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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_806_23

# Impact of smartphone on mental health among medical undergraduates: A cross-sectional study

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## Abstract:

**BACKGROUND:** Smartphones have become an indispensable part of almost everyone's life. India has now become the leading and second-largest Smartphone market in the world. It has been noted that the purpose of Smartphone usage has exceptionally changed over the past few years, especially among students, professionals, and the common man. Smartphones have now become essential and the need of the hour, and medical students are no exception. Smartphones can make "smart students smarter"! There are now 10,275 unique applications labeled under the "Medical" and "Healthcare and Fitness" categories. The common medical applications used are MedCalc, Drug Infusion, Flashcards, Encyclopedia, Merck Manual, Medscape, PubMed, Epocrates, MedlinePlus, Lab test applications, Medical Dictionary, Eponyms etc. Despite the advantages and needs of smartphones, they have proven to be a source of potential hazard to human health, not only physical but also mental, social, and emotional well-being. There is consistent evidence for co-morbidity (such as obesity, heart diseases, neck and back pain, etc.) between excessive smartphone use and other psychiatric disorders, such as depression, anxiety, obsessive and compulsive disorder (OCD), and attention deficit hyperactivity disorder (ADHD) similar to internet addiction. The significant association of this addiction with poorer sleep quality and higher perceived stress has been a cause for concern. Hence, further investigation to explore the association between smartphone addiction and mental health, this study was undertaken.

**MATERIALS AND METHODS:** Our study was undertaken in Dr VMGMC, Solapur, from June to August 2022, after obtaining approval from the ethical committee, approval number 172/22. Total voluntary participation for the study was 600 (from first to final year), and accordingly convenient sample size was taken.

**RESULTS:** We found that out of the total participants, 42% of the participants had an average screen time of 4–6 h daily. A very small percentage of participants (4%) spent less than two hours in front of a screen. Alarming, 65% of the participants had an average screen time of more than 4 hours, which puts them at risk for the negative health impacts of prolonged screen time. Around 12% of them had symptoms of mild stress, 10.3% for mild anxiety, and 15.6% for mild depression. 10.6% had symptoms of moderate stress, 23.3% for moderate anxiety, and 16% for moderate depression. A small proportion of undergraduates, that is, 5%, 16%, and 11.6%, had symptoms of severe and extremely severe stress, anxiety, and depression, respectively.

**CONCLUSION:** The study participants did not feel a lot of stress, anxiety, or depression symptoms when smartphones were used judiciously and mostly for non-social purposes (such as studying, listening to music, or watching videos). This investigation led us to the conclusion that there are some positive effects of smartphones on mental health. However, those who spent an excessive amount of time on their smartphones for social contact, with an average screen time of 5 h, showed signs of mild to moderate sadness, moderate anxiety, and tension, demonstrating that social media had a negative impact on the mental health of medical undergraduates. Therefore, efforts should be made to inform medical students about how using a smartphone is harming their mental health.

## Keywords:

DASS-21, medical undergraduates, mental health, smartphones, social and non-social interaction groups

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**How to cite this article:** Prafull K, Rao A, Doijad V, Patil P, Daulatabad VS, John NA. Impact of smartphone on mental health among medical undergraduates: A cross-sectional study. J Edu Health Promot 2024;13:137.

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Received: 09-06-2023

Accepted: 11-09-2023

Published: 29-04-2024

## Introduction

In the rapidly evolving landscape of modern technology, smartphones have emerged as ubiquitous companions in our daily lives. These pocket-sized devices have revolutionized communication, information access, and entertainment, granting us unprecedented connectivity and convenience. As society embraces the benefits of smartphones, it is equally important to acknowledge the potential impacts they may have on various aspects of our lives, including mental health.

Smartphones have undeniably transformed the way we interact with the world. With just a few taps and swipes, we can instantly connect with friends and family, access a wealth of information, and immerse ourselves in an endless stream of social media, entertainment, and gaming. The use of smartphones for many purposes, ranging from communication to intricate transactions, has dramatically changed over time.<sup>[1,2]</sup> However, this convenience comes at a cost. As smartphones become integral parts of our existence, researchers and experts have begun to investigate their effects on mental well-being.

