



## ORIGINAL ARTICLE



# IMPACT OF SMART PHONE USAGE ON SLEEP, MELATONIN AND ITS CORRELATION WITH ANXIETY AND DEPRESSION IN FIRST YEAR MEDICAL STUDENTS

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### Abstract

Significant increase in the smart phone use had been associated with various effect on the health. Various theories have proposed for sleep, circadian rhythm disturbances and studies have shown effect on melatonin levels and mental health. The objective of this study was to evaluate the effect of smart phone on sleep time, sleep duration and serum melatonin levels. To determine academic and non-academic usage and its correlation with academic performance. Effect of smart phone usage on the mental health i.e. anxiety and depression in young adult first year medical students. Sample size was 100, 3 were absent. A brief questionnaires' was asked to all the study group regarding usage of mobile phone and sleep hours in night. 9 A.M Morning fasting blood samples were taken and serum melatonin was estimated by ELISA kit. Hamilton's anxiety scale and Hamilton's depression scale was applied to the study group. Study had shown the smart phone usage was having an impact on sleep. Study have shown late bedtime, long sleep duration in the students with high user group. This may be result of sleep displacement and circadian rhythm disturbances. Low levels of melatonin in high users as compared to low users, which may be due to exposure EMF leading to circadian rhythm disturbance. The academic and the non- academic usage was significantly high in high users, but with no significant difference in the academic performance. High academic usage of smart phone may lead to better academic performance despite of late bedtime. Non-academic usage of smart phone may cause emotional arousal leading to anxiety. Anxiety and depression score was high in high users group, but the difference was not statistically significant. But it is not clearly understood whether the smart usage is responsible for anxiety and depression or anxiety and depression causes high smart phone usage. Smartphones affect the academic lives of the undergraduate medical students. This study can conclude with the fact that using smartphones made an impact on students both positively and negatively.

**KEYWORDS:** - Smart phone, sleep, Melatonin, Anxiety, Depression

## 1 | INTRODUCTION

A smart phone is the mobile phone having advanced functions along with the basic features of making and receiving calls and text messages. These advanced functions include internet access and various 'apps'. Significant increase in smart phone use and capabilities allow everyone to access internet, social media anytime anywhere. Smart phone is associated with use of internet and social media which are part and parcel of computer assisted technology.

Though there are lots of benefits of a smart phone but it may also lead to overuse and addiction which further have negative health consequences like sleep disturbances, circadian rhythm disturbances and mental health. Various theories have been proposed to explain the mechanism of sleep disturbances due to excessive use of electronic media like smart phones- interference with sleep through increased psychophysiological arousal, through bright light exposure to electromagnetic radiations and physical discomfort caused by prolonged media use<sup>1</sup>. Bright light may impact sleep in two ways: by delaying the circadian rhythm when exposure takes place in the evening<sup>2</sup> and also by causing an immediate activation in itself.<sup>3,4</sup> The authors have already found poor sleep quality among students with increasing hours of usage of mobile per day<sup>5</sup>

The cell phones, tablets, computers and other electronic gadgets have become such a huge part of life that it's often hard to put them down—even at bedtime. Whether it is surfing the web, playing a video game, or using your phone as an alarm clock in the late evening, it is being away from a restful night. The blue light emitted by screens on cell phones, computers, tablets, and televisions restrain the production of melatonin. Melatonin is a natural hormone made by our body's pineal gland. During the day the pineal gland is inactive. Melatonin secretion in humans exhibits diurnal variation: levels are lowest during the day, and peak overnight during sleep<sup>6</sup>. It is a hormone that controls your sleep/wake cycle or circadian rhythm<sup>7</sup>. Reducing melatonin makes it harder to fall and stay asleep. Melatonin exerts physiologic effects that are enhancement of immune response,

scavenging of free radicals and suppression of tumour growth in humans and experimental animals<sup>8</sup>. A decrease in nocturnal melatonin secretion in rodents chronically exposed to EMF has been reported<sup>9</sup>. Experiments on humans acutely exposed to EMF for a night have not resulted in reproducible effects on serum melatonin or urinary excretion of its main metabolite, 6-sulfatoxymelatonin (6-OHMS)<sup>10,11</sup>.

