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Smartphone Addiction Associated With Mental Disorders And Daytime Sleepiness In University Students

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Summary:
Introduction: *The continuous use of smartphones has had several impacts on the health of its users, including smartphone addiction (SA). This study aimed to observe the relationship between SA, minor mental disorders and daytime sleepiness in university students.*
Materials and methods: *The sample consisted of 34 volunteer students (22.7 ± 8.7 years old) from the Psychology course at a private university in Feira de Santana, BA. The Self-Report Questionnaire (SRQ-20), the Smartphone Dependence Scale and the Epworth Sleepiness Scale were used. Statistical analysis was carried out using the Shapiro Wilk normality test. Through descriptive analysis, continuous variables were presented by mean ± standard deviation while categorical variables were summarized through absolute and relative frequencies. The inferential analysis used Pearson's linear correlation (r). Cronbach's alpha was used to check the internal consistency of the scales. Finally, multiple regression analysis was used to determine the influence of SA on minor mental disorders and daytime sleepiness in students. All the analyses were carried out in the SPSS software version 22.0.*
Results: *Smartphone addiction showed a positive correlation with minor mental disorders (r = 0.52) and with daytime sleepiness (r = 0.41). In addition, minor mental disorders were also positively correlated with daytime sleepiness (r = 0.35).*
Conclusion*: It can be concluded that SA is associated with minor mental disorders and daytime sleepiness in university students.*
Keywords: *Smartphones; Mental disorders; Sleepdisorders due to excessive sleepiness; Technology addiction.*

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I. Introduction

The development of new technologies has brought about significant changes in human behavior. A striking example is the smartphone, a multifunctional device that allows you to perform numerous tasks, including storing information, accessing emails, recording images, listening to music, watching movies, carrying out financial transactions and, of course, making phone calls (Sohn, Rees, Wildridge, Kalk, & Carter, 2019). Smartphones have transformed the way we act in our daily lives, concentrating several functions in a single device (Zhang, Yang, Tu, Ding, & Lau, 2020).

However, the continuous use of smartphones has had a number of health impacts on its users, such as smartphone addiction (SA). This condition can affect various spheres of a person's life, both emotionally and behaviorally, including anxiety, depression, social isolation and aggressive behavior (Hadar et al., 2017).

Problematic smartphone use can consist of factors such as dangerous use while driving and in prohibited places, or at inappropriate times, such as during classes (Kuss et al., 2018).

SA is associated with morphological and functional changes in the central nervous system, such as altered gray matter density, which correlates with compulsive behaviors (Horvath et al., 2020). These changes are similar to those observed in individuals with other types of addiction, such as alcoholism and drug addiction (Hu, Long, Lyu, Zhou, & Chen, 2017). Compulsive behaviors are characterized by the repeated practice of actions that are harmful to the individual in an uncontrolled way, such as checking and excessive use of the smartphone without need (Caracol, Alturas, Martins, 2019).

Compulsive smartphone use, defined as excessive use time (more than five hours a day), can be considered a behavioral addiction and has symptomatological similarities to other addictive behaviors, such as drug use and alcohol dependence (Hu et al., 2017). In addition, it can lead to mental health problems, such as sleep disorders, depression and high psychological distress (Moura et al., 2021). This occurs for psychological and biological reasons, since evidence indicates that electromagnetic radiation from smartphones can alter the antioxidant defense systems of human tissues, leading to oxidative stress (Lee, Chang, Lin, & Cheng, 2014). Al-barashdi, Bouazza & Jabur (2015) observed that the main health risk factors and poorer perceived quality of life, such as poor sleep quality, depression and decreased academic performance, are related to the excessive use of electronic tools (e.g. smartphones, computers and video games).

In addition, the overuse of technology can be associated with minor mental disorders, which are characterized by less severe mental disorders, including symptoms such as memory alterations, difficulty concentrating and making decisions, insomnia, irritability and fatigue, which are highly detrimental to quality of life (Fiorotti, Rossoni, Borges, & Miranda, 2010). SA can also result in the delayed onset and interruption of sleep, causing damage such as excessive daytime sleepiness, characterized by an increase in the subjective perception of the need to sleep during the day, contributing to a decrease in productivity, social interaction and quality of life (Yang et al., 2020).