The impact of smartphones on mental health is a complex and multifaceted topic. On one hand, they offer an array of mental health apps and resources that provide support for stress reduction, meditation, and emotional well-being. These digital tools have the potential to improve mental health awareness and facilitate access to mental health services, which can be particularly beneficial for those in remote or underserved areas.

Conversely, there is growing concern about the detrimental effects of excessive smartphone usage on mental health. The constant connection to social media platforms and the barrage of notifications can lead to feelings of anxiety, loneliness, and low self-esteem. In addition, the addictive nature of smartphone use can result in decreased attention spans, disrupted sleep patterns, and diminished overall psychological well-being.

Medical undergraduate students, like others, have embraced smartphones due to their versatile applications in communication and instruction. The rapid expansion of smartphone usage, coupled with their affordability and easy accessibility, makes them an essential tool for aspiring doctors.<sup>[3]</sup> Smartphone applications such as WhatsApp can play a crucial role in fostering communication and education among groups of medical students.<sup>[4]</sup> A study by Shrivastava and Shrivastava revealed that WhatsApp serves as an effective approach to bridging the gap between teachers and students, becoming an integral part of the global

community of medical students due to its flexibility and instant messaging capabilities.<sup>[5]</sup> However, while WhatsApp and similar instant messaging platforms offer numerous benefits, studies have also highlighted their potential negative impact on mental health.<sup>[6]</sup>

The increasing prevalence of medical applications highlights the seamless integration of smartphones into the healthcare landscape. Presently, there are a remarkable 10,275 distinct applications categorized under "Medical" and "Healthcare and Fitness," addressing diverse medical requirements. These apps offer valuable tools such as MedCalc, Drug Infusion, Flashcards, and medical references.<sup>[7]</sup> Acknowledging this emerging trend, a study in the USA strongly advocated for the early incorporation of smartphone education into medical curricula and continuing medical education programs. The objective is to equip current and future healthcare providers with the necessary knowledge and skills to leverage smartphones effectively in their practice.<sup>[8]</sup>

While smartphones have many benefits, they may potentially be harmful to human health. As with internet addiction, excessive smartphone use has been linked to comorbid conditions like obesity, heart disease, neck and back pain, as well as psychiatric problems like depression, anxiety, OCD, and ADHD.<sup>[9]</sup> Youth media multitasking and heavy smartphone use have negatively impacted academic achievement, socioemotional functioning, and cognitive control over time.<sup>[10]</sup> However, some studies, including one by Kathrin Karsay, found no evidence of a clear correlation between excessive smartphone use and loneliness or stress.<sup>[11]</sup> Social networking sites (SNS), like Facebook, have been implicated in mental health concerns. Certain SNS activities have been linked to symptoms of depression and low self-esteem, particularly among children and adolescents. However, studies have also presented contradictory results, highlighting the need for further investigation.<sup>[12]</sup> In order to determine the effect of screen time and smartphone usage on mental health, a study was created. Similar research among teenagers in South Korea revealed that while moderate smartphone use had different effects on mental health depending on the goal, heavy usage had negative effects on stress perception, sleep satisfaction, depressive symptoms, and suicide-related markers.<sup>[13]</sup>

There is a strong correlation between smartphone addiction and worse sleep quality as well as higher levels of stress, per a 2019 study done in Western Maharashtra to find out how common smartphone addiction is among medical undergraduates.<sup>[14]</sup> In addition, during the past several years, there has been an increase in incidents damaging the mental well-being of the public in general. These results mentioned earlier underline the need for

additional research into the link between smartphone addiction and mental health.

### Aims and objectives

Considering the increasing prevalence of mental health issues and to have a better insight on this topic, our study aims to examine the prevalence of mental health issues, including stress, anxiety, and depression, among medical undergraduates with regard to screen time and the primary purpose of their smartphone usage. This investigation will contribute valuable insights for developing effective treatment modalities and guiding future research in this rapidly evolving field.

