SHORT COMMUNICATION

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Impact of Screen Time on Sleep and Attention Among Physiotherapy Students- An Observational Study

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Abstract

Advancements in technology have led to increased exposure to digital screens out of which the most commonly used are mobile phones. Excessive use of mobile screens for more than 2-3 hours has negatively impacted sleep and attention, which are students' basic needs for overall academic performance and clinical practice. Our study aims to determine the impact of screen time on sleep quality and its correlation with sustained attention, selective attention, and divided attention. An observational study with 200 participants, with an age range of 18-25 years, included males and females, and screen time of less than 2 hours was excluded. Outcome measures were average screen time, PSQI, d2 attention test, Deary-Liewald task, and walk and turn test. The study showed the significance of increased poor sleep quality (t-13.89, p<0.001) with an increase in screen time, also associated with poorer attention performance (t-2.90, p-0.004). Our study also showed that screen time negatively correlates with sustained attention (r-0.160, p-0.023) among physiotherapy students. The study concluded that there is no significance shown between screen time and selective and divided attention. Still, there was a significant association between screen time and poor sleep quality, contributing to impaired attention performance.

Major Findings: 1. Increased screen time is associated with poor sleep quality (t = 13.89, p < 0.001). **2.** Higher screen time correlates with diminished attention performance (t = 2.90, p = 0.004). **3.** Increased screen exposure negatively affects sustained attention abilities (r = -0.160, p = 0.023) among physiotherapy students.

Keywords: Attention, Screen Time, Sleep, Students

1. Introduction

'Screen time' encompasses any time spent in front of a screen, be it a computer, wearable device, television, tablet, smartphone, or video gaming console. Smartphones are common devices, and students spend more time on phones, leading to smartphone addiction. Advancements in technology enable global access to different stimuli through mobile devices, resulting in excessive screen time that exceeds the recommended maximum of 2-3 hours per day. Excessive use of mobile phones deteriorates sleep quality, leading to disruption of sleep and lowering sleep quality. 86.6% of the population uses the internet in advanced nations 47% in developing nations, and the remaining

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19.1% in less developed countries. In India, 37% of the population had internet connections 92% of the population owned a mobile phone. Inadequate sleep slows down cognitive processing, reduces overall alertness, and impedes concentration. 49.8% of the students in the research reported inadequate quality sleep. Two out of ten medical students in India suffer from inadequate sleep; 62.6% reported having poor sleep quality in undergraduate students [6,7]. Data on the possible harmful effects of prolonged exposure to screens in young adults is limited, even though digital media use and attention disorders are becoming more common among them[8]. Information processing is what makes attention unique, and it can be classified into selective attention, sustained attention, and divided attention. As age increases, there are changes in attention processing[9]. Lack of sleep reduces focus on easy tasks and makes people more easily distracted, since adequate sleep is essential for both physical and mental well-being, as well as appropriate neurocognitive and psychomotor functioning. Poor sleep quality can cause attention problems and poor academic performance[10]. Previous studies have shown that increased time spent on mobile phone screens among young adults is likely to develop sleeping problems causing poor sleep quality and attention problems due to which students find it difficult to focus and keep attentiveness in academic performance and professional practice, the study aims to determine the impact of screen time on sleep quality and its correlation with sustained attention, selective attention, and divided attention.

2. Materials and Methods

2.1 Participants

A cross-sectional study was conducted among physiotherapy students at Srinivas Institute of Physiotherapy, Mangalore. The total number of participants was 200, 75 were males, and 125 were females. Participants whose screen time was less than 2 hours and who were above 25 years of age were excluded, and aged 18-25 of both males and females were included.

2.2 Procedure

After the ethical clearance was received by the Institutional Ethical Board, the investigator took informed consent from participants and proceeded with the tests. At first, average screen time was calculated over 2 weeks using the digital well-being option on smartphones[11]. Then, participants were asked to complete the Pittsburgh Sleep Quality Index (PSQI) questionnaire via Google Forms, and the scores were collected in Excel sheets. Two categories were created based on PSQI scores: ≤5 for excellent sleep and >5 for poor sleep quality[12]. Then the three attention tests were followed.

2.2.1 Deary-Liewald Test[11]

The Deary-Liewald test is used for checking reaction time, how long a person can focus, and how it impacts sustained attention. Participants were given two tasks – a simple and a complex task. In a simple task at a brief but unpredictable time circle will light up. Once the circle lights, participants were instructed to press the button as soon as possible. On the other hand, a complex task here consists of 4 circles, of which only one circle will light up. Participants were instructed that once the light pops up in any of the circles, the button beneath should be pressed as soon as possible. This test measures the reaction time.

