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A Mediational Evaluation of Smartphone Addiction Effect on Insomnia and Sleepiness in Adolescents and Young Adults

Ergenlerde ve Genç Yetişkinlerde Akıllı Telefon Bağımlılığının Uykusuzluk ve Uykululuk Üzerindeki Etkisinin Aracı Olarak Değerlendirilmesi

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Abstract

Objective: Good sleep quality is an important factor for a healthy life. The aim of this study was to investigate the factors affecting insomnia and daytime sleepiness in adolescents and young adults.

Materials and Methods: This cross-sectional study was conducted on 394 adolescents and young adults aged between 15 to 30 years. Our questionnaire consisted of a sociodemographic section, questions about factors affecting sleep quality, Smartphone addiction scale-short form, Epworth Sleepiness Scale, and Insomnia Severity Index Scale.

Results: The mean age of the 394 participants was 20±3.65 years. Risk factors for insomnia in adolescents and young adults were found to be smoking, caffeine consumption between the hours of 18:00-24:00, pre-sleep eating habits, and possible smartphone addiction. Risk factors for daytime sleepiness included being female, daytime sleeping habits, lack of regular physical activity habits, and possible smartphone addiction. The rates of sleepiness and insomnia were higher in both those under the age of 18 and those with possible smartphone addiction. A weak positive correlation was found between smartphone addiction, daytime sleepiness, and insomnia. Smartphone addiction increased the risk of daytime sleepiness by Odds ratio (OR)= 2.652 times and moderate-clinical insomnia severity by OR=2.102 times, while lack of physical activity habit increased daytime sleepiness by OR=1.801 times. Smartphone addiction was found to be a partial mediator of sleepiness.

Öz

Amaç: Uyku kalitesinin iyi olması sağlıklı bir yaşam için önemli bir faktördür. Bu çalışmanın adölesan ve geç yetişkinlerde uykusuzluk ve gündüz uykululuğu üzerindeki etkili olan faktörlerin incelenmesidir.

Gereç ve Yöntem: Bu kesitsel tipteki çalışma 394 15-30 yaş aralığındaki adölesan ve genç yetişkin üzerinde yapılmıştır. Anket formu; sosyodemografik bölüm, uyku kalitesini etkileyen faktörlerle ilgili sorular, akıllı telefon bağımlılığı ölçeği-kısa form, Epworth Uykululuk Ölçeği ve Uykusuzluk Şiddeti Endeks Ölçeğinden oluşmaktadır.

Bulgular: Çalışmaya dahil edilen 394 kişinin yaş ortalaması 20±3,65 dir. Adölesan ve genç erişkinlerde uykusuzluk için risk faktörleri; sigara kullanmak, kafein tüketim zamanının 18.00-24.00 saatleri arasında olması, uyku öncesi yeme alışkanlığı ve muhtemel akıllı telefon bağımlılığıdır. Gündüz uykululuğu için risk faktörleri kadın olmak, gündüz uyuma alışkanlığı, düzenli fiziksel aktivite alışkanlığı yokluğu ve muhtemel akıllı telefon bağımlılığıdır. Hem 18 yaşın altındakilerde hem de olası akıllı telefon bağımlılığı olanlarda uykululuk ve uykusuzluk oranlarının daha yüksek olduğu tespit edilmiştir. Akıllı telefon bağımlılığı ile gündüz uykululuğu ve uykusuzluk arasında pozitif yönde zayıf korelasyon olduğu bulunmuştur. Akıllı telefon bağımlılığının gündüz uykuluğu riskini odds oranı (OR)= 2,652 kat, orta-klinik düzeyde uykusuzluk şiddetini OR=2,102 kat, fiziksel aktivite alışkanlığı olmamasının gündüz uykuluğunu OR=1,801 kat arttırdığı bulunmuştur. Akıllı telefon bağımlılığının uykululuk üzerinde kısmi mediatör olduğu bulunmuştur.

