56:29-33.
13. Lepp A, Barkley JE, Karpinski AC. The relationship between cell phone use, academic performance,

anxiety, and satisfaction with life in college students. Computers in human behavior. 2014;31:343-50.
14. Castro O, Bennie J, Vergeer I, Bosselut G, Biddle SJ. How sedentary are university students? A systematic review and meta-analysis. Prevention science. 2020;21:332-43.
15. Kerrigan DJ, Rukstalis MR, Ehrman JK, Keteyian SJ, She R, Alexander GL. 5-2-1-0 Lifestyle risk factors predict obesity in Millennials. Clinical obesity. 2019;9(3):12306.
16. Healy GN, Clark BK, Winkler EA, Gardiner PA, Brown WJ, Matthews CE. Measurement of adults' sedentary time in population-based studies. Am J Prev Med. 2011;41(2):216-27.
17. Hashmi AM, Khawaja IS, Butt Z, Umair M, Naqvi SH, Ul-Haq J. The Pittsburgh sleep quality index: validation of the Urdu translation. J Coll Physicians Surg Pak. 2014;24(2):123-6.
18. Moutinho IL, Maddalena NC, Roland RK, Lucchetti AL, Tibiriçá SH, Ezequiel OD, et al. Depression, stress and anxiety in medical students: A cross-sectional comparison between students from different semesters. Rev Assoc Med Bras (1992). 2017;63(1):21-8.
19. Basudan S, Binanzan N, Alhassan A. Depression, anxiety and stress in dental students. Int J Med Educ. 2017;8:179-86.
20. Kwon M, Kim DJ, Cho H, Yang S. The smartphone addiction scale: development and validation of a short version for adolescents. PloS one. 2013;8(12):83558.
21. Wu X, Tao S, Zhang Y, Zhang S, Tao F. Low physical activity and high screen time can increase the risks of mental health problems and poor sleep quality among Chinese college students. PloS one. 2015;10(3):119607.
22. Haug S, Castro RP, Kwon M, Filler A, Kowatsch T, Schaub MP. Smartphone use and smartphone addiction among young people in Switzerland. J Behav Add. 2015;4(4):299-307.
23. Christensen MA, Bettencourt L, Kaye L, Moturu ST, Nguyen KT, Olgin JE, et al. Direct measurements of smartphone screen-time: relationships with demographics and sleep. PloS one. 2016;11(11):165331.
24. Wu X, Tao S, Zhang S, Zhang Y, Chen K, Yang Y, et al. Impact of screen time on mental health problems progression in youth: a 1-year follow-up study. BMJ open. 2016;6(11):11533.
25. Soni R, Upadhyay R, Jain M. Prevalence of smart phone addiction, sleep quality and associated behaviour problems in adolescents. Int J of Res Med Sci. 2017;5(2):515-9.
26. Domingues MS. Clinical and psychological effects of excessive screen time on children. J Paed Child Health. 2017;53(4):333-8.
27. Desouky DE, Abu-Zaid H. Mobile phone use pattern and addiction in relation to depression and anxiety. Eastern Mediterranean Health J. 2020;26(6):692-9.
28. Grimaldi PM, Fernández BJM, Fennell C, Sañudo B. Associations of objectively-assessed smartphone use with physical activity, sedentary behavior, mood, and sleep quality in young adults: A cross-sectional study. International J Environ Res Pub Health. 2020;17(10):3499.
29. Yuan Y, Heizhati M, Wang L, Li M, Lin M, Gan L, et al. Poor sleep quality is associated with new-onset hypertension in a diverse young and middle-aged population. Sleep Medicine. 2021;88:189-96.
30. Girela-Serrano BM, Spiers AD, Ruotong L, Gangadia S, Toledano MB, Di Simplicio M. Impact of mobile phones and wireless devices use on children and adolescents' mental health: a systematic review. European child and adolescent psychiatry. 2022:1-31.
31. Maurya C, Muhammad T, Maurya P, Dhillon P. The association of smartphone screen time with sleep problems among adolescents and young adults: cross-sectional findings from India. BMC public health. 2022;22(1):1686.
32. Lavados RP, Andrade MO, Morales G, Muñoz S, Balboa CT. Association of screen time and physical activity with health-related quality of life in college students. J Am Coll Health. 2023;71(5):1504-9.
33. Santos RM, Mendes CG, Sen Bressani GY, Alcantara VS, Almeida NYJ, Miranda DM, et al. The associations between screen time and mental health in adolescents: a systematic review. BMC psychology. 2023;11(1):1-21.
34. Haug S, Castro RP, Kwon M, Filler A, Kowatsch T, Schaub MP. Smartphone use and smartphone addiction among young people in Switzerland. J Behav Add. 2015;4(4):299-307.
35. Salfi F, Amicucci G, Corigliano D, D'Atri A, Viselli L, Tempesta D, et al. Changes of evening exposure to electronic devices during the COVID-19 lockdown affect the time course of sleep disturbances. Sleep. 2021;44(9):80.
36. Souza TC, Oliveira LA, Daniel MM, Ferreira LG, Della Lucia CM, Liboredo JC, et al. Lifestyle and eating habits before and during COVID-19 quarantine in Brazil. Public health nutrition. 2022;25(1):65-75.
37. Long J, Liu TQ, Liao YH, Qi C, He HY, Chen SB, Billieux J. Prevalence and correlates of problematic smartphone use in a large random sample of Chinese undergraduates. BMC psychiatry. 2016;16:1-2.

Cite this article as: Haque S, Singh S, Narayan J, Tripathi A, Ahmad M, Kumar T, Verma S. Effect of smartphone use on sleep and mental health status of Indian medical students: a cross-sectional study. Int J Res Med Sci 2024;12:3737-46.