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Smartphone addiction and its correlation with academic performance in high school adolescents: An observational study

Rakesh Kumar[1*], Alpa Gupta[2], Ashvita Jaiswal[3]

[1]Associate Professor, [2]Professor, [3]Junior Resident, Department of Pediatrics, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Dehradun, Uttarakhand, India

Abstract

Background: The widespread use of smartphones, particularly among youth, has raised concerns about smartphone addiction and its adverse effects on physical activity and academic performance. This study conducted in Uttarakhand investigates the frequency of smartphone addiction and its influence on academic performance in high school adolescents, with implications amplified by the COVID-19 pandemic's increased smartphone reliance on education.

Objectives: This research aims to (a) assess the prevalence of smartphone addiction, (b) correlate addiction levels with academic performance, and (c) scrutinize the influence of daily smartphone usage on scholastic outcomes.

Materials and Methods: This cross-sectional observational study involved 331 students aged 12–17 in Dehradun, India. Data collection employed self-administered questionnaires comprising demographic parameters, the Smartphone Addiction Scale-Short Version, and self-reported academic results. Statistical analysis utilized nonparametric tests, the Chi-square test, Fisher's exact test, and Spearman rank correlation. Statistical significance was set at a $P < 0.05$.

Results: The mean age of the participants was 14.60 ± 1.2 years and an equitable gender distribution. Most attended Classes 8 and 9, with parents typically well-educated and employed. Notably, most students 224 (67.7%) borrowed smartphones rather than owning them 97 (29.3%). Daily smartphone usage averaged 2.27 ± 1.34 h, with video watching 97 (29.3%), music listening 91 (27.5%), and social media engagement 84 (25.4%) as common activities. Sixty-eight (20.5%) of students showed smartphone addiction, but this addiction did not significantly correlate with academic performance. Nevertheless, a negative correlation was observed between time spent on smartphones and academic marks ($r = -0.198$, $P < 0.000$), underscoring the importance of interventions to manage smartphone usage.

Conclusions: Although many school-going adolescents exhibit some level of smartphone addiction, this study did not find a substantial correlation between smartphone addiction and academic achievement. However, it emphasized the significance of addressing and moderating the time spent on smartphones to optimize academic outcomes.

Keywords: Addiction, mental health, nomophobia, smartphone addiction scale

Address for correspondence: Dr. Rakesh Kumar, Department of Pediatrics, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Dehradun, Uttarakhand, India.
E-mail: drrakesh99@yahoo.com

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INTRODUCTION

The pervasive use of smartphones, particularly among adolescents and young adults, has raised concerns about the increase in smartphone addiction and its multifaceted impact on individuals' lives. Research by Cohen revealed that nearly half of teenagers self-reported smartphone addiction, while 59% of adults believed that younger generations were highly attracted to smartphones.[1] In addition, a recent survey indicated that 45% of teenagers claimed to use the Internet almost continuously.[2] Smartphone addiction is categorized as a form of technology addiction characterized by impulsive and excessive smartphone use, leading to adverse consequences.[3] Excessive smartphone use has been associated with reduced physical activity, disrupted daily routines, and physical and psychological issues such as eye and neck pain, anxiety, depression, and relationship problems.[4]

Numerous studies have indicated that students, when given access to smartphones, tend to shift their focus toward leisure activities,

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particularly social media use, affecting their academic performance. For instance, checking Facebook and messaging during assignments has been linked to lower academic performance.[5] Even when smartphones are employed for educational purposes, they can still negatively impact tutorial-related activities, leading to reduced group activities and decreased motivation to learn.[6]