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Conclusion: Smartphone addiction is directly and indirectly associated with sleep problems in adolescents and young adults.
Keywords: Sleep, adolescent, technology addiction

Sonuç: Adölesan ve genç yetişkinlerde akıllı telefon bağımlılığının direkt ve indirekt etkiyle uyku sorunları ile ilişkilidir.
Anahtar Kelimeler: Uyku, adölesan, teknoloji bağımlılığı

Introduction

Sleep is the reversible and partial loss of the organism's communication with the environment. On average, humans spend one-third of their lives sleeping. Sleep is not only a component of daily life; but also a vital necessity that forms the basis of a healthy life in which the body renews itself.[1] Sleep quality has been found to be affected by many factors including diet, physical activity, genetics and environmental factors.[2] Quality sleep holds significant importance for health, and the enduring consequences of inadequate sleep are linked to various severe health conditions such as diabetes, cardiovascular disease, depression, anxiety, heart attack, obesity, and stroke.[3] Additionally, sleep disorders heighten the susceptibility to infectious diseases.[4] An important limitation of research on the relationship between sleep and health is the lack of a clear definition of "good-quality sleep".[5] Sleep quality is usually defined by the individuals themselves. Since everyone has different lifestyles, habits and needs, what makes sleep "good quality" varies greatly.[6] Sleep has a great impact on the health and well-being of children and adolescents. While proper nutrition, physical activity and healthy social relationships improve sleep quality, stress, or irregular sleep-wake patterns, stimulants such as caffeine, nicotine and alcohol have been found to reduce sleep quality in various studies.[7] It has also been shown that nighttime use of screen-based media devices, especially cell phones or television, is associated with negative sleep outcomes such as insufficient sleep duration and poor sleep quality in adolescents.[8] It has been observed that young people have a trend of spending more time daily on online activities using various technological devices (smartphones, tablets, laptops and computers) for various educational and entertainment purposes and this habit may turn into a health risk factor. Some of the problems that occur as a result of problematic technology/internet use are shortened and disorganised sleep, and problems with initiating and ending sleep.[9] Since there is a significant increase in the occurrence of sleep disorders today, it is of great importance to understand the factors affecting sleep quality. The aim of this study was to investigate the effect of factors such as caffeine consumption, smartphone addiction and physical activity on insomnia and daytime sleepiness in adolescents and young adults.

Materials and Methods

This cross-sectional study was conducted in Adana, Türkiye between December 2022 and February 2023 by researchers from Çukurova University Faculty of Medicine Department of Public Health. The population of the study consisted of adolescents and young adults aged 15-30 years living in Adana. The sample size was calculated as 384 with Epi-Info™ ver.7 software[10] with a reference frequency of 50%, a type 1 error of 5% and a confidence interval of 95%, and a design effect of 1. The total number of people reached was 394. Adolescents and young adults living in Adana were reached by convenience sampling method and invited to fill out an online questionnaire prepared with Google™ forms. The online questionnaire was disseminated by Çukurova University Faculty of Medicine intern physicians using the telephone interview technique and telephone messaging application tools after explaining the purpose of the study. Ethical approval was obtained from Çukurova University Faculty of Medicine Non-Interventional Clinical Researches Ethics Committee (approval number: 35, date: 02.12.2022). In the prepared questionnaire form, the purpose of the research was mentioned, stating that the information obtained would be kept confidential and used anonymously for scientific purposes only. The participants who gave consent were allowed to fill in the electronic questionnaire form consisting of sociodemographic information, questions about factors affecting sleep quality, and three scales: Smartphone Addiction Scale-Short form, Epworth Sleepiness Scale and Insomnia Severity Index Scale. Caffeine consumption was classified as ≤200 mg/day; 200.1-400 mg/day and ≥400.1 mg/day.[11]

Smartphone Addiction Scale-Short Form

The Smartphone Addiction Scale-Short Form was developed by Kwon et al.[12] to measure the risk of smartphone addiction in adolescents and its Turkish validity and reliability study was conducted by Noyan et al.[13] in 2015 The scale consists of 10 items and is evaluated on a six-point Likert scale (scored between 1 and 6). The total score varies between 10 and 60. The higher the score obtained from the test, the higher the risk for addiction is predicted. The scale has one factor and no subscales. The cut-off scores were 31 for men and 33 for women referencing the Korean sample by Kwon et al.[12] The internal consistency coefficient (Cronbach's alpha) of the scale calculated to determine the reliability of the scale is 0.867.[13]

Epworth Sleepiness Scale

The Epworth Sleepiness Scale, developed by Johns[14], underwent a Turkish validity and reliability study conducted by Izci et al.[15] This scale was utilized to gauge individuals' levels of sleepiness and displayed a Cronbach's alpha coefficient of 0.86, indicating strong internal consistency. As a straightforward, self-report-based tool, its purpose is to evaluate the likelihood of experiencing sleepiness across eight different daily life scenarios, such as reading in a seated position, watching television, being in public, traveling in a car, napping in the afternoon, engaging in conversation, remaining quietly after lunch without consuming alcohol, and being in a stationary car amidst traffic for a few minutes. With a cut-off score set at >10, it exhibits both high sensitivity and specificity in detecting abnormal daytime sleepiness.

