

Smartphone addiction and its association with hypertension and quality of sleep among medical students of Northern Border University, Arar, Saudi Arabia

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ABSTRACT

الأهداف: لمراقبة انتشار إدمان الهواتف الذكية وعلاقته بارتفاع ضغط الدم وجودة النوم.

المنهجية: تم إجراء هذه الدراسة في كلية الطب، جامعة الحدود الشمالية، عرعر، المملكة العربية السعودية في الفترة من أكتوبر 2022 إلى مارس 2023. وتم اختيار ما مجموعه 200 طالب طب باستخدام عينات ملائمة. تم استخدام الإجراءات القياسية لتقدير طول الطالب ووزنه وكتلة الجسم وضغط الدم. تم تقييم إدمان الهواتف الذكية باستخدام Smartphone Addiction Scale-Short Version وتم تقييم جودة النوم باستخدام Pittsburgh Sleep Quality Index. تم تقدير العلاقات بين إدمان الهواتف الذكية وجودة النوم وارتفاع ضغط الدم والسمنة باستخدام الانحدار اللوجستي متعدد المتغيرات. واعتبر $p < 0.05$ ذات دلالة إحصائية هامة.

النتائج: كان معدل انتشار إدمان الهواتف الذكية 36% (39.8% عند الرجال و 30.5% عند النساء) وكان معدل انتشار ارتفاع ضغط الدم 35.5% (42.4% عند الرجال و 25.6% عند النساء). أظهر ارتفاع ضغط الدم وجود علاقة إيجابية كبيرة مع إدمان الهواتف الذكية (odds ratio [OR]=2.12, 95% confidence interval [CI] =1.034–4.36)، و سوء جودة النوم (OR=3.54, 95% CI=1.73–7.22)، والسمنة (OR=3.03, 95% CI=1.09–8.42).

الخلاصة: ثبت أن لإدمان الهواتف الذكية معدل انتشار كبير بين طلاب الطب الجامعيين ويرتبط بشكل كبير بارتفاع ضغط الدم.

Objectives: To observe the smartphone addiction's prevalence and its relation to hypertension and sleep quality.

Methods: This study was carried out at the College of Medicine, Northern Border University, Arar, Kingdom of Saudi Arabia from October 2022 to March 2023. A total of 200 medical students were selected using convenience sampling. Standard procedures were used to estimate the student's height, weight, body mass, and blood pressure. Smartphone addiction was assessed using the Smartphone

Addiction Scale-Short Version and sleep quality was assessed using Pittsburgh Sleep Quality Index. Relationships between smartphone addiction, sleep quality, hypertension, and obesity were estimated using multivariate logistic regression. A $p < 0.05$ was viewed as statistically significant.

Results: Prevalence rate of smartphone addiction was 36% (39.8% in men and 30.5% in women) and prevalence rate of hypertension was 35.5% (42.4% in men and 25.6% in women). Hypertension showed a significant positive relationship with smartphone addiction (odds ratio [OR]=2.12, 95% confidence interval [CI] =1.034–4.36), poor sleep quality (OR=3.54, 95% CI=1.73–7.22), and obesity (OR=3.03, 95% CI=1.09–8.42).

Conclusion: Smartphone addiction has been demonstrated to have a high prevalence among medical undergraduates and has been associated significantly with elevated blood pressure.

Keywords: smartphone, hypertension, sleep disorder, prevalence

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Smartphones, which are modern touchscreen devices with multiple functions, have become an integral component of life and have proliferated in society steadily over the years.¹ They allow people to connect instantly with friends and family, as well as provide a wide range of applications for communication and entertainment.² Smartphones have gained popularity because of a wide range of functions that allow users to surf the Internet, navigate to places, send emails, playing games, and use social networking sites, such as Facebook and Twitter.² They are portable and easy to use at any time and place. These features have resulted in excessive smartphone use and dependence, particularly among younger generations, which has been termed as smartphone addiction and entails the desire to use a smartphone repeatedly, with the potential to interfere with one's daily activities.³ However, some scientists do not want to label this behavior an addiction, instead describing it as the problematic use of smartphones in ways that affect daily life negatively.⁴

Mobile phone subscriptions crossed 6 billion globally in 2022, and the numbers are increasing daily.⁵ It has been reported that 72.8% of the population in Saudi Arabia is now using smartphones.⁶ A study carried out in Jeddah found that 89.1% of medical students had smartphones, and over 90% used them for texting and calling while driving.⁷ Problematic mobile phone use has been observed in about one-third to one-half of the users and has been linked to various health effects. Alsanosi et al⁹ reported that a 60-minute phone call not only affects the hearing threshold but is also associated with headaches, vertigo, and tinnitus.⁸ It also has been found to reduce sleep quality and negatively affect mood and energy levels.