The relationship between smartphone usage and educational outcomes has been investigated in numerous studies, but the results have been mixed. Younger generations tend to prefer smartphones over personal computers due to the convenience and versatility they offer, including features such as chatting, video streaming, social media, and access to study materials.[7] Smartphone addiction is characterized by features resembling those of behavioral addictions. It is often colloquially referred to as "nomophobia" (No Mobile Phone Phobia). A recent study comparing pre-and postcoronavirus pandemic rates of nomophobia among medical students did not find any increase in smartphone addiction but there was an increased rate of checking for notifications and connectedness.[8] Prevalence rates of smartphone addiction vary but are significant, ranging from 39% to 48%.[9]

This study's primary objective is to examine the prevalence of smartphone addiction and investigate its relationship with the academic performance of school-going adolescents. Based on existing literature, the hypothesis is that a higher degree of smartphone addiction will correlate with lower academic scores. While a substantial body of literature exists on this subject, the results are inconsistent, and a definitive association remains unclear, warranting further research. In addition, limited studies have been conducted in the Uttarakhand region. This study aims to contribute specific literature on this topic within the Uttarakhand context. It is particularly relevant as the COVID-19 pandemic has significantly relied on online education, making smartphones a crucial tool for learning. This heightened use may have exacerbated smartphone addiction among adolescents due to easy access to smartphones at home. This study was done with the following objectives:

1. To estimate the prevalence of smartphone addiction in high school adolescents
2. To correlate the level of smartphone addiction with Scholastic performance
3. To correlate the time spent on smartphones and scholastic performance.

MATERIALS AND METHODS

This was a cross-sectional observational study done in a school in Dehradun after permission from the school's principal. Regular students from Classes 6 to 12 in the academic year 2022–23 were enrolled. The inclusion criteria are a citizen of India 12–17 years of age, a regular student of the school, and an understandable knowledge of English. Participants not providing assent were excluded.

Based on a previous study reporting the incidence of smartphone addiction to be 31.5%, the sample size calculated using the Cochran formula was 327.[10] Assuming a 10% error in filling forms and a 10% incomplete response rate, a sample size of 391 was estimated. Participants were enrolled through a purposive sampling technique.

Questionnaires were distributed in a self-administered format to be filled by students after assent with the help of the school coordinator. The opening page consisted of a description of the purpose of the study, the benefits and risks of participation, and how the individual data will be kept confidential. After reading the opening page, assent/consent was taken to participate and complete the questionnaire. Students were requested for maximal participation. No identifying information was collected, and students were reminded not to write names on the questionnaire sheet.

The questionnaire was prepared based on data from existing literature. It contained a total of 27 items. Apart from the demographic parameters (17 items), the questionnaire incorporates the following screening scores as a component, namely the Smartphone Addiction Scale – short version containing 10 items.

Smartphone addiction was detected by using the Smartphone Addiction Scale-short version (SAS-SV), which is a ten-item scoring scale. Participants' responses to the items are documented using a Likert Scale that spans from strongly disagree to strongly agree. The scale items were taken from a much-detailed SAS containing 31 items. The minimum score on the scale is 10, and a maximum score of 60. In a previous study, different cutoff values have been given to boys and girls to detect smartphone addiction. A cutoff value of 31 in boys and a cutoff value of 33 in girls was found to have adequate sensitivity and specificity for detecting addiction. This tool has been validated in the pediatric population.

Academic performance was assessed through a self-reported percentage of marks in the last annual examination or sessional examination (whichever is later) conducted by the school. Data thus obtained were entered in Microsoft Excel spreadsheets and were stored in a password-protected laptop by the researcher. The final analysis used the Statistical Package for the Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 25.0.

"Categorical variables were presented as numbers and percentages (%). Quantitative data were presented as the means ± standard deviation (SD) and as the median with 25th and 75th percentiles (interquartile range). The normality of data was checked by using the Kolmogorov–Smirnov test. Quantitative nonnormal variables were compared using the Mann–Whitney *U*-test. Qualitative variables were compared by using the Chi-square test and Fisher's exact test. Spearman rank correlation coefficient was used for the correlation between academic performance and smartphone addiction and time spent on smartphones and academic performance. For statistical significance, $P < 0.05$ was considered statistically significant.