Insomnia Severity Index Scale

The Insomnia Severity Index Scale, developed by Bastien et al.[16] and validated for Turkish use by Boysan et al.[17] in 2010, assesses the severity of insomnia. With a Cronbach's alpha coefficient of 0.79, it demonstrates good internal consistency. This scale comprises seven items on a five-point Likert-type scale, where each item ranges from 0 to 4. The total score spans from 0 to 28, with classifications as follows: 0-7 signifies clinically insignificant insomnia, 8-14 suggests subthreshold insomnia, 15-21 indicates clinically moderate insomnia, and 22-28 represents clinically severe insomnia.

Statistical Analysis

SPSS 20 (IBM-U.S.A.) software was used for data analysis. Qualitative data were given as frequency and percentage; while quantitative data as median and interquartile range. Kolmogorov-Smirnov test was used to test the normality. The data were further analysed using the Mann-Whitney U test, Kruskal-Wallis test, One-Way ANOVA test, chi-square test, logistic regression analysis, and mediation analysis with a $p<0.05$ being considered statistically significant.

Results

The mean age of the 394 participants was 20±3.65 years and <18 years %21.8, among them male-to-female ratio was 38.3% to 61.7%, 95.2% were single, 19.3% smoked cigarettes, 25.1% drank alcohol, 44.2% had high school diploma or lower, 55.8% had bachelor or higher education diploma, 12.4% had chronic physical/mental illness, 11.4% was regular medication user, and 21.6% were active-workers. Regarding the characteristics related to sleep routines, 22.8% of the participants reported having children in their sleeping/living environment, 34.3% having daytime sleeping habits, 32.5% having pre-sleep eating habits, 92.4% having pre-sleep screen exposure, 29.2% using blue screen filters, and 39.6% to have regular physical activity habits. When the characteristics related to caffeine consumption were analysed, 79.7% of them reported that they consume less than 200 mg of caffeine daily, 32.2% consume caffeine-containing food/beverage 1-4 days a week, 42.9% of the participants consume caffeine between 12:00-18:00 hours and 32.5% between 18:00-24:00 hours (Table 1).

It was found that Insomnia Severity Index Scale scores were statistically significantly higher in smokers ($p=0.002$), those consuming caffeine between 18.00-24.00 hours ($p=0.017$), those with pre-sleep eating habits ($p<0.001$), and those with possible smartphone addiction ($p<0.001$). The scores obtained from the Epworth Sleepiness Scale were found to be statistically significantly higher in women ($p=0.020$), people with daytime sleeping habits ($p<0.001$), people who did not engage in regular physical activity ($p<0.001$) and people with possible smartphone addiction ($p<0.001$) (Table 2). In cases where the rates of sleepiness and insomnia are higher in both those under the age of 18 and those who have a possible smartphone addiction. A confounding effect of age was observed in this relationship. Age causes smartphone addiction and its effect on sleepiness to be

Table 1. Participants' sociodemographic characteristics, sleep and daily habits

Characteristics	Mean ± Standard deviation (Min-Max)
Age	20±3.65 (15-35)
	Frequency (%)
Age	
<18 years	86 (21.8)
≥18 years	308 (78.2)
Sex (n=394)	
Male	151 (38.3)
Female	243 (61.7)
Marital status (n=394)	
Single	375 (95.2)
Married	19 (4.8)
Smoking (n=394)	
Yes	76 (19.3)
No	318 (80.7)
Alcohol consumption (n=394)	
Yes	99 (25.1)
No	295 (74.9)
Monthly income of the family (n=329)	
Income more than expenditure	62 (15.7)
Income equal to expenditure	187 (47.5)
Income less than expenditure	80 (20.3)
Education status	
Diploma of high school and lower	174 (44.2)
Diploma of under- and post-graduate	220 (55.8)
Chronic disease status	
Yes	49 (12.4)
No	345 (87.6)
Regular medication use (n=394)	
Yes	45 (11.4)
No	349 (88.6)
Employment status (n=394)	
Active worker	85 (21.6)
Not active worker	309 (78.4)
Presence of children in sleeping/living area (n=394)	
Yes	90 (22.8)
No	304 (77.2)
Daytime sleep	
Yes	135 (34.3)
No	259 (65.7)
Pre-sleep eating habit (n=394)	
Yes	128 (32.5)
No	266 (67.5)
Screen exposure before sleep	
Yes	364 (92.4)
No	30 (7.6)