Excessive smartphone use also has been linked to anxiety, depression, sleep disturbances, and a higher risk of obesity, diabetes, and metabolic abnormalities.^{10,11} Poor sleep quality can lead to endothelial dysfunction, which is a risk factor for cardiovascular disease, and all these diseases can affect blood pressure. The relationships between hypertension, social, and psychological risk factors have been studied widely.¹² Hypertension predisposes a person to various cardiovascular diseases, and its prevalence is increasing among young people.

Therefore, the need exist to identify factors that can be modified to help prevent hypertension and associated cardiovascular morbidities.¹³ The worldwide age-standardized prevalence of elevated blood pressure was reported to be 24.1% in men and 20.1% in women in 2015.¹⁴ Some studies have suggested that excessive smartphone use exposes users to radiofrequency electromagnetic fields, which might be involved in the pathogenesis of hypertension.^{15,16} A study carried out on 7 men and 3 women found that exposure to radiofrequency electromagnetic fields for 35 minutes led to elevated blood pressure. However, the sample size and exposure time suggest that more extensive research is needed.¹⁷ Other studies conducted previously to examine the relationship have elicited conflicting results.^{18,19} Therefore, the present study aimed to determine the smartphone addiction's prevalence and its relation to hypertension and sleep quality.

Methods. The present study comprised a 6-month, cross-sectional study carried out on 200 medical students, both men and women, from the College of Medicine, Northern Border University, Arar, Kingdom of Saudi Arabia. The duration of the study was 6 months (October 2022 to March 2023). The RAOSFT sample size calculator was used to estimate the sample size by assuming a 95% confidence level, 5% sampling error, and 50% probability of occurrence. The estimated sample size was 200. The Bachelor of Medicine and Bachelor of Surgery classes were selected randomly using Excel software for Windows. From each selected class, participants were chosen in for the study using convenience sampling. Inclusion criteria were possession of a smartphone for >6 months and the absence of any known medical illnesses, such as: diabetes, hypertension, or depression. The study was carried out according to Helsinki Declaration principles.

The university's Ethical Review Committee approved the study protocol and data collection procedures (HAP-09-A-043). The participants were briefed on the study's objective before providing consent. Questionnaires were used to collect the data and were available in English and Arabic. The first part of the questionnaire collected demographic data, and the second part measured smartphone addiction using Smartphone Addiction Scale-short version.²⁰ The scale comprised of 10 components evaluated on a scale of one (strongly disagree) to 6 (strongly agree). The maximum score was 60 and minimum was 10. The higher the score, the greater the smart phone addiction. The cut-off values were set at ≥ 31 and ≥ 33 for male and female students, respectively. The questionnaire's third

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part measured sleep quality using the PSQI, which comprised 19 questions that assess sleep quality and duration, any sleep disturbance, drug use, and daytime alertness.²¹ The PSQI score ranges from 0 to 21, with high scores indicating poor sleep quality, particularly those higher than 5.

All participants underwent medical examinations by a team of trained physicians to rule out the presence of renal or cardiovascular disease. The participants did not take any medications. The student's height and weight were measured using standard methods. Body mass index (BMI) was also measured. Height was measured using a height-measuring stand, without shoes, with heels touching each other and the head in contact with the ruler aligned horizontally. Lever scales were used to assess weight, with the participant barefoot and wearing light clothing. A BMI of ≥ 25 kg/m² was viewed as overweight and >30 kg/m² as obese.²²

Blood pressure was measured in a quiet room in a sitting position using a mercury sphygmomanometer. Three readings were taken at 5-minute intervals, and the average of 3 was recorded. A person with systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg was viewed as hypertensive.²³

Statistical analysis. The data were analyzed using the Statistical Package for the Social Sciences, version 29 (IBM Corp. Armonk, NY, USA.). Means and standard deviations (SDs) were calculated for continuous variables, and frequencies were assessed for categorical variables. Group differences were assessed using Pearson's Chi-square test. Univariate and multivariate analyses were conducted to determine the relationships among hypertension, poor sleep quality, smartphone addiction, and BMI. *P*-values of <0.05 were identified as statistically significant.