Numerous psychiatric problems related to excessive smartphone use have been identified, including depressive symptoms, anxiety<sup>12</sup> and low self-esteem<sup>13</sup>. However, in a study of 755 university students, smartphone addiction was found to be significantly associated with depression, anxiety, obsessive-compulsive symptoms, and impulsivity<sup>14</sup>.

If smartphone use can cause mental illness, and to examine this, psychologist Dr. Jon Elhai and his colleagues conducted a systematic review of the literature of smartphone behaviors<sup>15</sup>. The researchers identified 23 peer-reviewed articles that investigated the relationship between problematic smartphone use and symptoms of anxiety and depression. The researchers found that smartphone use was in fact associated with symptoms of anxiety and depression, as well as increased experience of stress. The more participants used their smartphones, the more likely they were to experience symptoms associated with these disorders and report being stressed. Why might this relationship exist? It is possible that problematic smartphone use represents a form of addiction similar to internet addiction<sup>16</sup>. Problematic smartphone use - compulsive or excessive - could worsen symptoms of anxiety and depression. Research has found that some individuals experience intense anxiety when separated from their phones<sup>17</sup>, and some even exhibit withdrawal-like symptoms if they can't check their device<sup>18</sup>.

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Most people find it rewarding to check their apps and notifications. But some can become addicted to this positive feeling, compulsively checking their phones for updates. Such behaviour could become stressful, leading to worsening symptoms of anxiety and depression<sup>19</sup>. The "fear of missing out" (FOMO) could partially drive this cycle<sup>18</sup>, leading smartphone users to anxiously check their phones for fear of missing out on important social events or interactions. With smartphones so central to society, is mental health doomed because of technology?

Before worrying too much, keep two important facts in mind. First, the researchers found that the effects greater smartphone use were weak to moderate, meaning that it does not guarantee worse mental health. Second, and perhaps more importantly, the studies examined were correlational, meaning that it is not clear if smartphone use causes symptoms of mental illnesses or if symptoms of mental illness cause greater smartphone use. For example, perhaps a depressed person is more likely to use their smartphone to seek out social interactions or evade their negative thoughts. Similarly, an anxious person might be driven to check their social media feeds by an anxiety such as FOMO<sup>18</sup>. And it might be that someone experiencing increased stress is more likely to check their smartphone as a distraction. These cases would lead to greater smartphone use without ever causing negative effects. Here the smartphone use may be a symptom rather than a cause.

We still have much to learn about problematic smartphone use and its relationship to anxiety and depression. It is unlikely that smartphone use causes any substantial spike in mental health problems for most people. However, it is worth keeping in mind that your symptoms of anxiety and depression might be related to how you use your phone. If you are concerned, discuss this issue with a trained mental health professional.

Medical professionals is having a great responsibility of the society to carve themselves as eminent doctors, so they are required to be alert & attentive during learning period . To acquire professional level knowledge & skills of patient care, medical students who already have lots of academic burden and sleep problems due to other factors, smartphone

overuse/addiction if present may further complicate the things and may lead to significant stress which may be subsequently responsible for anxiety and depression.

The objective of this study was to evaluate whether

1. Usage of smart phone has effect on sleep time or sleep duration among the first year medical students.
2. Usage of smart phone has effect on serum melatonin levels
3. Academic usage and non-academic usage affects the academic performance
4. Effect of smart phone usage on the mental health i.e. anxiety and depression in young adult first year medical students

## 2 | METHODS

This is a cross sectional study done on first year M.B.B.S students of both sexes in the age group 17-23 yrs. from urban and rural backgrounds of Government Medical College, Gondia during April – May 2017. The study was approved by Institutional Ethical committee. We planned for purposive sampling, so our sample size was 100 . 3 students were absent (47 boys and 50 girls). We grouped the students in two – first group comprises of low users ( using smart phone for less than or equal to 2hrs and They were informed about the purpose of the study and asked to participate in the study. An informed written consent was taken from all the volunteers medical students prior to the start of study. A brief questionnaires' was asked to all the study group regarding usage of mobile phone and sleep hours in night.

Blood samples were taken in morning and serum melatonin was estimated by ELISA kit (ELABSCIENCE).