Understanding how SA is associated with minor mental disorders and daytime sleepiness is of paramount importance for improving the physical, mental and social well-being of university students, as well as helping to implement practical alternatives for reducing the compulsive use of this tool (Moura et al., 2021).

Thus, the aim of this study was to observe the existence of relationships between SA, minor psychological disorders and daytime sleepiness in university students. The initial hypothesis is that SA will show a significant association with minor mental disorders and daytime sleepiness in students.

II. Materials And Methods

Study Design

This is a descriptive correlational study with a cross-sectional design, which seeks to explore relationships between variables, without establishing a cause-effect relationship (Thomas, Nelson, & Silverman, 2009).

Participants

The sample consisted of 34 volunteers (30 women), with an average age of 22.7 ± 8.7 years, all of whom were Psychology students at a private university in Feira de Santana, BA. The participants were selected non-probabilistically. The inclusion criteria were: 1) Being an undergraduate student, owning a smartphone and referring to its use; 2) Being enrolled and attending classes during the collection period; 3) Being over 18 years old. Exclusion criteria included: 1) Filling in the questionnaires incorrectly; 2) Not completing all the items on the questionnaires. All the participants signed the Free and Informed Consent Form (FICF), which detailed the research procedures and affirmed the voluntary nature of their participation.

Data collection procedures

The procedures for this research followed the criteria for Ethics in Research with Human Beings, in accordance with Resolution no. 466/12 of the National Health Council (CNS). The study is part of an institutional project approved by the Research Ethics Committee (CEP) of the Federal University of the São Francisco Valley (UNIVASF) under sight no. 3.967.082. Initially, the teachers and coordinators responsible for the course in question were contacted to request authorization to collect data from the students.

The questionnaires were collected in private rooms at the college. The questionnaires were administered collectively, in a private room, with 2 to 4 volunteers at a time, without the presence of coordinators and teachers. While the questionnaires were being filled in, the evaluators were present to answer questions about the items and ensure that there was no conversation between the participants. The questionnaires took approximately 30 minutes to complete and all the instructions were standardized to avoid bias.

Figure 1 illustrates the detailed flowchart of the data collection process used in this study. The entire collection process was conducted in a standardized way to minimize bias and guarantee the quality of the data obtained.

Instruments

Smartphone Dependency Measurement

The Smartphone Dependence Scale, adapted and validated in Brazil by Sales and collaborators (2018), was used to assess the use of the device. The scale consists of 14 Likert-type questions, ranging from 0 to 4, where 0 = never, 1 = rarely, 2 = sometimes, 3 = often and 4 = very often. To analyze this scale, the values are added together. According to Sales et al. (2017), higher scores indicate greater dependence and compulsive smartphone use.

Self-Reporting Questionnaire

The Self-Reporting Questionnaire (SRQ-20) consists of 20 dichotomous questions to screen for minor mental disorders (for example, "do your hands shake?"), validated for the Brazilian population by Mari and Williams (1986). In this study, male subjects with scores of up to 7 points and female subjects with scores of up to 6 points were considered negative SRQ-20s; higher scores were considered positive SRQ-20s according to Gastaud et al. (2006).

Daytime Sleepiness Assessment

To assess excessive daytime sleepiness, we used the Epworth Sleepiness Scale, a Likert-type scale ranging from 0 to 3, made up of 8 questions (e.g. "sitting reading a book"), validated in Brazil by Bertolazi et al. (2009). For analysis, the values are added up and the results are categorized as: 0-10 no sleepiness; 10-16 mild sleepiness; 16-20 moderate sleepiness; 20-24 excessive sleepiness.

