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Effects of Smartphone Use on Sleep Quality, Depression, Anxiety, and Academic Achievement

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Abstract

Smartphones are popular devices that can process a lot of information than standard cell phones. The easier access to the internet due to the increase in smartphone technology is followed by the increase in the prevalence of smartphone users. There are several adverse effects due to smartphone use, such as physiological, psychological, social, and emotional disturbances. They depend on the duration and frequency of smartphone use. This study aimed to determine the effect of smartphone use on sleep quality, depression, anxiety, and academic achievement in students. It is an observational analytic study with a cross-sectional design. The subjects of this study were 100 students given questionnaires about smartphone use with the Smartphone Addiction Scale-Short Version (SAS-SV), sleep quality with the Pittsburgh Sleep Quality Index, and depression anxiety using DASS21, and academic achievement. The data was analyzed by using Spearman rho analysis. This study found a significant relationship between smartphone use to sleep quality, depression anxiety with a p-value of 0.027 and <0.001 respectively, but no significant relationship between smartphone use and academic achievement (p-value = 0.182).

Introduction

Access to the internet is easier due to the increase in smartphone technology and the prevalence of smartphone users (Demirci et al., 2015). According to Statista, the current smartphone users in the world today is 3.8 billion, and that means 48.53 percent of the world's population owns a smartphone. This number is slightly higher than in 2016 when there were just 2.5 billion users, 33.58% of the global population that year. Smartphones are now used globally as a center of information and communication technology. In addition to the advantages, the use of a smartphone has several side effects (Ibrahim et al., 2018). Depending on the amount of time spent on gadgets (duration and frequency), there are several adverse effects such as physiological, psychological, social, and emotional disturbances (A. K. Kumar & Sherkhane, 2018). Using smartphones can cause sleep problems, which can affect levels of focus and academic performance (Ibrahim et al., 2018). Furthermore, poor quality of sleep is associated with an increased risk of physical and mental disorders (Yogesh et al., 2014).

Exposure to electromagnetic frequency (EMF) at night affects the rhythm of melatonin and brain activity, especially pineal gland activity, which leads to changes in cerebral blood flow and electrical activity of the brain and thus impairs sleep quality. In particular, excessive use of smartphones at night can keep an individual awake, interrupt sleep, and lead to stress and depression (Lemola et al., 2014). Anxiety is characterized by worry, fear, and palpitations. An object such as a smartphone can be used as a diversion to reduce these feelings. Excessive worry can cause individuals to repeatedly check their smartphones for convenience. In addition, individuals with anxiety tend to avoid face-to-face communication. Anxiety causes worry and alertness at all times even

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when faced with something that is not harmful. Anxiety is strongly associated with substance abuse and addiction (Demirci et al., 2015). The related factors of anxiety need to be explored further to overcome anxiety so that it does not affect other health problems if anxiety is not overcome (Husna et al., 2022). This study aimed to determine the effect of smartphone use on sleep quality, depression, anxiety, and academic achievement in students. This study is a follow-up research that combines four variables sleep quality, depression, anxiety, and academic achievement.

Methods

This study was approved by the ethics committee of the Faculty of Medicine at Universitas Sumatera Utara. The subjects of this study were 100 students of the Faculty of Medicine, Universitas Sumatera Utara. A stratified random sampling approach was used to choose the medical students included in this study. All students were fully informed about the purpose and methods of the study and signed informed consent. Inclusion criteria were students of the Faculty of Medicine, Universitas Sumatera Utara who agreed to participate in this study. Exclusion criteria were students, who did not fill out the questionnaire completely, consuming sedative drugs, consuming certain substances or drugs that give the effect of insomnia, have a history of sleep disorders since childhood, having been or are being diagnosed by a doctor with serious mental disorders.

Smartphone addiction level was measured with the Smartphone Addiction Scale-Short Version (SAS-SV). The SAS-SV questionnaire consists of 10 questions, each scored on a 6-point Likert scale from one "strongly disagree" to six "strongly agree." Total scores were summarized, where higher scores showed higher levels of smartphone addiction. The results of the assessment are categorized into: a male score ≥ 31 is indicative of a high addiction rate, a male score <31 is indicative of a low addiction rate, and girls score ≥ 33 is indicative of a high addiction rate, score <33 is indicative of low addiction rate. Participants also completed the 19-item Pittsburgh Sleep Quality Index, a well-validated self-report instrument that comprehensively assesses current sleep impairment in the following seven domains: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction (Buysse et al., 1989). The component scores are summed to yield a global PSQI score; higher scores reflect more sleep disturbance. A Global PSQI score >5 is indicative of significant sleep impairment.