2.2.2 Attention Test[13]

This test is time-limited and evaluates one's capacity to focus on pertinent details of a task while disregarding irrelevant details, and speed, accuracy, and consistency in completing the task. The participants were shown the target image, which comprised a central figure and a variable number of small figures that were embedded on top or bottom of the central figure. The next step contained the target image with attention-grabber stimuli that resembled the target image. In each step, the participants should select all target images and avoid the distracting images. When participants had completed selecting all the images of their choice, they were told to confirm it by pressing the confirm button located at the bottom right of the screen within the time allowed. The time taken to complete the task in seconds and the accuracy in percentage were calculated.

2.2.3 Walk and Turn Test[14]

The walk and turn test is a "divided attention" standardised field sobriety test. Used for identifying cognitive impairment, mainly divided attention. Participants were told to follow directions and walk nine steps heel-to-toe in a straight line, and on the ninth step, the participants were told to turn back or pivot back and walk back along the same line for nine more steps. The examiner then

looks for the following eight indications or mistakes: Walking off the line, Not maintaining balance, Beginning the test before instructions were finished, Stopping midway through the test, Not touching heel to toe while walking, Deviations from straight line, Using arms to maintain balance, Turning inappropriately, Participants were considered to fail if they made two or more mistakes or they were unable to finish steps

2.3 Data Analysis

The normality of the data distribution was checked using the Kolmogorov–Smirnov test. The mean and Standard Deviation (SD) were calculated for continuous variables with a normal distribution, and the median with Interquartile Range (IQR) for continuous variables with a non-normal distribution. Comparison between the groups will be done by students' unpaired T-Test or Mann-Whitney U test as per the normality of the data.

Table 1. Descriptive statistics for age, screen time, PSQI, sustained attention, and selective attention

(n = 200)	Range	Mean	S.D.
Age (Years)	19 to 25	22.11	1.72
Screen time (Hours)	3 to 17	6.21	1.96
PSQI sleep	1 to 17	5.73	3.02
Sustained attention (Sec)	0.11 to 0.83	0.51	0.10
Selective attention (Sec)	15 to 150	89.90	27.42
Selective attention (%)	9 to 100	80.26	19.29

Table 1 shows the total number of participants along with their age, screen time, PSQI, sustained attention, and selective attention, and their calculated range mean and standard deviation.

Table 2. Distribution of gender, sleep quality and divided attention

		Frequency	%
Gender	Male	75	37.5
	Female	125	62.5
Sleep quality (PSQI)	Poor	114	57
	Good	86	43
Divided attention	Pass	168	84
	Fail	32	16

Among the total participants, 62.6% were female and 37.5% were male (Table 2). Among them, 57% of participants have poor sleep quality, and 43% have good sleep quality. 84% had passed Divided Attention, and 16% had failed Divided Attention

The chi-square test will be used for qualitative data. A statistical package, SPSS version. 24.0 will be used to do the analysis. $p<0.05$ will be considered significant.

3. Results

The independent sample t-test ($p > 0.05$) revealed no significant differences between genders in screen usage, sleep quality, or attention. The chi-square test found a significant connection between attentiveness and gender

Table 3. Comparison of age, screen time, PSQI, sustained attention, and selective attention according to gender

	Gender	Mean	S.D.	"t"	p-value
Age (Years)	Male	22.07	1.74	-0.24	0.808
	Female	22.13	1.72		
Screen time (Hours)	Male	6.26	1.89	0.26	0.792
	Female	6.18	2.01		
PSQI sleep	Male	5.63	3.32	-0.36	0.722
	Female	5.78	2.83		
Sustained attention (Sec)	Male	0.51	0.11	-0.12	0.904
	Female	0.51	0.10		
Selective attention (Sec)	Male	86.36	28.38	-1.42	0.158
	Female	92.02	26.71		
Selective attention (%)	Male	82.12	20.41	1.06	0.291
	Female	79.14	18.59		

The Independent sample "t" test was used to compare age, screen time, PSQI, sustained attention, and selective attention according to gender (Table 3). There was no difference ($p > 0.05$) in age, screen time, PSQI, sustained attention as well and selective attention between males and females.

Table 4. Association between sleep quality, attention and gender

	Gender				Chi-square	p-value
	Male		Female			
	n	%	n	%		
Sleep quality (PSQI)	37	49.3	77	61.6	2.88	0.090
	38	50.7	48	38.4		
Attention	69	92.0	99	79.2	5.71	0.017*
	6	8.0	26	20.8		

The Chi-square test was used to find the association between sleep quality, attention, and gender (Table 4). The attention was associated ($p < 0.05$) with gender.