Hamilton's anxiety and depression scale was applied to the study group. Hamilton's anxiety scale was applied to the study group. Anxiety scale consists of 14 items, each defined by a series of symptoms, and measures both psychic anxiety (mental agitation and psychological distress) and somatic anxiety (physical complaints related to anxiety). Each item is scored on a scale of 0 (not present) to 4 (severe), with a total score range of 0–56, where <17 indicates

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mild severity, 18–24 mild to moderate severity and 25–30 moderate to severe<sup>20</sup>.

Hamilton's and depression scale was applied to the study group. This version contains 17 items (HDRS17) pertaining to symptoms of depression experienced. Method for scoring varies by version. For the HDRS17, a score of 0–7 is generally accepted to be within the normal range (or in clinical remission), while a score of 20 or higher (indicating at least moderate severity)<sup>21</sup>.

## DATA ANALYSIS

Statistical analysis was done SPSS software version 21. Test used for data analysis and level of significance was Kruskal- Wallis test and Mann-Whitney U test

## 3 | RESULTS

**TABLE 1: Distribution of the smart phone usage**

Smart phone usage	No.	Percentage
less than 2 hours	17	17.5%
2 to 5 hours	67	68%
5 to 7 hours	12	12.4%
more than 7 hours	1	1%

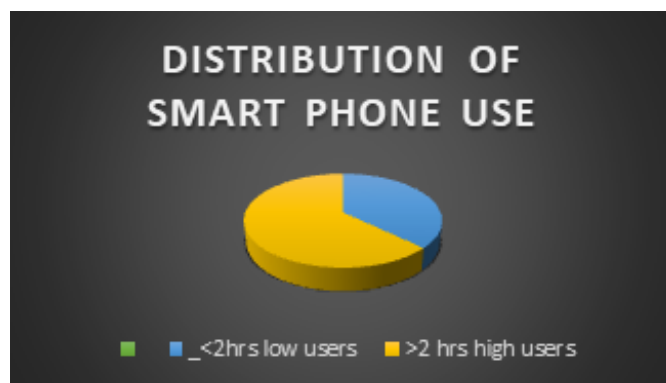
Table no. 1. Shows the distribution of smart phone usage in study population, with maximum numbers of students falling in the group of 2 to 5 hours usage.

**TABLE 2: Correlation between sleep hours and smart phone use**

Hours on smart phone	No.	Average Sleep duration in hours
<2hrs low users	36	5.5+ <sub>-</sub> 0.87
>2 hrs high users	61	6.2+ <sub>-</sub> 1.17
<b>p value</b>		0.220 NS

Table no. 2. Shows the distribution of students with respect to smart phone usage and their average sleep duration. 61 students come under high users with average sleep duration of 5.5+<sub>-</sub>0.87 hours whereas 36 students come under low user group with the average sleep duration of 6.2+<sub>-</sub>1.17. From the above results we found that the sleep duration was long in

high user groups as compared to low user group. The p value was 0.220 which is not significant.



**FIGURE 1:**

**TABLE 3: Correlation of bedtime with smart phone usage**

Bed time	No	Smart phone usage	p value
11PM	17	2.44+ <sub>-</sub> 1.30	0.051
11PM-12AM	33	2.67+ <sub>-</sub> 1.06	
12-1AM	32	2.97+ <sub>-</sub> 1.51	
1AM-2AM	15	3.77+ <sub>-</sub> 1.67	

Table no. 3. Shows the correlation of bedtime with the smart phone usage. The above results show that the smart phone usage is more in the students whose bedtime is late. The p value was 0.051 which not statistically significant.

**TABLE 4: Correlation of smart phone usage with Melatonin level**

Smart phone usage	No.	Melatonin levels	p value
<2hrs low users	36	32.76+ <sub>-</sub> 20.87	0.416
>2 hrs high users	61	29.58+ <sub>-</sub> 17.05	

Table no.4. Correlation of smart phone usage with Melatonin level. We found lower levels of melatonin in high users as compared to low users. The p value was 0.416 which was statistically nonsignificant.