Table 1. Continued	
Characteristics	**Mean ± Standard deviation (Min-Max)**
Blue screen filter (n=394)	
Yes	115 (29.2)
No	279 (70.8)
Regular physical activity (n=394)	
Yes	156 (39.6)
No	238 (60.4)
Amount of caffeine consumption	
0-200 mg/day	298 (79.7)
200.1-400 mg/day	62 (16.6)
400.1 mg/day and more	14 (3.7)
Caffeine consumption	
Never/rare	60 (15.2)
1-4 days a week	127 (32.2)
5-7 days a week	207 (52.5)
Time of caffeine consumption	
06:00-12:00	88 (22.3)
12:00-18:00	169 (42.9)
18:00-24:00	128 (32.5)
24:00-06:00	9 (2.3)
n: Number of partecipants, min-max: Minimum-maximum	

0.7% less, and its effect on insomnia to be 0.9% less. (Table 3). Logistic regression analysis to predict the likelihood of daytime sleepiness and insomnia severity was found to be significant (omnibus test p<0.001). Two models were created; daytime sleepiness was the dependent variable in the first model and insomnia severity in the second model. The independent variables of both models were possible smartphone addiction, sex, smoking, alcohol use, pre-sleep screen exposure, blue screen filter use, pre-sleep eating habits, regular physical activity habits, chronic disease comorbidity and regular medication use. Among the variables included in the model, possible smartphone addiction (p<0.001) and lack of regular physical activity (p=0.009) were found to be statistically significant predictors of daytime sleepiness; while possible smartphone addiction was found to be a significant (p=0.014) predictor of insomnia severity. The probability of daytime sleepiness was found to be 2.652 times higher in those with smartphone addiction and 1.801 times higher in those who did not engage in regular physical activity. The risk of moderate-to-clinical insomnia increased 2.102-fold in those with possible smartphone addiction (Table 4). When the partial correlations (controlling for age) between the scores of the Smartphone Addiction Scale, Epworth Sleepiness Scale and Insomnia Severity Index Scale were analysed, it was found that there was a weak positive correlation between smartphone addiction and sleepiness and insomnia (Table 5). In the mediation analysis evaluating the relationship between insomnia, sleepiness and smartphone addiction; smartphone addiction was found to be a direct and indirect predictor of sleepiness. While 86.6% of the effect of smartphone addiction on sleepiness was direct, 13.4% was indirect. Insomnia is an important mediator of sleepiness. Smartphone addiction led to increased insomnia and increased insomnia led to increased sleepiness (Figure 1).

Discussion

Sleep is an important part of health and normal development. Daily activities, individual factors and changes in the environment may affect sleep. In studies conducted so far, it has been found that there are many factors affecting sleep quality.[18] In this study in which we examined the factors affecting sleep quality in adolescents and young adults, the risk factors for insomnia were smoking, caffeine consumption time between 18:00-24:00 hours, pre-sleep eating habits and possible smartphone addiction, while the risk factors for daytime sleepiness were being female, daytime sleeping habit, lack of regular physical activity habit and possible smartphone addiction. It was found in cases where the rates of sleepiness and insomnia are higher in both those under the age of 18 and those who have a possible smartphone addiction, while smartphone addiction increased the risk of daytime sleepiness by 2.652 times, and moderate-to-clinical insomnia severity by 2.102 times. The lack of physical activity habits increased daytime sleepiness by 1.801 times. Smartphone addiction was found to have a direct effect on sleepiness and an indirect effect through increasing insomnia. A weak positive correlation between smartphone addiction and sleepiness or insomnia was also found.