Table 5. Comparison of age, screen time, PSQI, sustained attention and selective attention according to sleep quality

	Sleep Quality	Mean	S.D.	"t"	p-value
Age (Years)	Poor	22.17	1.70	0.58	0.561
	Good	22.02	1.76		
Screen time (Hours)	Poor	6.12	1.74	-0.73	0.465
	Good	6.32	2.23		
PSQI sleep	Poor	7.56	2.76	13.89	< 0.001*
	Good	3.29	0.82		
Sustained attention (Sec)	Poor	0.51	0.10	0.51	0.612
	Good	0.50	0.11		
Selective attention (Sec)	Poor	90.28	27.31	0.23	0.822
	Good	89.40	27.71		
Selective attention (%)	Poor	79.25	20.90	-0.84	0.400
	Good	81.58	16.97		

The Independent sample "t" test was used to compare age, screen time, PSQI, sustained attention, and selective attention according to sleep quality (Table 5). There was a difference ($p < 0.05$) in the PSQI according to sleep quality.

Table 6. Comparison of age, screentime, PSQI, sustained attention, and selective attention according to attention

	Attention	Mean	S.D.	"t"	p-value
Age (Years)	Pass	22.07	1.74	-0.74	0.459
	Fail	22.31	1.66		
Screen time (Hours)	Pass	6.04	1.91	-2.90	0.004
	Fail	7.11	2.03		
PSQI sleep	Pass	5.48	2.82	-2.65	0.009
	Fail	7.00	3.68		
Sustained attention (Sec)	Pass	0.51	0.10	-0.26	0.795
	Fail	0.51	0.13		
Selective attention (Sec)	Pass	89.44	26.49	-0.54	0.588
	Fail	92.31	32.23		
Selective attention (%)	Pass	83.29	16.17	5.46	< 0.001*
	Fail	64.31	25.86		

("t" = Independent sample "t" test; * Significant)

The Independent sample "t" test was used to compare age, screen time, PSQI, sustained attention, and selective attention according to attention (Table 6). There was a difference ($p < 0.05$) in the selective attention (%) according to attention.

Table 7. Impact of screen time on sleep and attention

	Screen time (Hours)	
	"r"	p-value
PSQI sleep	0.073	0.302
Sustained attention (Sec)	-0.160	0.023*
Selective attention (Sec)	-0.005	0.941
Selective attention (%)	-0.061	0.388

The Pearson correlation coefficient ("r") was used to find the impact of screen time on sleep and attention (Table 7). There was a negative correlation ($p < 0.05$) between sustained attention (Sec) and screen time (Hours).

Table 8. Relation between screen time, PSQI, sustained attention, selective attention according to age

	Age (Years)	
	"r"	p-value
Screen time (Hours)	-0.090	0.205
PSQI sleep	-0.063	0.375
Sustained attention (Sec)	-0.068	0.338
Selective attention (Sec)	0.194	0.006*
Selective attention (%)	0.004	0.958

Table 8 shows the Pearson correlation coefficient ("r") used to find the relation between screen time, PSQI, sustained attention, selective attention, and age. There was a positive correlation ($p < 0.05$) between selective attention (Sec) and age.

(p-value = 0.017, $p < 0.05$). Interestingly, the independent sample t-test revealed a significant difference in sleep quality (PSQI) based on sleep quality (p-value < 0.001). Furthermore, the independent sample t-test revealed enhanced selective attention in response to attention, with a p-value of less than 0.001. Further Pearson correlation coefficient analysis found a negative relationship between sustained attention and screen time ($r = -0.160$, $p = 0.023$) and a positive correlation between selective attention and age ($r = 0.194$, $p = 0.006$). Notably, there were nevertheless no significant associations between sustained and selective attention.

4. Discussion

The study conducted by Baria D, *et al.*, found a significant correlation between increased screen time and poor sleep quality among undergraduate medical students with complications of headaches because of increased screen time. Due to the biological significance of sleep

for human beings, even brief quality sleep deprivation that lasts a few days can impair mental and physical abilities. Both an individual's general productivity and health. As a result, sleep helps the mind and body return to their natural "equilibrium" between their many activities and their typical levels of neural activity. The amount of time college students spend using screens on different types of electronics, particularly those studying medicine, has increased dramatically since the COVID-19 pandemic[15,16]. Excessive screen use was directly linked to negative sleep outcomes, as 73.3% of participants acknowledged that their sleep patterns were affected, leading to sleeping problems in 64% of the surveyed students17. This study showed a similar significance in increased poor sleep ($t=13.89$, $p<0.001$) with an increase in screen time also associated with poorer attention performance ($t=2.90$, p-0.004) among physiotherapy students.