Table no. 5. shows the distribution of smart phone usage for academic purpose and non-academic purpose. There were 36 students whose smart phone usage was equal or less than 2hrs (low users) a day

**TABLE 5: Showing the distribution of smart phone usage ( academic and non-academic use)**

Hours on smart phone	No.	Academic hours	Nonacademic hours
<2hrs low users	36	0.604+ <sub>-0.44</sub>	1.11+ <sub>-0.61</sub>
>2 hrs high users	61	1.26+ <sub>-0.701</sub>	2.28+ <sub>-1.27</sub>
<b>p value</b>		0.000*	0.000*

**TABLE 6: Relation of smart phone use with Academic performance**

Hours on smart phone	No.	Academic performance
<2hrs low users	36	23.03+ <sub>-2.95</sub>
>2 hrs high users	61	22.97+ <sub>-3.38</sub>
<b>p value</b>		0.376

were using smart phone for lesser time for academic purpose as compared to the 61 students whose smart phone usage was more than 2hrs ( high users). the p value was found to be significant. The non-academic usage of the mobile was also lower in low users group of students as compared to the high users group of students. The p value was also found to be significant.

Table no.6 shows the academic performance in low users and high users. The academic performance was low in high users groups as compared to low user group. The p value was 0.376 which is statistically nonsignificant.

**TABLE 7: Correlation of smart phone usage with Anxiety and Depression**

Smart phone usage	No.	Anxiety score	Depression score
<2hrs low users	36	4.89+ <sub>-4.9</sub>	3.94+ <sub>-5.22</sub>
>2 hrs high users	61	6.04+ <sub>-6.014</sub>	4.39+ <sub>-5.51</sub>
<b>p value</b>		0.378	0.610
Mann-Whitney U test			

Table no.7. shows the correlation of smart phone usage with the anxiety and depression. Anxiety score

was found to be higher in students with high users as compared to low users. The p value was 0.378 which is statistically nonsignificant. Similar results were found with depression score which was higher in high users as compared to low users. The p value was found to be 0.610 which was statistically nonsignificant.

## 4 | DISCUSSION

The study results have shown 68% of students were having 2-5 hours of smart phone usage with majority of the study population falling in high user group (more than 2 hours).The smart phone usage was having an impact on sleep and caused sleep disturbances<sup>22</sup>. The smart phone usage was more in students whose bedtime was late, but the p value was not significant. Increased use of smart phone is associated with increased internet use, and increased Internet use is associated with shorter sleep duration<sup>22</sup>; later bedtimes and rise times<sup>22,23,24</sup>; longer sleep latencies<sup>24</sup>; and increased daytime tiredness in adolescents<sup>22,23</sup>. We also found that sleep duration was more in the high user students, though the p value was not significant. Our results were similar to the previous study<sup>25</sup>. There are various theories regarding the effect of smartphone usage at bedtime on sleep quality. Some studies had shown that the use of smartphone affects sleeps through several mechanisms . One of them is sleep displacement; with the convenience of using a smartphone in bed, the time may fly without noticing and therefore displace the time of sleeping. According to previous studies, adolescents who owned smartphones were more likely to go to bed later, with the sleep duration not being affected<sup>26</sup>, which is almost similar to our finding with more sleep duration in high user groups. Another mechanism was that electromagnetic radiation emitted by mobile phones 30 minutes before sleeping was found to delay the onset of melatonin production which in turn might affect sleep<sup>27</sup>. Evidences that EMR reduces melatonin in human being commenced with Wang (1989) who found that the workers who were exposed to radiation field had dose response increase in serotonin levels and indicated a dose response reduction in melatonin<sup>28</sup>. This

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study showed that non visible electromagnetic field exposure depresses the conversion of serotonin to melatonin. A study done by EL- Helaly revealed that electronic equipment repairers who were exposed to extremely low ELF field had a lower mean levels of serum melatonin than that of controls with a high statistically significant difference<sup>29</sup>. A light-emitting diode (LED) emitted by smartphone screens was also reported to suppresses melatonin secretion which reduces sleepiness<sup>30</sup>. We found low levels of melatonin in high user group, but the difference was not significant. The reduced melatonin level may be the result of disturbed circadian rhythm which may be responsible for sleeplessness and health effects<sup>31</sup>.