This study was approved by the institutional ethical committee vide letter no. SRHU/HIMS/ETHICS/2022/397."

RESULTS

This study was carried out among children 12–17 years of age studying at a private public school in the district of Dehradun, Uttarakhand, between March 2023 and June 2023. The questionnaire was distributed by the school coordinator to eligible children of Classes 7–12. A total of 377 students were given forms out of

which 331 consented to participate. Smartphone addiction as per the SAS-SV was present in 68 (20.5%) of children. Out of these, 30 (44.1%) were girls and 38 (55.9%) were boys. There was no significant difference in the frequency of smartphone addiction among boys and girls (P = 0.208). As seen in Table 1, the mean age of the participants was 14.60 ± 1.59 years. There was no difference in smartphone addiction with respect to age, sex, class of study, parental age, occupation, or monthly household income.

As seen in Table 2, only 32.3% of participants had their own smartphone, and most of them 185 (55.9%) took the smartphone of their mothers to use. The most frequent source of Internet was mobile data (77.9%). The average smartphone use was 2.27 ± 1.34 h and there was no association between time spent on a smartphone on addiction. Smartphone was commonly used for watching videos 97 (29.3%) followed by listening to music 91 (27.5%).

As seen in Table 3, the aggregate marks obtained in the last examination was 72.93 ± 13.36% and there was no significant difference in marks obtained between addicted and not addicted participants.

Table 4 shows the response to individual items in the SVS. The Cronbach's Alpha of the SAS-SV was 0.862.

Spearman's correlation was done with aggregate marks and scores on the SAS-SV score, and there was no significant correlation between the two variables (r = 0.008, P = 0.887, Figure 1).

Spearman's correlation was done with aggregate marks and time spent on smartphones each day. A significant negative correlation was observed between these two variables (r = −0.198, P < 0.000, Figure 2).

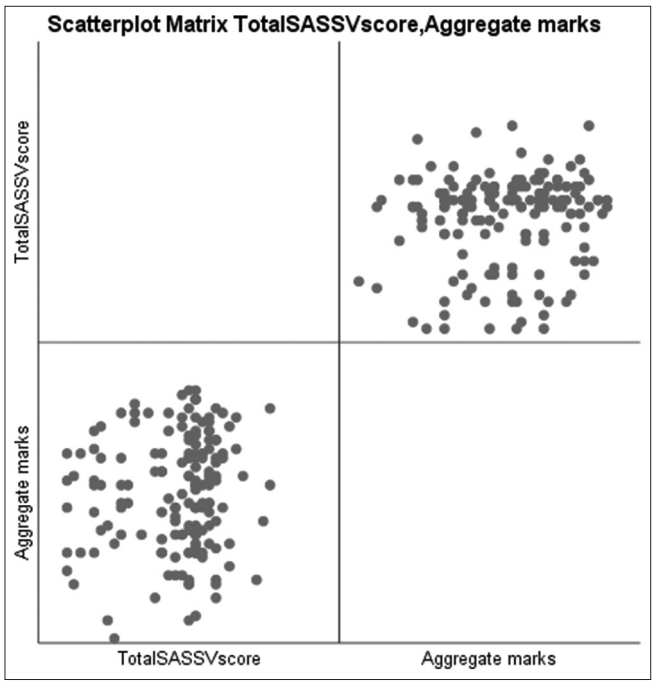

Figure 1: Scatter plot matrix smartphone addiction scale-short version score and aggregate marks. SVS-SV: Smartphone addiction scale-short version

DISCUSSION

This study aimed to find the prevalence of smartphone addiction in school-going adolescents and its impact on their academic performance. This study gathered information about the general use of smartphones, which slowly grows into addiction and may impact their academic performance. A total of 68 (20.5%) of participants were found addicted to smartphones.