Montagni I, *et al* found in a cross-sectional study that increased screen time exposure led to increased self-perceived attention problems. As earlier said, university students are more prone to use smartphones in their day-to-day life, which can affect their sleep quality and attention. Our study related the same to the addition that poor sleep quality is associated with attention problems ($t=2.65$, $p=0.009$). It's likely understood that memory and interpretation of emotionally distressing stimuli are biased due to poor sleep quality, which may be due to increased screen time. According to our study, we found that increased screen time is associated with poor attention performance, and it negatively correlates with sustained attention, that is, when the screen time is increased, sustained attention performance decreases ($r=0.160$, $p=0.023$). The study also shows that the time taken for selective attention rises with age. Gobin CM et al showed that poor sleep quality led to a decrease in sustained attention. After losing sleep for a single night, people became more impulsive to unpleasant stimuli, making it harder for them to control their reactions and causing them to react incorrectly more quickly, indicating reduced sustained attention[18]. Notably, 52% admitted that their sleep quality deteriorated due to excessive screen time[19]. Our study correlates' the same in that even increased screen time reduces sustained attention among physiotherapy students. The study noted that attention spans measured through digit span tests did not correlate significantly with sleep scores, indicating that while screen time affects sleep, its impact on attention may be less direct[20]. As mentioned earlier, lack of sleep reduces focus on easy tasks and makes people more distracted; hence, there is a requirement for splitting tasks, also regarded as divided attention when multiple tasks are carried out. This happens when tasks must compete for limited cognitive resources, which causes interference with each other. In our study, we found no significance between screen time and divided attention among physiotherapy students. Thus, it states that increased screen time will gradually impact poor sleep quality while simultaneously affecting attention, which results in poor quality of academic performance as well as quality of life as age increases. The study was conducted among physiotherapy students, and only the 18-25 years of age population was included. This can be a limitation of the study; in further study, IT workers, scholars, etc., can be taken into the study, also larger populations can be estimated.

5. Conclusion

The study concluded that there is no significant correlation between screen time and selective attention and divided attention, but the study found that there is a significant association between increased screen time and poor sleep quality, contributing to impaired attention performance, also found that when screen time increases, sustained attention performance decreases.

5.1 Informed Consent Statement: YES

Informed consent was obtained from all subjects involved in the study.

5.2 Acknowledgments

The authors would like to acknowledge the participants of the study for their cooperation.

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APPENDIX 1

INFORMED CONSENT FORM

TITLE OF THE STUDY: IMPACT OF SCREEN TIME ON SLEEP AND ATTENTION AMONG PHYSIOTHERAPY STUDENTS-AN OBSERVATIONAL STUDY

INVESTIGATOR: Interns (JANE CARYN LOBO, HEMANTH A V) training at Srinivas Institute of Physiotherapy, Srinivas University, Mangalore – 575001.

PURPOSE OF RESEARCH: I, Mr./Miss....., have been informed by the investigators that the study is to find the impact of screen time on sleep quality and its correlation with sustained attention, selective attention, and divided attention.

BENEFIT OF THE STUDY: The findings from the study will provide data that will help assess the effect of screen time on sleep quality and attention among physiotherapy students.

PROCEDURE: I understand that the study involves me performing the test to find the screen time sleep quality and tests to assess attention among physiotherapy students. I am also told that I must cooperate and follow instructions.

RISK AND DISCOMFORTS: I understand that the investigator will be present during the Procedure, and I will not injure myself.

CONFIDENTIALITY: I understand that the medical information produced by this study will be confidential. If the data is used for publication in medical literature or for teaching purposes, no names will be used, and other literature, such as photographs and audio or video tapes, will be used only with permission.

REQUEST FOR MORE INFORMATION: I understand that the researchers will be available to answer my questions or concerns, and I will be informed of significant new findings discovered during the study. I understand that I may ask more questions about the study at any time to Miss JANE CARYN LOBO and that she will be available to answer my questions or concerns. Contact number:7349680983 and email ID: janeclobo21@gmail.com. I also understand that I will be informed of any significant new findings discovered during the study. A copy of the consent form will be given to me to keep for future reference. I have explained to Mr. /Ms..... ..... the purpose of the research, the procedure required, and the possible risks and benefits to the best of my ability.

SIGNATURE: DATE:

REFUSAL OR WITHDRAWAL: My participation is wholly voluntary, and I reserve my right to withdraw myself and discontinue from the study at any time during the period of the study. I also understand that the investigator may terminate my participation in the study at any time after they have explained the reasons for doing so.

INJURY STATEMENT: I understand that in the unlikely event of injury resulting directly from my participation in the study, medical treatment would be available to me. I understand that with my agreement to participate in this study, I am not waiving any of my legal rights.

We have explained to Mr./Mrs.…… ……the purpose of the research, the procedure required and the possible risks and benefits to the best of our ability.

INVESTIGATORS: JANE CARYN LOBO

HEMANTH A V

DATE:

I confirm that they have explained to me the purpose of the research, the study procedure I will undergo, and the possible risks, discomfort, and benefits that I may experience. I have read, and I understand its consent form; therefore, I agree to give my consent to participate as a subject in this research project.

PARTICIPANT:

DATE:

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