The objective is:

1. To study the prevalence of mental health issues (stress, anxiety, and depression) among medical undergraduates.
2. To examine the relationship between mental health issues and the primary purpose of smartphone usage among medical undergraduates.
3. To compare mental health issues and screen time of medical undergraduates based on the purpose of main usage.

## Materials and Methods

### Study design

Quantitative non-experimental, descriptive, and cross-sectional study design.

### Study participants and sampling

The target population of this study was medical undergraduates, from first-year MBBS to final year MBBS students from a government medical college in Solapur.

### Ethical consideration

Our study was undertaken in Dr VMGMC, Solapur, from June to August 2022, after obtaining approval from the ethical committee vide approval number 172/22.<sup>[15]</sup>

### Sampling

The total number of undergraduates in the college was 500 (from first to final year), out of which 300 students (60%) voluntarily took part in the study. Medical undergraduate students from first year to final year were given a brief conceptualization of the study regarding the use of smartphones and its implications on mental health, and those interested participated voluntarily in the study.

### Data collection tool and technique

Data collection was carried out via a self-guided questionnaire (Google Forms). In addition, there was a disclaimer at the beginning of the questionnaire, which explained the details of the study and the purpose for

which the information provided by the participants would be used. Participants were screened for the study in accordance with the inclusion and exclusion criteria, and confounding factors were identified and addressed in these criteria.

### Inclusion criteria

- Individuals who were currently medical undergraduate students from Dr. VMGMC, Solapur.
- Age group 18–25 years
- Individuals should own a smartphone for more than a year.

### Exclusion criteria

- Individuals who were not willing to participate
- Known cases of depression/stress/anxiety were not included in the study
- Individuals taking antidepressants, antipsychotics, antidiabetic or any chronic drug history
- Participants who submitted incomplete responses were also excluded from this study.

### Limitations to the above criteria

- Included participants based on a voluntary basis
- Limited to one government medical college in Solapur
- Undergraduates suffering from any major psychiatric or comorbid illness were not included, affecting the outcome of prevalence through this study
- As the study is based on an online questionnaire and not in-person interviews, wherein chances of subject bias would increase.

Google Forms consisted of THREE main sections-

1. Section I: Sociodemographic variables, which included the age of the participant, gender, and year of study.
2. Section II: Information about their smartphone, which included ownership of their smartphone, average screen time, and main purpose of using their smartphone.
3. Section III: Set of questions regarding mental health, which included a standardized Depression, Anxiety and Stress Scale – 21 (DASS-21) questionnaire (which was used to assess depression, anxiety, and stress level) and an open-ended question about their take on smartphone and its impact on overall mental health.

### DASS-21

Depression, Anxiety, Stress Scale is a 4-point Likert scale and consists of 3 subscales with 7 items each that evaluate depression, anxiety, and stress. The score obtained from the scale varies from 0–21 for each subscale. The scores are then multiplied by 2 before comparing with the DASS-21 scale. The DASS-21 has demonstrated excellent internal coherence, discriminative, concurrent,

and convergent validity, as well as an excellent Cronbach’s alpha value.<sup>[16-19]</sup> The DASS-21 had good internal reliability (Cronbach’s alpha) and its ordinal alpha which demonstrated good internal reliability for all its subscales. Regarding the criterion validation, it demonstrated a satisfactory ability to discriminate cases from non-cases.

The following Table 1 explains the scores for depression, anxiety, and stress.

**Table 1: DASS-21 scale<sup>[18]</sup>**

Meaning	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28+	20+	34+

**Statistical analysis**

Data collected was analyzed using MS Excel, Statistical Package for the Social Sciences (SPSS)-20 software. To determine whether there was a significant association between the two groups, descriptive statistical analysis including average, mean with standard deviation, and comparison between the two groups was carried out using the paired *t*-test. Pie charts have been used to visualize the data in order to determine the distribution of average screen time and the primary reason for smartphone usage.

**Results**

A total of 300 medical undergraduates participated in the study. Out of these participants, 152 were males and 148 were females. About 41% (123) participants were from first-year MBBS, 30% (89) from second-year MBBS, 22% (66) from third-year MBBS, and 7% (22) from fourth-year or final-year MBBS. Participants were aged between 18 and 24 years, with a mean age of 20.3 years. Among these, 96.3% (289) of them owned only one smartphone, while the rest 3.6% (11) owned one or more (2) smartphones.