Smartphone use in teenagers is increasing, possibly due to the developmental age of growing independence, increased free time, high degree of peer influence, the desire for peer and social connectedness, and increased incorporation of technology in daily routine.[2,11]

In 2014 Problem Smartphone Use (PSU) was declared to be a global behavioral addiction and public health concern impairing human function by the World Health Organization.[12] Adding to the two decades of PSU research, this study contributes findings that students in high school in Uttarakhand have access to a smartphone, integrate the device into their life, use the device for different works, and a significant number of them become addicted to its use.

The findings of this study also show that high school students use their smartphones frequently, and some use them inside the classroom, too. The reasons for use are to communicate with family and friends and to counter boredom (listening to songs and mobile games). The smartphone was used by 100% of participants in this study.

Based on age-specific statistical data, it can be observed that the prevalence of smartphone usage among children varies across different age groups. Specifically, the data indicates that smartphone usage stands at 35% for children aged 3–4 years, 38% for those aged 5–7 years, 75% for the age group of 8–11 years, and 86% for children aged 12–15 years.[13] The mean age of the participants in this

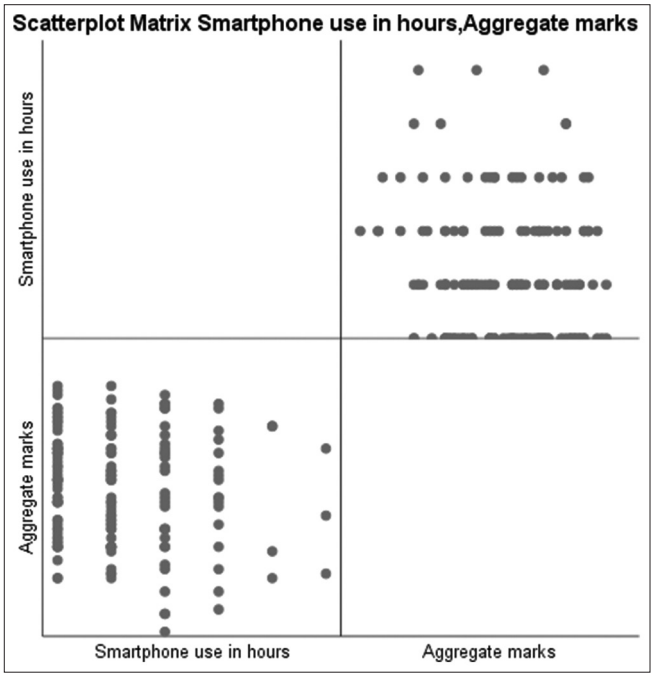

Figure 2: Scatter plot matrix showing time spent on smartphones and aggregate marks