The results of a meta-analysis revealed that smokers have a 1.47 times higher likelihood of encountering sleep-related issues compared to non-smokers.[19] Nicotine, by stimulating cholinergic neurons in the basal forebrain, heightens arousal and alertness. Various forms of nicotine intake-such as patches, pills, or cigarettes-might contribute to sleep disturbances. Regardless of the form, nicotine consumption diminishes total sleep duration, prolongs the time taken to fall asleep, hampers deep and rapid eye movement (REM) sleep stages, and elevates the likelihood of early morning awakening. Consequently,

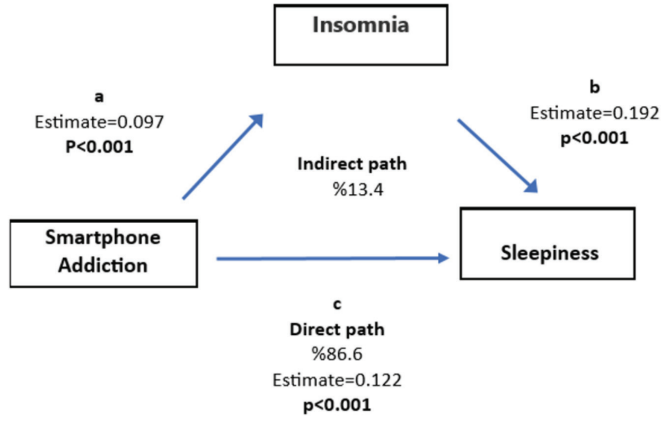

Figure 1. Mediation analaysis path diagram between smartphone addiction and sleepiness with insomnia mediation

Table 2. Association of participants' sociodemographic characteristics and habits with insomnia severity (by Insomnia Severity Index Scale) and daytime sleepiness (by Epworth Sleepiness Scale)

Characteristics		Insomnia Severity Index Scale Scores	p	Epworth Sleepiness Scale Scores	p
		Median (IQR)		Median (IQR)	
Age	<18 years	11 (7)	0.530	10 (7)	0.563
	≥18 years	10 (6)		9 (8)	
Sex	Female	11 (6)	0.250	10 (8)	**0.020***
	Male	9 (6)		8 (8)	
Smoker	Yes	12.5 (7.75)	**0.002***	9 (7.5)	0.682
	No	10 (5)		10 (7.25)	
Alcohol comsumer	Yes	10 (5)	0.957	8 (9)	0.204
	No	10 (6)		10 (7)	
Chronic disease comorbidity	Yes	11 (6.5)	0.990	10 (9)	0.676
	No	10 (6)		9 (7.5)	
Regular medication use	Yes	12 (6)	0.330	10 (9)	0.366
	No	10 (5.5)		9 (8)	
Caffeine consumption	Rare	9 (4.75)	0.169	9 (7)	0.278
	1-4 days a week	10 (6)		9 (8)	
	5-7 days a week	11 (6)		10 (7)	
Time of caffeine consumption	06.00-12.00	10 (6)	**0.017***	10 (8.75)	0.921
	12:00-18:00	10 (5)*		9 (8)	
	18:00-24:00	12 (8)*		9 (7.75)	
	24:00-06:00	11 (12)		9 (8.5)	
Bed partner	Yes	10 (5)	0.872	10 (9)	0.582
	No	10 (6)		9 (7)	
The child where he/she sleeps	Yes	11 (6)	0.519	9 (7.25)	0.818
	No	10 (5.75)		9.5 (7)	
Screen exposure before sleep	Yes	10 (6)	0.433	9 (7)	0.129
	No	9 (5.25)		8 (9.25)	
Blue screen filter use	Yes	10 (6)	0.495	9 (10)	0.986
	No	10 (6)		9 (7)	
Daytime sleeping habits	Yes	10 (6)	0.702	11 (7)	**<0.001***
	No	10 (6)		8 (8)	
Pre-sleep eating habits	Yes	12 (7)	**<0.001***	10 (8)	0.131
	No	9.5 (5.25)		9 (8)	
Regular physical activity	Yes	10 (6.75)	0.806	8 (7)	**<0.001***
	No	10 (6)		11 (7)	
Possible smartphone addiction	Yes	12 (7)	**<0.001***	12 (8.75)	**<0.001***
	No	9 (6)		8 (8)	

*Statistically significant differences,
IQR=Interquartile range

avoiding nicotine is advised to uphold quality sleep.[20] In our study, we similarly observed that smoking escalated the severity of insomnia.