1. Distribution of the average screen time among medical undergraduates is [Figure 1]:  
We found that 42% of the participants had an average screen time of 4-6 h daily. A very little proportion (4%) had screen time of less than 2 h. A significant portion of the participants (65%) had an average screen time of more than 4 h, which is alarming as it predisposes them to the detrimental effects of increased screen time on health.

2. Screen time among Non-Social Interaction (NSI) and Social Interaction (SI) groups [Table 2]  
To evaluate the impact of smartphones on mental health according to their main purpose of usage, we categorized the participants who used smartphones primarily for social interaction purposes (like social media, YouTube) as the “Social Interaction group” (SI group) and the group that used them for non-social purposes (like study related, music, gaming) as the “Non-Social Interaction group” (NSI group).

We observed that the average screen time in the SI group (5 h) was slightly more than in the NSI group (4 h). Also, the *P* value observed was 0.000659 (*P* < 0.05), signifying that the observation has statistical significance.

3. Distribution of the main purpose of smartphone usage [Figure 2]  
Smartphone is used for various purposes by the students these days. Though the purpose may be overlapping, but for the sake of the study, we asked the participants what was the one main purpose for which they used smartphones. We observed that 28% of the participants used smartphones mainly for study purposes like attending online lectures, watching videos, etc., implying the current trend of smartphone use as a study resource. About 23% of them used smartphones for social interaction purposes. A minute proportion of the participants used smartphones for gaming, watching, and web shows, which signifies that its prevalence has reduced among medical undergraduates.

4. DASS-21 questionnaire results were:  
The mean scores of the stress, anxiety, and depression of the participants with respect to their severity are depicted below [Figures 3-5].

The majority of the participants did not have any symptoms of stress, anxiety, or depression, which was a good sign implying that not everyone was mentally affected by smartphones. Though 12% of them had symptoms of mild stress, 10.3% for mild anxiety, and 15.6% for mild depression. 10.6% had symptoms of moderate stress, 23.3% for moderate anxiety, and 16% for moderate depression. A small proportion of undergraduates, that is, 5%, 16%, and 11.6%, had symptoms of severe and extremely severe stress, anxiety, and depression, respectively, which is concerning, and hence attempts were made to look into the likely cause.

5. [Table 3] DASS-21 score comparison in NSI and SI groups  
Out of a total of 300 participants, it was observed that 166 (55.4%) came under the NSI group and 134 (44.6%) under the SI group. To compare the results of DASS-21 and screen time among NSI and SI groups, we used the mean of the two data and

$P$  value (if  $P < 0.05$  implies statistical significance and  $P > 0.05$  implies not of statistical significance).

For the NSI group, the average score for stress, anxiety, and depression came out to be 9.024, 6.518, and 6.964, which are in the normal range. Whereas for the SI group, we found out that the average stress score was 13.925 (~14), implying mild stress. The average anxiety score was 10.20, which is indicative of moderate anxiety, and the average depression score was 12.98, which is indicative of mild depression.

## Discussion

### Recent global trend for utilizing smartphones among medical students

Smartphones are now one of the most important items in everyone's life in the age of technological advancement technology. Smartphones are no longer just used for communication; they have also grown to be one of the biggest sources of knowledge for the medical community. The use of smartphones has also evolved significantly over the past few years. In our study, we discovered that a sizable fraction of participants used smartphones for academic purposes (28%); 23% used smartphones for social connections, and it appeared that the incidence of gaming and binge viewing had decreased. Participants who used cell phones to listen to music made up about 19%. Similar findings to our study have been found in a number of prior investigations.

A study conducted by Mohapatra D *et al.*, showed that smartphones were used for various purposes by medical students viz, note taking, cloud storage, imaging, web browsing, clinical handbooks, textbooks, question banks, medical calculators, simulation apps, etc.<sup>[18,19]</sup> A study conducted by Daulatabad *et al.*,<sup>[20]</sup> showed that the most preferred gadget for online classes was a smartphone. Students can now watch offline video lectures, attend online lectures, and watch elaborative anatomical/surgical videos whenever and wherever they wish to see them.