Table 1: Demographic parameters

Variable	Addicted, *n* (%)	Not addicted, *n* (%)	Total, *n* (%)	*P*
Addiction	68 (20.5)	263 (79.5)	331 (100)	-
Age, median (IQR)	15.00 (13.0–16.0)	14.00 (13.0–16.0)	15 (13–16)	0.760#
Sex				
Female	30 (44.1)	133 (50.6)	163 (49.24)	0.414
Male	38 (55.9)	130 (49.4)	168 (50.76)	
Class				
7	2 (2.9)	9 (3.4)	11 (3.3)	0.955*
8	19 (27.9)	78 (29.7)	97 (29.3)	
9	18 (26.5)	56 (21.3)	74 (22.4)	
10	14 (20.6)	56 (21.3)	70 (21.1)	
11	5 (7.4)	17 (6.5)	22 (6.6)	
12	10 (14.7)	47 (17.9)	57 (17.2)	
Mothers age, median (IQR)	39.0 (36.0–41.0)	39.00 (36.0–42.0)	39.0 (36.0–42.0)	0.982#
Fathers age, median (IQR)	43.0 (40.0–46.0)	44.0 (41.0–47.0)	43.0 (41.0–46.0)	0.259#
Mother's education				
Illiterate	2 (2.9)	11 (4.2)	13 (3.9)	0.978*
Able to read and write	3 (4.4)	16 (6.1)	19 (5.7)	
Primary school	3 (4.4)	17 (6.5)	20 (6.0)	
Secondary school	10 (14.7)	41 (15.6)	51 (15.4)	
Graduate	34 (50.0)	118 (44.9)	152 (45.9)	
Postgraduate	16 (21.1)	60 (78.9)	76 (23.0)	
Father's education				
Illiterate	1 (1.5)	8 (3.0)	9 (2.7)	0.453*
Able to read and write	6 (8.8)	12 (4.6)	18 (5.4)	
Primary school	3 (4.4)	12 (17.5)	15 (4.5)	
Secondary school	11 (16.2)	46 (42.2)	57 (17.2)	
Graduate	34 (50.0)	111 (28.1)	145 (43.8)	
Postgraduate	13 (19.1)	74 (28.1)	87 (26.3)	
Mother's employment				
Unemployed	2 (2.9)	4 (1.5)	6 (1.8)	0.600*
Homemaker/Housewife	49 (72.1)	200 (76.0)	249 (75.2)	
Self-employed	4 (5.9)	16 (6.1)	20 (6.0)	
Salaried	8 (11.8)	33 (12.5)	41 (12.4)	
Professional	5 (7.4)	10 (3.8)	15 (4.5)	
Father's employment				
Unemployed	0	0	0	0.410*
Homemaker/Housewife	0	4 (1.5)	4 (1.2)	
Self-employed	22 (32.4)	64 (24.3)	86 (26.0)	
Salaried	32 (47.1)	146 (55.5)	178 (53.8)	
Professional	14 (20.6)	49 (18.6)	63 (19.0)	

*Fisher's exact test, #Mann–Whitney *U*-test. IQR: Interquartile range

study was 14.60 ± 1.59 years. The mean age was 13.78 ± 2.43 years in a study done by Xin *et al*.[14] According to a study conducted by Csibi *et al*., it was determined that individuals in the preschool age group as well as young people face the greatest susceptibility to smartphone-related addictive tendencies.[15]

The average age of the mother in this study was 39 ± 4.06 years, while that of the father was 43.8973 ± 4.13 years. The majority of the mothers had educational qualification of graduation or higher (68.9%), similarly majority of fathers had an educational qualification of graduation or higher (70.1%). While most of the mothers were homemakers, most of the fathers were salaried.

There was no significant association found between smartphone addiction and variables such as gender, household income, or parent's level of education. The findings presented here align with previous research studies that have indicated a lack of substantial association between smartphone addiction and gender.[16,17] According to a survey conducted by Groupe Speciale Mobile Association (GSMA) in 2011, the utilization of smartphones among children aged 8–18 years was not found to be influenced by either household income or parents' level of education.[18] Bhanderi *et al*. found that teenagers belonging to higher socioeconomic backgrounds exhibit a greater propensity for smartphone addiction.[19] Firat *et al*. identified maternal education as the sole predictor of SA in their study.[20]

Smartphones provide a diverse range of content that is customized to suit the specific interests of individuals from various socioeconomic backgrounds. This enables each user to access content that aligns with their personal preferences or addresses their specific needs or deficiencies. This may be the reason for the observation that demographic characteristics generally had no significant correlation with smartphone addiction.

The average duration of smartphone use by participants in this study was 2.27 ± 1.34 h (range 1–3 h). In a study by Gangadharan *et al*., the average smartphone use was 2.9 ± 1.5 h on weekdays and 3.8 ± 1.2 h on weekends.[21] Liu *et al*. provided data on the average daily smartphone usage times for primary, middle, and high school students, which were 0.76 ± 0.90, 1.34 ± 1.29, and 2.39 ± 1.66 h,