In a systematic review conducted, the impact of smartphone addiction on sleep quality was examined. The study revealed that smartphone addiction leads to poor sleep quality, and this in turn negatively affects the individual's daily life.[21] In a study conducted at a university in Türkiye with university students, more than half of the participants were found to have poor sleep quality, with a smartphone addiction frequency of 34.6%. It was also found that university students with smartphone addiction have a statistically significantly higher risk of having poor sleep quality compared to other students.[22] A large population study in the United Kingdom

Table 3. Association between possible smartphone addiction and daytime sleepiness and insomnia severity

Age			Possible smartphone addiction		p*	p**	Crude OR	Adjusted OR	Counfounding effect
			Yes	No					
			n (%)	n (%)					
<18	Sleepiness	High	18 (41.9)	25 (58.5)	<0.038	<0.001	2.70	2.72	-%0.7
		Low	8 (20.5)	31 (79.5)					
≥18	Sleepiness	High	66 (45.2)	80 (54.8)	<0.001				
		Low	36 (23.4)	118 (76.6)					
<18	Insomnia severity	High	24 (39.3)	37 (60.7)	0.001	0.005	2.23	2.21	-%0.9
		Low	2 (9.5)	19 (90.5)					
≥18	Insomnia severity	High	86 (36.6)	149 (75.4)	0.049				
		Low	16 (24.6)	49 (75.4)					

*Chi-square test, **Cochran's and Mantel-Haenszel test, OR: Odds ratio

Table 4. Logistic regression analysis predicting daytime sleepiness and insomnia severity

Models (Dependent variables)	Model 1 (Sleepiness estimate)			Model 2 (Insomnia estimate)		
Characteristics (Independent variables)	B	p	OR (95% CI)	B (SE)	p	OR (95% CI)
Age ≥18 years (ref.)/<18 years	0,000	0,990	1,000 (0,941-1,062)	-0,050	0,155	0,951 (0,887-1,019)
Possible smartphone addiction None (ref.)/Present	0.975	<0.001*	2.652 (1.675-4.199)	0.743	0.014*	2.102 (1.165-3.792)
Sex Male (ref.)/Female	0.173	0.464	1.189 (0.749-1.887)	0.492	0.072	1.636 (0.957-2.798)
Smoker No (ref.)/Yes	0.205	0.501	1.227 (0.676-2.230)	-0.651	0.093	0.522 (0.244-1.115)
Alcohol user No (ref.)/Yes	0.292	0.305	1.340 (0.766-2.342)	0,350	0.289	1.419 (0.743-2.711)
Screen exposure before sleep No (ref.)/Yes	-0.268	0.514	0.765 (0.342-1.712)	-0.268	0.588	0.765 (0.290-2.016)
Pre-sleep eating habits No (ref.)/Yes	-0,213	0.367	0.808 (0.508-1.284)	-0,204	0.477	0.816 (0.466-1.430)
Regular physical activity habits No (ref.)/Yes	0.589	0.009*	1.801 (1.157-2.806)	0.108	0.684	1.113 (0.663-1.870)
Chronic disease comorbidity No (ref.)/Available	0.211	0.616	1.234 (0.543-2.808)	0.114	0,831	1.121 (0,394-3.189)
Regular medication use No (ref.)/Available	0.207	0.645	1.231 (0.510-2.972)	1.096	0.099	2.993 (0.813-11,024)
	Chi-square (omnibus): 10,236; p<0.001; -2 log likelihood=495,852; Nagelkerke R^2=0,112; n=382			Chi-square (omnibus): 11,577; p=0.006; -2 log likelihood=383,013; Nagelkerke R^2=0,095; n=382		

*Statistically significant differences, SE: Standard error, OR: Odds ratio, CI: Confidence interval

Table 5. Partial Correlations between smartphone addiction and insomnia, sleepiness

		Smartphone Addiction Scale Scores	Epworth Sleepiness Scale Scores	Insomnia Severity Index Scale Scores
Smartphone Addiction Scores	r	1.000	0.331*	0.247*
	p	.	<0.001	<0.001
Epworth Sleepiness Scale	r		1.000	0.242*
	p		.	<0.001
Insomnia Severity Index Scale	r			1.000
	p			.

*Statistically significant differences, controlling for "age"

examining the relationship between smartphone addiction and poor sleep quality found that approximately 61.6% of participants reported poor sleep, and 68.7% of those with smartphone addiction had poor sleep quality.[23] Commonly consumed stimulants like caffeine, prevalent in coffee, tea, chocolate, energy drinks, and sodas, are widely used even by children and adolescents.[24] Having four cups of brewed coffee (equivalent to 400 mg caffeine) up to 6 hours before bedtime notably disrupts sleep quality.[25] Even consuming caffeine in the morning can shift the REM phase of sleep to earlier nighttime hours.[25] In a study involving 309 children aged 8 to 12, the impact of sleep quality, caffeine intake, and daytime behaviors was explored. Caffeine consumption was linked to poorer sleep quality, increased morning fatigue, and disrupted sleep routines. Among children, the primary sources of caffeine were reported to be coffee and tea (41%) and carbonated drinks (40%).[26] Notably, our study observed higher insomnia severity among individuals consuming caffeinated beverages between 6:00 PM and midnight. Intake during these hours could delay the onset of sleep.