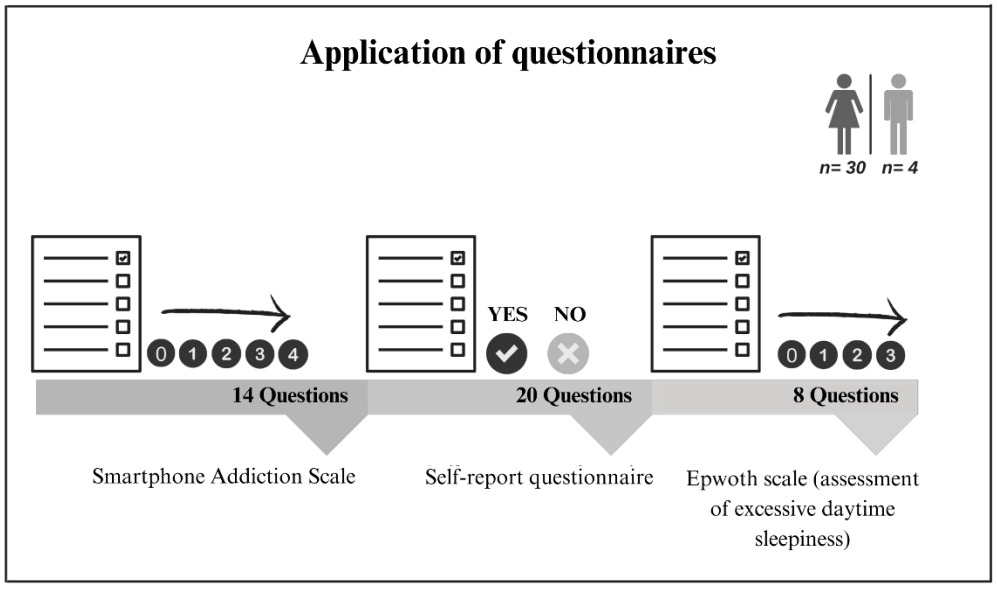

Figure 1. Flowchart of the instrument application process.

Statistical analysis

The data was double-entered into the SPSS for Windows computer package (IBM Corp., Armonk, NY, United States of America [USA], version 22.0, 2013) and analyzed with consistency and amplitude checks. The normality of the data distribution and the homogeneity of the measurements were tested using the Shapiro-Wilk and Levene tests, respectively. Through descriptive analysis, continuous variables were presented by mean ± standard deviation while categorical variables were summarized using absolute and relative frequencies.

The inferential analysis used Pearson's linear correlation (r) to verify the univariate linear relationship between the variables. Cronbach's alpha was used to check the internal consistency of the scales. Finally, multiple regression analysis was used to determine the influence of SA on minor mental disorders and daytime sleepiness among psychology students. All analyses were two-tailed with the exact p-values calculated with a significance level set at 5% ($p \leq 0.05$).

III. Results

Table 1 shows the descriptive results through the reliability coefficients of all the scales and the correlations for all the variables analyzed. The results show that the sum of the items on the university students' Smartphone Addiction Scale indicated moderate levels of SA (25.9 ± 9.8 points). With regard to minor mental disorders, the university students reported high scores (8.4 ± 4.9 points). As for daytime sleepiness, the students had an average score indicating mild sleepiness (10.1 ± 3.8 points).

The linear correlations identified that SA is positively associated with minor mental disorders (r = 0.52) and daytime sleepiness (r = 0.41). In addition, minor mental disorders were also positively correlated with daytime sleepiness (r = 0.35).

With regard to the internal consistency values of the scales, the Cronbach's alpha values ranged from α = 0.72 to α = 0.84, indicating a strong internal consistency of the data among the students.

Table 1. Correlation between the scores of the study variables.

Variables	***Correlation value (r)***		
	1	**2**	**3**
1. Smartphone addiction	-	**0,52***	**0,41***
2. Minor mental disorders		-	**0,35***
3. Daytime sleepiness			-
Average	25,88	8,44	10,12
Standard deviation	9,75	4,85	3,78
Cronbach's Alpha	0,72	0,81	0,84

Significant correlation: *p < 0,05.

Table 2 presents the results of the multiple regression analyses, showing that our model, which included smartphone addiction as a predictor variable, explained a significant amount of the variance in minor mental disorders and daytime sleepiness. Specifically, smartphone addiction explained 25% of the variance in minor mental disorders ($R^2 = 0.25$, $\beta = 0.52$; $p < 0.01$) and 14% of the variance in daytime sleepiness ($R^2 = 0.14$, $\beta = 0.41$; $p < 0.05$).

Table 2. Multiple regression analyses showing smartphone addiction as a predictor of minor mental disorders and daytime sleepiness.