Table 2: Smartphone usage characteristics

Smartphone characteristics	Addicted (*n*=68; 20.5%)	Not addicted (*n*=263; 79.5%)	Total (*n*=331; 100%)	*P*
Own self smartphone				
Yes	22 (32.4)	85 (32.3)	107 (32.3)	1.00$
No	46 (67.6)	178 (67.7)	224 (67.7)	
Owner of smartphone				
Own smartphone	22 (32.4)	85 (32.3)	107 (32.3)	0.640*
Mother's	38 (55.9)	147 (55.9)	185 (55.9)	
Father's	3 (4.4)	20 (7.6)	23 (6.9)	
Other family members	4 (5.9)	9 (3.4)	13 (3.9)	
Relative's	1 (1.5)	2 (0.8)	3 (0.9)	
Mode of Internet used				
Mobile data	57 (83.8)	201 (76.4)	258 (77.9)	0.250*
Wifi	11 (16.2)	62 (23.6)	73 (22.1)	
Average smartphone use in a day median (h)	2 (1–2.25)	2 (1–3)	2 (1–3)	0.482#
The most frequently used activity				
Chatting on WhatsApp	11 (16.2)	36 (13.7)	47 (14.2)	0.533*
Watching video	16 (23.5)	81 (30.8)	97 (29.3)	
Use for social media	15 (22.1)	69 (26.2)	84 (25.4)	
Listening music	23 (33.8)	68 (25.9)	91 (27.5)	
Use for calling friends	3 (4.4)	9 (3.4)	12 (3.6)	
Social media use				
Yes	42 (32.9)	210 (79.8)	252 (76.1)	0.003$
No	26 (32.9)	53 (20.2)	79 (23.9)	
Use of smartphones in school				
Yes	0	4 (1.5)	4 (1.2)	0.585*
No	68 (100.0)	259 (98.5)	327 (98.8)	

*Fisher's exact test, #Mann–Whitney *U*-test, $Chi-square test

Table 3: Academic performance of participants

	Addicted	Not addicted	Total	*P*
Marks (aggregate percentage, median [IQR])	71.50 (63.25–87.75)	73.0 (60.0–82.0)	73.0 (62.0–83.0)	0.311#

#Mann–Whitney *U*-test. IQR: Interquartile range

Table 4: Item description Smartphone Addiction Scale

Item	Disagree strongly, *n* (%)	Disagree, *n* (%)	Disagree weakly, *n* (%)	Agree weakly, *n* (%)	Agree, *n* (%)	Agree strongly, *n* (%)
"Missing planned work due to smartphone use"	3 (0.9)	77 (23.3)	149 (45.0)	102 (30.8)	0	0
"Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use"	42 (12.7)	22 (6.6)	241 (72.8)	17 (5.1)	9 (2.7)	0
"Feeling pain in the wrists or at the back of the neck while using a smartphone"	58 (17.5)	26 (7.9)	236 (71.3)	7 (2.1)	4 (1.2)	0
"Won't be able to stand not having a smartphone"	76 (23.0)	33 (10.0)	209 (63.1)	9 (2.7)	4 (1.2)	0
"Feeling impatient and fretful when I am not holding my smartphone"	73 (22.1)	35 (10.6)	209 (63.1)	8 (2.4)	6 (1.8)	0
"Having my smartphone in my mind even when I am not using it"	80 (24.2)	28 (8.5)	218 (65.9)	5 (1.5)	0	0
"I will never give up using my smartphone even when my daily life is already greatly affected by it"	0	105 (31.7)	154 (46.5)	67 (20.2)	5 (1.5)	0
"Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook"	79 (23.9)	24 (7.3)	214 (64.7)	6 (1.8)	2 (0.6)	6 (1.8)
"Using my smartphone longer than I had intended"	38 (11.5)	27 (8.2)	248 (74.9)	6 (1.8)	7 (2.1)	5 (1.5)
"The people around me tell me that I use my smartphone too much"	50 (15.1)	26 (7.9)	233 (70.4)	0	11 (3.3)	11 (3.3)

respectively.[22] In the study by Bhanderi *et al*., it was concluded that the more daily hours of smartphone use, the more the likelihood of Smartphone addiction but it was also postulated that this may be a vicious cycle with one perpetuating the other.[19]

This study was conducted after the COVID-19 pandemic when most of the teaching has gone offline, thus decreasing the time spent on smartphones and the smartphone addiction prevalence may have come down. Furthermore, the questionnaire was distributed just before the exams in March where there may be parental vigilance and restriction on the use of smartphones due to upcoming exams thus limiting time spent by participants on smartphones.