Results. Altogether, 200 students were included in the study, of whom 59% (118) were men with a mean age of 22.91 ± 1.8 years and 41% (82) were women with a mean age of 22.89 ± 2.07 years (Table 1). The prevalence rates of smartphone addiction was 36% (39.8% in men and 30.5% in women) and poor sleep quality was 37.5% (44.1% in men and 28% in women). Statistically significant differences were observed in sleep quality and systolic and diastolic blood pressure between male and female students.

Factors associated with smartphone addiction. Factors associated with smartphone addiction were assessed using univariate analysis (Table 2). Prevalence of poor sleep quality, elevated blood pressure, and obesity was high among students with smartphone addiction.

Factors associated with hypertension. Hypertension was observed in 35.5% of the medical students (42.4% men and 25.6% women). It was detected more frequently among students with smartphone addiction and poor sleep quality, as presented in Table 3.

Multivariate analysis. A multivariate logistic analysis was carried out to detect any relationship between poor sleep quality, gender, BMI, and smartphone addiction with hypertension. Compared with individuals with no smartphone addiction, the risk of hypertension among those with smartphone addiction was predicted to increase by 2.12 fold, as presented in Table 4. Furthermore, hypertension risk was 3.54 times higher among medical students with poor sleep quality as compared with those with good sleep quality (Table 4).

Discussion. The study found a higher prevalence of smartphone addiction, and it has positive relationship with hypertension and poor sleep quality among medical undergraduates. The study's finding indicated that 36%

Table 1 - Comparison of study parameters between male and female students.

Parameters	Total (N=200)	Male (n=118)	Female (n=82)	<i>P</i> -value
Age	22.90±1.96	22.91±1.8	22.89±2.07	
BMI (kg/m ²)	25.09±2.79	24.50±2.04	24.31±2.61	0.069
18-24.5	88 (44)	50(42.37)	38(46.34)	
25-29.5	81(40.5)	54(45.76)	27(32.92)	
Above 30	31(15.5)	14(11.86)	17(20.73)	
Systolic BP mmHg	131.34±8.43	132.52±7.98	129.63±8.81	0.003
Diastolic BP mm Hg	81.68±7.12	82.67±7.02	80.24±7.06	<0.001
Sleep quality				0.021
Good	125 (62.5)	66 (55.9)	59 (72.0)	
Poor	75 (37.5)	52 (44.1)	23 (28.0)	
Smartphone addiction				0.176
Present	72 (36.0)	47 (39.8)	25 (30.5)	
Absent	128 (64.0)	71 (60.5)	57 (69.5)	

Values are shown as mean \pm SD or number (percentage) where appropriate. *P*-values were calculated using Chi-square test. BMI: body mass index, BP: blood pressure

Table 2 - Factors associated with smartphone addiction -Univariate analysis (N=200).

Factor	Total	SA present n=72	SA absent n=128	P-value
Gender				0.176
Male	118 (59.0)	47 (39.8)	71 (60.16)	
Female	82 (41.0)	25 (30.5)	57 (69.5)	
BMI				0.019
Normal	88 (44.0)	17 (19.3)	71 (80.6)	
Over weight	81 (40.5)	39 (48.1)	42 (51.9)	
Obese	31 (15.5)	16 (51.6)	15 (48.4)	
Hypertension				0.026
Yes	71 (35.5)	41 (57.7)	30 (42.3)	
No	129 (64.5)	31 (24.0)	98 (76.0)	
Sleep quality				<0.001
Good	125 (62.5)	26 (20.8)	99 (79.2)	
Poor	75 (37.5)	46 (61.3)	29 (38.7)	

SA: Smartphone addiction, BMI: body mass index

Table 3 - Factors associated with hypertension - Univariate analysis (N=200).

Factor	Total	Hypertension present n=71 (35.5)	Hypertension absent n=129 (64.5)	P-values
Gender				0.067
Male	118(59)	50(42.37)	68(57.62)	
Female	82(41)	21(25.60)	61(74.39)	
BMI				0.008
Normal weight	88(44)	14(15.9)	74(84.09)	
Over weight	81(40.5)	43(53.08)	38(46.91)	
Obese	31(15.5)	14 (45.16)	17 (54.83)	
Sleep quality				< 0.001
Good	125(62.5)	25(20)	100(80)	
poor	75(37.5)	46(61.33)	29(38.66)	
Smartphone				0.026
Present	72(36)	41(56.94)	31(43.05)	
Absent	128(64)	30(23.43)	98(76.56)	

Table 4 - Analysis of factors associated with hypertension by Multivariate logistic regression.