Depression and anxiety were measured with depression, anxiety, and stress (DASS21). This questionnaire consists of various statements that may be following experience in dealing with everyday life situations during the past week DASS-21 consists of 21 questions, each of which consists of seven questions for the evaluation of depression, anxiety, and stress. Responses are given on a 4-point Likert scale, ranging from 0 if " I strongly disagree" to 3 if "I completely agree". Academic achievement is assessed by GPA. GPA is a measure of the academic achievement of a College/University student; is determined on a 4-point scale of grading by dividing the total number of grade points obtained. The cumulative number of credits is between 0 and 4. Data was analyzed using the software Statistical Package for Social Sciences (SPSS) version 25.0. General Characteristics of the students were analyzed using descriptive statistics. Spearman's correlation (rho) was used to determine the significance of the relationship between smartphone addiction and sleep quality, depression, anxiety, and academic achievement. The level of statistical significance for all tests was set at p-value < 0.05. This study was approved by the ethical commission of medical faculty, Universitas Sumatera Utara with letter number 310/KEP/USU/2020.

Results and Discussion

The sample study was 100 undergraduate students (38% men and 62% women), with a distribution of 34% from first-year students, 33% from second-year students, and 34% from third-year students. Most students have GPAs of < 2.75 (96%). The degree of smartphone addiction in this study was classified into two groups: a low level of smartphone addiction (48%) and a high level of smartphone addiction (52%). In sleep quality, 55 students (55%) have

poor sleep quality, and 45 students (45%) have good sleep quality.

Table 1. Characteristics of study participants (n=100)

	Number	Percent (%)
Gender		
Male	38	38
Female	62	62
Participants		
1st year	34	34
2nd year	33	33
3rd year	33	33
Smartphone addiction		
Low	48	48
High	52	52
Sleep Quality		
Good	45	45
Poor	55	55
Depression		
Normal	41	41
Mild	16	16
Moderate	23	23
Severe	10	10
Very Severe	10	10
Anxiety		
Normal	36	36
Mild	5	5
Moderate	17	17
Severe	19	19
Very Severe	23	23
GPA		
>2,75	96	96
≤ 2,75	4	4

Source:

Table 2. Correlations between Variables

		Smartphone addiction		Correlation Coefficient (r)	p-value
		Low	High		
Sleep Quality	Good	25	20	0.221	0.027
	Poor	23	32		
Depression	Normal	27	14	0.367	<0.001
	Mild	6	10		
	Moderate	11	12		
	Severe	3	7		
	Very Severe	1	9		
Anxiety	Normal	23	13	0.367	<0.001
	Mild	4	1		
	Moderate	6	11		
	Severe	9	10		
	Very Severe	6	17		
GPA	>2.75	44	52	0.134	0.182
	≤ 2.75	4	0		

Spearman rank test, * p value<0.05

Source:

Correlations are shown in Table 2. There was a statistically significant positive correlation between smartphone addiction and sleep quality (p-value = 0.027). This study showed that smartphone addiction has a positive relationship with sleep quality, the disturbance in sleep quality will increase when the duration of smartphone use is increased. These results are also consistent with other previous studies (Lemola et al., 2014; Xie et al., 2018; V. A. Kumar et al., 2019; Chang et al., 2015). Prior studies have shown that a sedentary lifestyle and frequent smartphone use can raise the likelihood of poor sleep quality (Zhai et al., 2020). A survey of 362 adolescents indicated that the use of electronic media at night is associated with sleep disturbances. Sleep disturbance, in particular, tends to be a partial mediator of the association between nighttime use of electronic media and depressive symptoms (Lemola et al., 2014). The use of a smartphone before bedtime increases the time it takes to fall asleep, delays circadian cycles, suppresses melatonin hormone levels that improve sleep, decreases the amount and time of REM sleep, and reduces morning alertness (Chang et al., 2015). These sources of light can reduce both subjective and objective sleepiness, delay the time it takes for sleep to start, and reduce the amount of blue light between 450 and 480 nanometers, which is responsible for the high efficiency of blue light to suppress melatonin and boost alertness (Shechter et al., 2017). Because sleep is a crucial physiological process for mammals, even modest sleep deprivation for a few days can harm a person's productivity, health, and cognitive and physical functioning. Consequently, sleep restores both normal levels of brain activity and proper "balance" among the many central nervous system functions in a variety of ways (Baria et al., 2023). Technology's influence, particularly the usage of smartphones, has repercussions on both the quality and quantity of sleep, with effects on adolescents' performance and well-being during the day (de Sá et al., 2023). Adolescent health depends on adequate sleep, both in terms of duration and quality. However, in recent years, young people's sleeping habits have deteriorated. Access to and use of interactive electronic devices (e.g., smartphones, tablets, portable gaming devices) and social media have become entrenched aspects of adolescent lives and have been linked to poor sleep (Dibben et al., 2023).