Dependent variable	**R^2**	**β**	**IC95%**	**DW**	**F**	**p**
Minor mental disorders	0,25	0,52	0,10 - 0,41	2,396	11,92	< 0,01
Daytime sleepiness	0,14	0,41	0,03 - 0,28	1,680	6,409	< 0,05

SA: Smartphone Addiction; β = Standardized regression coefficient; CI = 95% confidence interval; DW= Durbin-Watson.

IV. Discussion

The aim of this study was to observe SA in university students and its association with minor mental disorders and excessive daytime sleepiness. The findings are relevant as they contribute to the need for more scientific evidence on SA in the university context, helping to create strategies to reduce excessive smartphone use. Our main results confirm the hypothesis presented, showing a significant association between SA and minor mental disorders ($R^2 = 0.25$, $\beta = 0.52$; $p < 0.01$) and between SA and daytime sleepiness ($R^2 = 0.14$, $\beta = 0.41$; $p < 0.05$).

Current literature shows that SA is associated with negative psychological outcomes such as attention deficit, hyperactivity, bullying, depression and anxiety. Hadar et al. (2017) indicate that the ability to repeat a behavior compulsively is associated with negative psychological outcomes. Picon et al. (2005) observed that subtypes of technology addiction, including electronic games, social networks, pornography and smartphones, are related to negative psychological disorders.

Albursan et al. (2019) found that gender and major directly influence SA in Middle Eastern university students. Fook et al. (2021) investigated problematic smartphone use and the risk of SA among university students in Malaysia, concluding that there is a high prevalence of addiction. The findings of the present study corroborate these results, showing that SA is associated with the development of negative psychological disorders among university students.The findings of the study also show a significant association between SA and minor mental disorders. These results suggest that the excessive use of smartphones may favor psychology students' perception of the development of minor mental disorders. Previous studies in Brazil, such as the one by Rocha & Sassi (2013), found a 33.6% prevalence of minor mental disorders in medical students, associated with factors such as the length of the course and age.

A risk factor for the development of minor mental disorders is the change in daily habits after passing the entrance exam, which can lead to frustration, study overload and lack of leisure (Rocha & Sassi, 2013). Perini, Delanogare & Souza (2019) found a 40% prevalence of minor mental disorders among university students in Rio

Grande do Sul, with a higher prevalence among women (48.6% vs. 27.6%). In addition, 83.3% of students who felt rejected by their peers and 70% of those who were dissatisfied with their career choice had minor mental disorders. SA share risk factors with minor mental disorders, such as social isolation, which explains the association observed in this study.

Another relevant finding was the positive association between SA and daytime sleepiness. Studies suggest that excessive smartphone use impairs sleep quality and reduces engagement in tasks the following day (Moura et al., 2021). Freitas et al. (2017) assessed the relationship between smartphone use before bed and sleep quality in medical students, finding that 79% used their smartphone for at least 15 minutes after going to bed and 35% had excessive daytime sleepiness. After an intervention to reduce smartphone use before bed, only 5% remained above the cut-off point for daytime sleepiness, supporting our findings that SA negatively affects daytime sleepiness.

Finally, although the results of this study are valuable for the academic community, some limitations should be highlighted. Firstly, as this is a cross-sectional study, it is not possible to establish causality between the variables. Secondly, the size of the sample limited more detailed comparisons, such as academic performance, gender and length of course (Moura et al., 2021). In addition, the sample was restricted to students from a single course, not allowing the results to be generalized to all university students. Future studies should include longitudinal approaches and larger, more diverse samples to validate these findings in different contexts, genders, study shifts and courses.

V. Conclusion

The results showed that SA is significantly associated with both minor mental disorders and daytime sleepiness, confirming the study's initial hypothesis. The positive association between SA and daytime sleepiness suggests that excessive smartphone use impairs sleep quality, affecting students' productivity and quality of life. Interventions that promote the reduction of smartphone use, especially before bedtime, may be effective in improving sleep quality and reducing daytime sleepiness.

Despite the need for future research that considers longitudinal studies with larger and more diverse samples, it is inferred that the implementation of effective strategies to reduce compulsive smartphone use will contribute significantly to improving the mental health and quality of life of this population.

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