Research exploring the link between physical activity and sleep quality has presented varied findings. Some studies suggest that individuals engaged in physical activity experience better sleep quality compared to those who are less active.[27,28] However, other research indicates that moderate physical activity doesn't notably enhance sleep duration, habitual sleep efficiency, or reduce sleep disturbances.[28] A meta-analysis revealed that the overall impact of physical activity on sleep quality wasn't substantial. It did indicate that physical activity significantly influenced the sleep quality of children, middle-aged, and elderly individuals, but didn't notably affect the sleep quality of young people. Additionally, moderate to low-intensity physical activity was linked to improved sleep quality, whereas high-intensity physical activity didn't demonstrate a significant effect.[29] Interestingly, our study revealed that lower physical activity levels increased the likelihood of daytime sleepiness. This association could potentially be attributed to improved physical resilience in individuals who engaged in regular activity, leading to them feeling more energized the following day after exercising. Although delays in sleep patterns were expected to occur as part of the physiological impact of adolescent development and the resulting changes in the circadian regulation of sleep, lifestyle changes resulting from increased access and use of screen-based media devices were shown to contribute greatly to adolescents' poor sleep hygiene.[30] In a study among 323 university students, high levels of smartphone addiction were associated with poorer sleep quality.[31] In a study examining the relationship between smartphone use and sleep quality based on 4-month sleep data collected from 75 participants' sleep trackers and smartphone usage data collected from their personal devices; smartphone use in bed was shown to increase sleep latency and increase mean heart rate. These results suggested that smartphone use in bed worsened both rest quality and sleep quality. Smartphone use may also lead to the shortening of total sleep time by increasing awake time during the night.[32] In a cross-sectional study conducted among 9846 adolescents in Norway, 90% of the participants reported using digital devices in the last hour before lights out. This was found to be associated with delayed sleep onset and shorter sleep duration.[33]

Study Limitations

The limitations of our study include the fact that the population of the study consists only of adolescents and young adults living in Adana, the use of non-probability sampling method, the use of online surveys and the fact that the data are based on self-reports. Due to the use of non-probability sampling method, the representativeness of the sample was low and there was a selection bias. Using an online survey may have caused information bias in participants' understanding and interpretation of the questions.

Conclusion

According to the results of our study, in adolescents and young adults, possible smartphone addiction, smoking, caffeine consumption between 18:00-24:00, and pre-sleep eating habits were associated with insomnia, while possible smartphone addiction, being female, daytime sleeping habits, and lack of regular physical activity habits were associated with daytime sleepiness. Smartphone addiction was an important risk factor for both conditions. We recommend that adolescents and young adults should be educated about the importance of sleep in terms of health, and efforts should be made to increase awareness of smartphone, cigarette and caffeine addiction and physical activity. More emphasis should be placed on measures that can be taken and activities that can be performed for each condition that worsens sleep quality.

Ethics

Ethics Committee Approval: Ethical approval was obtained from Çukurova University Faculty of Medicine Non-Interventional Clinical Researches Ethics Committee (approval number: 35, date: 02.12.2022).

Informed Consent: The participants who gave consent were allowed to fill in the electronic questionnaire form consisting of sociodemographic information, questions about factors affecting sleep quality, and three scales.

Footnotes

Authorship Contributions

Concept: F.A.Ü., O.Y., M.A., M.Y., D.Y., E.D.M., Design: F.A.Ü., O.Y., M.A., M.Y., D.Y., E.D.M., Data Collection or Processing: F.A.Ü., O.Y., M.A., M.Y., D.Y., E.D.M., Analysis or Interpretation: F.A.Ü., O.Y., M.A., M.Y., D.Y., H.D., B.M., E.D.M., Literature Search: F.A.Ü., O.Y., M.A., M.Y., D.Y., H.D., B.M., E.D.M., Writing: F.A.Ü., O.Y., M.A., M.Y., D.Y., H.D., B.M., E.D.M.

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