According to a study conducted by Nehra and Mehrotra, a significant proportion of the participants (39.5%; 168 out of 425) indicated that their primary use of smartphones was for social networking.[23] This was followed by 108 participants (25.4%) who reported using smartphones primarily for making calls and sending text messages. In addition, 97 participants (22.8%) stated that they primarily used smartphones for entertainment activities, including playing games and listening to music. In this study, students used smartphones for

chatting on WhatsApp (14.2%), watching videos (29.3%), listening to music (27.5%), using social media (25.4%), and calling friends.

This study found that the prevalence of smartphone addiction among the participants was 22.8%, with 22.3% for females and 23.2% for males. In a study conducted by Gangadharan *et al*., the prevalence rate of mobile phone addiction was 33.0%, with a little higher occurrence among boys (33.6%) compared to girls (32.3%), however, this difference did not reach statistical significance.[21] According to Kwon *et al*., it has been observed that PSU does not exhibit any form of gender discrimination. The study found that among the participants, 23% were male and 21% were female, both of whom were diagnosed with PSU.[16] The present study revealed that the prevalence of smartphone addiction among male participants was 18.4%, but among female participants, it was 22.6%. The obtained results did not demonstrate statistical significance. The statistical significance level for the given data is $P = 0.208$.

In John Damiao and Cavaliere's study, an examination of several individuals revealed a negative association between grade point average (GPA) and SAS scores ($r = -0.210$, $P = 0.066$) as determined by Pearson's correlation analysis.[24] This finding suggests that there is a tendency for students with higher smartphone addiction scores to exhibit lower GPAs. The present study did not observe a statistically significant negative relationship between smartphone addiction and academic performance ($r = 0.008$, $P = 0.887$). However, there was a significant negative correlation between the time spent on smartphones and aggregate marks obtained by the students ($r = -0.198$, $P < 0.000$).

A study conducted by Sapci *et al*. found that participants with a somewhat higher average daily phone usage (mean = 5.54, SD = 2.22) had a slightly worse GPA (mean = 2.89, SD = 0.83).[25] Their findings indicated that a mere 1% rise in smartphone usage resulted in an average loss of 0.33% in GPA. Similarly, a study by Felisoni and Godoi reported that every 100 min spent using these devices on average per day corresponds to a reduction of 6.3 points in students' entrance scores, which the authors found was equivalent to a decline of astounding 96.4 positions at the entrance exam's ranking.[26] Self-restraint and discipline in smartphone use can address the problem.

Limitations

The study included a cohort of one school only; a larger sample with students from both government and private schools will give a better picture of the problem in the area. Furthermore, this study was done in March, which was the examination season for the school, and students may have been restricted from using smartphones at home, thus decreasing the average duration and addiction levels; a comparative study at other times of the academic year may give a better idea. Furthermore, any preexisting mental condition or illness was not addressed which may have an impact on behavioral addictions and exam performance.

CONCLUSIONS

The present study's results contribute to the body of evidence regarding the detrimental effects of smartphone addiction on adolescents who attend school. The current study's findings imply that while teenagers enrolled in school may have some addictions, there is no link between smartphone addiction and poor academic achievement. Institutions should take the required actions to provide environmental and pedagogical awareness programs to support function and productivity while also educating on the unstructured and unproductive behaviors that hinder academic progress to prevent smartphone addiction.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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