A review article published by Vinay and Vishal, showed that there is a widespread usage of smartphones in medical usage and mentions about 16 and five medical applications available in Android OS and Apple iOS, respectively.<sup>[21]</sup> The study conducted by Browne *et al.*,<sup>[22]</sup> also found high rates of smartphone ownership and medical app use, which existed among Irish medical students, complementing our study findings. The study conducted by Muhammad Zahid Latif *et al.*,<sup>[23]</sup> found out that medical students use the mobile application for online textbooks (70%), medical podcasts (60%), medical calculators (75%), online lectures (50%), and notes taking (45%).

Relevant studies also concluded that the majority of students use smartphones for education (62.7%), communication (81.7%), and recreation (82.5%), which synergizes with our findings.<sup>[24]</sup> The study conducted by Rohilla R *et al.*,<sup>[25]</sup> also showed that 39.2% of medical students used various medical applications for learning.

### Prevalence of stress, anxiety, and depressive symptoms

Out of 300 participants, it was found out that 71.6% showed no symptoms of stress, 12% of the participants had symptoms of mild stress, 10.6% had symptoms of moderate stress, and 5% had symptoms of severe and extremely severe stress. This shows that almost 28.4% of medical undergraduates have some or the other grade of stress in their lives. Similarly, for anxiety, 50.3% showed no symptoms of anxiety, 10.3% for mild anxiety, 23.3% for moderate anxiety, and 16% had symptoms of severe and extremely severe anxiety. This proves that almost *half* of the medical undergraduates suffer from mild anxiety, with 39.3% who suffer from moderate or severe anxiety.

Our findings are potentiating the findings of a cross-sectional study conducted among the undergraduate medical students of GMC Haldwani, which showed that smartphone addiction is high among medical students and has a significant negative impact on their QOL (quality of life).<sup>[26]</sup> For depression, 56.6% of participants showed no depressive symptoms, while 15.6% had symptoms for mild depression, 16% for moderate depression, and 11.6% for severe and extremely severe depression, which is alarming as nearly 43.3% of participants showed depressive symptoms. The reason for above above-noted prevalence can be multifactorial. There are studies that showed excessive smartphone use is associated with problems of mental health and impaired psychological well-being.

A study conducted by Dhamija S. *et al.*,<sup>[27]</sup> in 2021 in Maharashtra it was found out that the prevalence of smartphone addiction among medical undergraduates is high and is associated with disturbed sleep patterns and negatively associated with low self-esteem. Also, in a study by John and VS, the DASS questionnaire showed severe stress was higher among nurses (28%), moderate stress was higher among interns (40%), and no stress was observed more among doctors (44%).<sup>[28]</sup>

### Comparing mental health issues of both groups

In the case of social interaction, For the NSI group, the average stress, anxiety, and depression scores came out to be 9.024, 6.518, and 6.964, which lie in the normal range. This result shows that when smartphones were used mainly for non-social purposes such as study-related, attending online lectures, listening to music, and watching web series, the majority of the participants

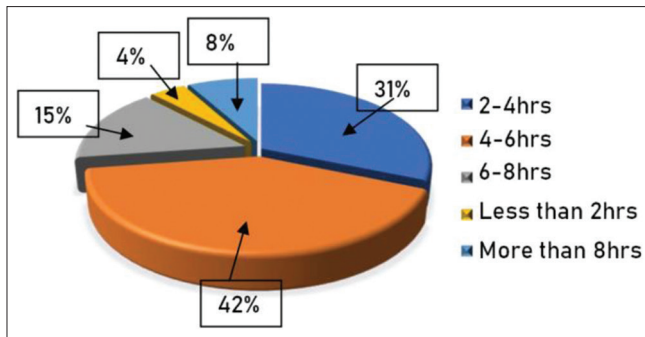


Figure 1: Average screen time (N = 300)