Variables	B	SE	OR (95% confidence intervals)	P-values
Gender				
Male	-.635	0.370	0.530(0.257-1.09)	0.086
Female			Ref	
Body mass index (BMI)				
<25 kg/m ²			Ref	
>25 kg/m ² (Over weight)	1.33	0.399	3.80(1.74-8.30)	<0.001
>30 kg/m ² (Obese)	1.10	0.521	3.03(1.09-8.42)	0.033
Smartphone addiction				
Yes	0.753	0.367	2.12(1.034 -4.36)	0.040
No			Ref	
Sleep quality				
Poor	1.266	0.364	3.54(1.73-7.22)	<0.001
Good			Ref	

OR: odd ratio, Ref: reference

of the medical students were addicted to smartphone use. These results resemble those of other international studies. The prevalence of smart phone addiction was reported to be 30%-45% in a study by Yang et al²⁴ on university students in the United Kingdom. Noe et al²⁵ reported smartphone addiction prevalence of to be 19%; however, that study examined older individuals. A multicenter study was carried out on college students in Saudi Arabia and found a prevalence of 19% for smart phone addiction.²⁶ The study carried out in Riyadh found a high prevalence of 48% among the university students.²⁷ These differences may be due to variations in study design, criteria, and cut-off values used for labeling smartphone addiction and differences in the study population.

In the present study, no gender-related differences were found in smartphone use. The findings are consistent with a study carried out in Riyadh.²⁸ The study conducted on Indian medical students elicited similar results, indicating an equal prevalence of smartphone addiction regardless of gender.²⁹ Smartphone addiction also was associated significantly with poor sleep quality which could exert detrimental effects on mental and physical health. Kumar et al³⁰ also reported poor sleep quality among medical students with smartphone addiction. Another study linked to smartphone addiction and poor sleep quality with poor academic performance directly by distracting students from their work and indirectly by affecting their physical and mental health.³¹ The present study also reported a positive relationship between excessive smartphone use and high BMI, consistent with previous studies' reports, indicating the need to intervene and reduce smartphone addiction among students.³²

Problems related to the extensive use of smartphones are complex and wide-ranging. They provide real-time interaction and a wide range of communication means. Many studies have found that certain health risks are associated with problematic smartphone use, such as: anxiety, depression, loneliness, sleep problems, and fatal road accidents.^{33,34} However, the literature on the relationship between smartphone addiction and hypertension is limited. The present study reported a high prevalence of phone addiction in adults with hypertension. Among 71 hypertensive students, 57.7% were addicted to smartphones, compared with 24% (31/129) who were not addicted. Furthermore, 61.3% of the students with poor sleep quality were hypertensive, which was much higher than individuals with good sleep quality (20%). Similar findings have been reported among Chinese adolescents, indicating a higher risk of hypertension for those with smartphone

addiction and poor sleep quality.¹⁹ Liu Shaojie³⁵ studied the relationship between various dimensions of smartphone use and elevated blood pressure among different grades of Chinese adolescents. He identified excessive smartphone use as a significant risk factor for developing hypertension. The results from a recent prospective observational study found a significant incidence of developing new-onset hypertension in persons using mobile phones.³⁶ The proposed mechanism for blood pressure elevation is deterioration of mental health and sleep quality leading to vascular damage, an important mechanism for hypertension.³⁷ Another possible explanation is prolonged exposure to radiofrequency electromagnetic fields, which can damage DNA, causing oxidative stress and inflammation.^{16,17} However, the exact mechanism needs further evaluation.

Study limitations. The study's cross-sectional design limited its validity for drawing conclusions regarding causation. Longitudinal studies are recommended to establish causation. Second, blood pressure was measured in a single setting, which may have resulted in an incorrect estimation. Furthermore, other parameters that are associated with high blood pressure, such as dietary factors, physical activity, and genetic factors were not considered.

In conclusion, this study found that smartphone addiction is quite prevalent among medical students, eliciting positive relationships with poor sleep quality and elevated blood pressure. Therefore, smartphone addiction should be evaluated further as an independent risk factor for hypertension. New and healthy methods of communication and amusement should be encouraged among students, and screen time should be limited. Strategies to intervene and tackle excessive smartphone usage are lacking, and more studies are needed to establish whether smartphone overuse is the root cause of all mental and physical health issues or whether it is just a poor management strategies resulting in psychosocial problems and comorbid conditions.

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