There were positive correlations between smartphone addiction and depression and anxiety (p-value < 0.001). This result is supported by previous studies conducted by a survey of 353 Korean students which achieved a positive association between smartphone addiction and depression with a correlation coefficient of 0.383. Also, depressed people are at high risk of being overused by smartphones (Kim et al., 2015). A study of 319 Turkish students also showed that mean scores for depression and anxiety were slightly higher for those with elevated levels of smartphone dependency and appeared as an independent indicator of the severity of smartphone addiction (Demirci et al., 2015). Previous studies stated that sleep quality is a mediator between smartphone use at bedtime with depression and anxiety in college students (Adams & Kisler, 2013). The findings suggest that the more you think about smartphones, the more depressed you are, but adolescents who are inexperienced in dealing with stress exhibit various forms of problematic behavior and social malpractice, which appears to manifest as smartphone dependence (Park & Yoo, 2023). Depressed individuals may cause a person to overuse a smartphone to avoid negative feelings of depression. However, the heavy use of smartphones will keep people up late at night, leading to more depression, irritability, and tension. As a consequence, smartphone addiction will involve a vicious loop of Psychopathology (Kim et al., 2015). The strong desire to use smartphones demonstrates the link between difficulty controlling impulsive use and depression. Although there is a static correlation between smartphone-related health problems and depression, studies have shown that they have a significant impact on mental health (Park & Yoo, 2023). Students who experience sleep problems due to smartphones can experience more life stress. They may feel anxious about the lack of opportunities to develop; thus, using a smartphone may attempt to minimize their anxiety (Adams & Kisler, 2013). The increased negative impact on mental health is due to abrupt lifestyle changes and decreased

social activity. Other sources of stress include switching from in-person to online classes and changing living arrangements (Endika & Azam, 2021). Another study conducted by Zhang and Bian revealed that many maladaptive concerns are related to pathological internet usage (PIU) and are growing increasingly widespread among younger generations. Anxiety has been identified as a major predictor of PIU, with the neural basis underpinning the interaction between these two mediation models indicating that persons with higher anxiety may be more inclined to use the Internet. The most likely rational explanation for these findings is that medical students are attempting to escape high academic stress by using their smartphones and are willing to be immersed in a virtual world that is compatible with their desires, but this tends to make them depressed (Alabdallat et al., 2023).

However, there was no correlation between smartphone addiction and GPA (p-value =0.182). This finding is consistent with previous research, which indicated that gender, residence location, working hours per week, faculty, academic achievement (GPA), lifestyle habits (smoking and consuming alcohol), and religious activity were not correlated with smartphone addiction scores (Matar Boumosleh & Jaalouk, 2017). Other studies have also stated that academic achievement has no independent/direct relationship with smartphone addiction. High-frequency smartphone users, as compared to low-frequency smartphone users, use their smartphones for purposes that ultimately improve their academic performance (academic-related purposes, entertainment through games that hone certain cognitive skills) (Lee, 2014). Although using a smartphone might harm, it can also help students engage in flexible mobile study, obtain vital information about potential future vocations, and accomplish personal goals. Adolescence is a vital life stage for future job and life goal accomplishment, and smartphone addiction may harm this process. However, studies have identified the benefits of using smartphones for communication and learning (Yoon & Yun, 2023). Because of the mobility of smartphones, students can access the same (internet-based) services as a personal computer virtually anywhere, practically all of the time. Students can search for study-related material indefinitely because these features are easily accessible. As a result, smartphones provide a multi-media platform for learning that cannot be replaced by reading a textbook. Furthermore, social networking sites and communication apps may aid in the rapid dissemination of important details. Faster communication among students, as well as between learners and educators, may help to more efficient studying and collaboration (Amez & Baert, 2020).

Conclusion

This study found a significant relationship between smartphone addiction to sleep quality, depression, and anxiety, but no significant relationship to academic achievement. The study suggests a limitation of time spent on smartphone use to avoid the adverse effects.

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