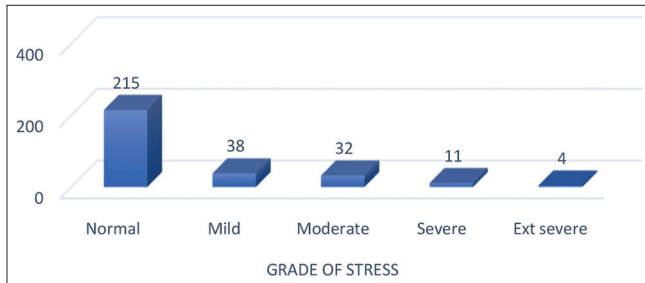


Figure 3: Stress score

showed no or any major symptoms of mental health problems. This may be attributed to the *positive* impact of smartphones when they are used for study purposes or relaxation. Whereas for the SI group, we found out that the score of average stress was 14, indicative of mild stress. The average anxiety score was 10.20, indicative of moderate anxiety, and the average depression score was 12.98, indicative of mild depression. This implied that medical undergraduates who used smartphones mainly for social purposes (using apps like Instagram, Facebook, etc.) were more prone to develop anxiety and depressive symptoms.

Our result is similar to the study conducted in China in 2020 by Yang Song *et al.*, which showed that anxiety was significantly associated with problematic smartphone use and sleep disturbance among medical students during the COVID-19 pandemic. Problematic smartphone use not only directly affected anxiety but also exerted a significant indirect effect on anxiety via sleep disturbance.<sup>[29]</sup>

A study conducted by Bashir H and Bhat S A implied that social media has dangerous effects on mental health, especially among the younger generations.<sup>[30]</sup>

Similarly, a study conducted by Muhammad Ali Balouch *et al.*,<sup>[31]</sup> found that the total time spent on social networking sites, was associated with depression.

In a study conducted by Lisa Barman *et al.*,<sup>[32]</sup> it was found that a significant proportion of medical students have a massive affinity towards SNS (social networking sites),

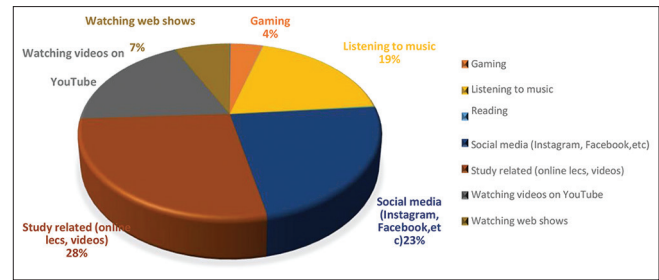


Figure 2: Distribution of the main purpose of smartphone usage (N = 300)

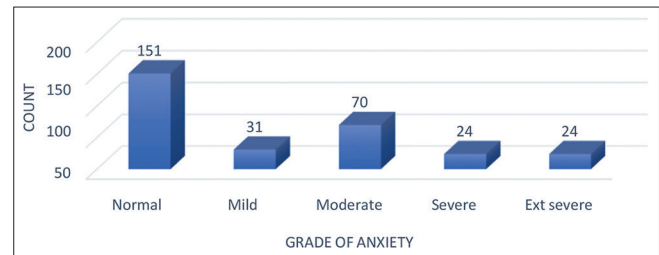


Figure 4: Anxiety score

Table 2: Distribution of average screen time among both groups

Screen time	NSI group number (%)	SI group number (%)
<2 h	9 (5%)	3 (2%)
2-4 h	64 (39%)	29 (22%)
4-6 h	60 (36%)	65 (49%)
6-8 h	24 (15%)	22 (16%)
>8 h	9 (5%)	15 (11%)
Total	166	134
Average screen time	4±2 h	5±2 h

Table 3: DASS score comparison in NSI and SI group

DASS score	NSI mean	SI mean	P
Stress	9.024	13.925	0.0089
Anxiety	6.518	10.209	1.2830
Depression	6.964	12.985	0.0048
Total (N=300)	166	134	

and it was significantly associated with depression and anxiety, similar to our findings.