A third proposed mechanism is emotional arousal. Smartphones serve as a way of communication between people and thus makes it a way of conducting bad or good news or even communicating a conflict between people which might increase emotional arousal at night, therefore, affects sleep. However, it has not yet been experimentally tested<sup>31</sup>. Incoming notifications, when the smartphone is not turned into silent mode, may wake up the individual and disrupt his/her sleep. Therefore we also tried to see the academic usage and the non-academic usage of the smart phone. As the more non academic usage will be having more emotional arousal. Our results shows that non-academic usage was higher in high user group as compared to low user group and the p value was statistically significant. So emotional arousal would be more in high users due high non-academic usage. This study which had focussed on the important confounding factor i.e. academic and non-academic use of smart phone. Academic usage was also found high in the high user group as compared to low user and the difference was statistically significant. This finding can be correlated to the academic performance in high user group, which is slightly low as compared to low user, but the difference is not statistically significant. High academic usage of smart phone may lead to better academic performance despite of late bedtime. Academic learning is now innovative as a result of smartphone and other media in promoting and advancing 21st century needed skills and knowledge<sup>32</sup>. Students have experiences of digital surroundings in a tactile and personal manner, which is brought about by some mobile devices,

including tablets and smartphones<sup>33</sup>. Mokoena et al argues that the use of smartphones by students improves collaborative learning through its connection to the internet<sup>34</sup>. This statement implies that the use of smartphones drives students to be more engaged in learner-centred participation learning. This is a vivid indication on numerous supports that smartphones have brought to the students; it advances their understanding by increasing academic performance, social media participation and information sharing; it helps their social skills by giving them opportunities to seek academic assistance and support, and many more<sup>34</sup>(Mokoena, 2012). But some studies have also shown smart phone usage and application usage when studying has the negative effect on students' academic performance<sup>35,36</sup>.

Numerous psychiatric problems related to excessive smartphone use have been identified, including depressive symptoms<sup>37</sup>, anxiety<sup>37</sup>, and low self-esteem<sup>38</sup>. Smartphone addiction was found to be significantly associated with depression, anxiety, obsessive-compulsive symptoms, and impulsivity<sup>39</sup>. In the present study we found anxiety score and depression score was more in high user group as compared to low user, the difference was not statistically significant. Problematic smartphone use - compulsive or excessive - could worsen symptoms of anxiety (<https://www.anxiety.org/what-is-anxiety>) and depression. Research has found that some individuals experience intense anxiety when separated from their phones<sup>40</sup>, and some even exhibit withdrawal-like symptoms if they can't check their device<sup>41</sup>. Given these findings, it is possible that certain forms of smartphone use could cause or worsen symptoms of mental illness. problematic smartphone use represents a form of addiction similar to internet addiction<sup>42</sup>. Most people FIND it rewarding to check their apps and notifications. But some can become addicted to this positive feeling, compulsively check-ing their phones for updates. Such behaviour could become stressful, leading to worsening symptoms of anxiety and depression<sup>43</sup>. The "fear of missing out" (FOMO) could partially drive this cycle<sup>41</sup>, leading smartphone users to anxiously check their phones for fear of missing out on important social events or interactions. With smartphones so central to society, is mental health doomed because of technology? So-

cial media use are associated with risk for depression and anxiety<sup>44</sup>. The problematic smartphone use is responsible for poor sleep, late bedtime. We still have much to learn about problematic smartphone use and its relationship to anxiety and depression.

## 5 | CONCLUSION

Smartphones affect the academic lives of the undergraduate medical students. In literature studies, there were arguments made for and against the impacts that smartphones have on the academic performance of students. This study can conclude with the fact that using smartphones made an impact on students both positively and negatively. Usage of smart phone has great impact on sleep, and is also associated with low melatonin levels. High Smart phone usage is correlated with anxiety and depression. But it is not clearly understood whether the smart usage is responsible for anxiety and depression or anxiety and depression causes high smart phone usage. It is unlikely that smartphone use causes any substantial spike in mental health problems for most people. However, it is worth keeping in mind that your symptoms of anxiety and depression might be related to how you use your phone. Other confounding factors need to be studied. Cell phones are undeniably convenient, helpful tools for study and can be a hurtful source of distraction depending on the attitude and use pattern of a student. Use of smart phone may be beneficial if use properly and cautiously can have better academic performance.

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