This suggests that social media can induce the user with negative experiences such as inadequacy with one's life, fear of missing out (FOMO), isolation, etc., which gradually turns into a vicious cycle, ultimately affecting the mental health of the person.<sup>[33]</sup>

There is evidence that, in young adults and adolescents, social media use is associated with nearly twice the risk of sleep disturbance in the heaviest users compared with the lightest users and with poorer sleep quality, lower self-esteem, and higher levels of anxiety and depression.<sup>[34]</sup>

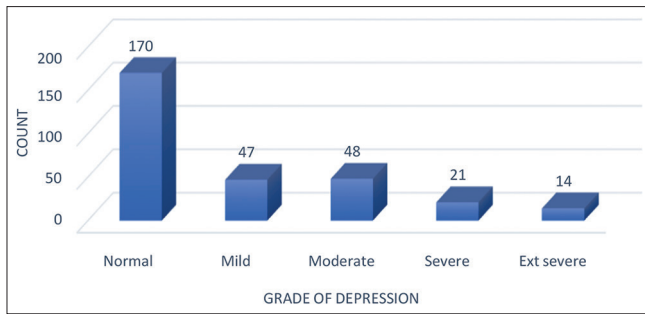


Figure 5: Depression score

Novel findings also showed reduced lateral orbitofrontal grey matter, especially in social networking platforms overuse, and that prolonged bedtime smartphone use has been associated with altered insula-centered functional connectivity.<sup>[9]</sup>

The average screen time for the NSI group was 4 h, while the SI group had a slightly increased average screen time of 5 h, indicating that absolute screen time was slightly more in the social interaction group, who experienced more symptoms of stress, anxiety, and depression in our study. This result is consistent with the findings of the study conducted by Xiaoyan Wu *et al.*,<sup>[35]</sup> who found a positive association between high screen time and mental health problems and poor sleep quality. Also, a study conducted by Vandana S. Daulatabad *et al.*, also observed that lack of physical activity and excessive smartphone had a negative impact on physical and mental health.<sup>[36,37]</sup> A study conducted by Anne-Linda Camerini *et al.*,<sup>[38]</sup> also found out that increased screen time was a risk factor for mental health problems. Recent studies show that excessive use of screens, including computer screens and smartphones, is associated with serious mental problems and cognitive impairments.<sup>[9]</sup> In addition to the psychological consequences, the excessive use of smartphones can potentially lead to impairments in cognitive functions. Such excessive use is related to impairments of specific attention domains (such as focused attention and divided attention), low inhibitory control, impaired working memory, reduced numerical processing capacity, and changes in social cognition.<sup>[39]</sup> Recent studies have also shown an association between excessive use of smartphones and abnormal activity of regions in the prefrontal cortex and in the networks that connect to these regions.<sup>[40,41]</sup> Hence, it becomes crucial to limit screen time and avoid excessive usage of smartphones.

### Limitations and recommendations

This research is restricted to a single medical school in Solapur. It would be inappropriate to generalize our current findings, given that there are just a few studies<sup>[23,42]</sup> that have demonstrated that smartphones and social media have improved mental health. In

addition, this study overlooks other aspects of a person's life that may also contribute to stress, anxiety, or depression from its assessment of mental health. Consequently, a multicentric study encompassing many medical undergraduates from both government and private medical colleges will certainly provide a better understanding. Further knowledge and comprehension of the therapeutic processes are also necessary.

## Conclusion

The study participants did not feel a lot of stress, anxiety, or depression symptoms when smartphones were used judiciously and mostly for non-social purposes (such as studying, listening to music, or watching videos). This investigation led us to the conclusion that there are some positive effects of smartphones on mental health. Whereas those who spent an excessive amount of time on their smartphones for social contact, with an average screen time of 5 h, showed signs of mild to moderate sadness, moderate anxiety, and tension, demonstrating that social media had a negative impact on the mental health of medical undergraduates. Therefore, efforts should be made to inform medical students about how using a smartphone is harming their mental health. They could be given direction and educated on how to make the most of the many resources on cell phones, such as those connected to studying and apps for mental health, to improve both their knowledge and mental health. However, if using social media negatively impacts their mental health, efforts should be taken to educate and assist them in lowering their overall time spent on social media.

### Acknowledgements

We hereby acknowledge the active participants of our study for their whole-hearted contribution to the study.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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