Effects of smartphone overuse on headache, sleep and quality of life in migraine patients

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ABSTRACT

الأهداف: التحقيق حول تأثير الإفراط في استخدام الهاتف الذكي على الصداع وجودة النوم والنعاس أثناء النهار ونوعية الحياة في مرضى الصداع النصفي.

الطريقة: أجريت هذه الدراسة بين يوليو وسبتمبر 2017م في عيادة الأعصاب في مستشفى خاص. استُخدم استبيان تقييم عجز الصداع النصفي (MIDAS) لتقييم حالة العجز، واستخدم مقياس مشاكل استخدام الهاتف المحمول (MPPUS) لتقييم تردد استخدام الهاتف الذكي. استخدم المقياس التناظري البصري (VAS)، استبيان نوعية الحياة خلال 24 ساعة للمصابين بالصداع النصفي (24-h MQoLQ)، مؤشر بيتسبرغ لنوعية النوم (PSQI) ومقياس إيبورث للنعاس (ESS) لتقييم شدة الألم، ونوعية الحياة، وجودة النوم والنعاس أثناء النهار، على الترتيب.

النتائج: شملت الدراسة ما مجموعه 123 مريضاً. كان هناك فرق كبير بين المجموعات من حيث شدة الألم ، والتردد والمدة فضلاً عن نتائج ESS ، 24-h MQoLQ، PSQI، VAS القيمة الإحصائية ($p<0.05$). كان هناك ارتباط سلبي بين MPPUS و PSQI حيث ($r=-0.367$, $p<0.05$) وارتباط إيجابي قوي بين MPPUS و ESS حيث ($r=0.675$, $p<0.05$) و ارتباط سلبي بين MPPUS و 24-h MQoLQ حيث ($r=-0.508$, $p<0.05$)

الخاتمة: لوحظ أن استخدام الهاتف الذكي يزيد مدة الصداع والتردد في مرضى الصداع النصفي. ويرتبط الإفراط في استعماله في مرضى الصداع النصفي بضعف نوعية النوم والنعاس أثناء النهار؛ علاوة على ذلك، مع زيادة استخدام الهاتف الذكي، تنخفض جودة النوم، ويزيد النعاس خلال النهار وتتراجع جودة الحياة.

Objectives: To investigate the effects of smartphone overuse on headache, sleep quality, daytime sleepiness and quality of life in migraine patients.

Methods: This study is a single-center, cross sectional comparative study. This study was conducted between July and September 2017 in the Neurology Clinic of a private hospital. Migraine disability assessment (MIDAS) questionnaire was used to evaluate the disability status, and Mobile Phone Problematic Use Scale (MPPUS) was used to evaluate smartphone use frequency. The Visual Analogue Scale (VAS), 24-h Migraine Quality of Life Questionnaire (24-h MQoLQ), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) were used to evaluate the pain intensity, quality of life, sleep quality and daytime sleepiness, respectively.

Results: The study included a total of 123 patients. There was a significant difference between the groups in terms of pain intensity, frequency and duration as well as VAS, PSQI, 24-h MQoLQ and ESS ($p<0.05$) scores. There was a negative correlation between MPPUS and PSQI ($r=-0.367$, $p<0.05$); a strong positive correlation between MPPUS and ESS ($r=0.675$, $p<0.05$) and a negative correlation between MPPUS and 24-h MQoLQ ($r=-0.508$, $p<0.05$).

Conclusion: Smartphone use has been observed to increase headache duration and frequency in migraine patients. Its overuse in migraine patients is related to poor sleep quality and daytime sleepiness; furthermore, as the smartphone use increases, sleep quality decreases, daytime sleepiness increases and quality of life decreases.

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The use of smartphones in daily life has increased because it is an easily accessible communication tool that people can keep with them at all times and places. Increased use of smartphones, one of the new media technologies, has increased their effect on the daily lives of people.[1] Today, smartphones have become an important part of the daily lives of people because many activities such as connecting to other people, calling family and friends and connecting to the Internet are carried out via smartphones.[2] With this increasing interest, it has become important to study the effects of smartphones on human health.

Some users experience issues such as headache, sleep disorders, forgetfulness, dizziness, and burning sensation in the head and ear during or after mobile phone use.[3,4] It has been stated that the main cause of these issues is mobile phone usage.[5] The clinical characteristics of headache related to smartphone overuse have been reported in the literature.[6,7] Additionally, smartphone overuse can cause physical, mental and behavioural health problems such as addiction, forgetfulness, blurred vision and pain in the hands and neck.[8]

Migraine is a type of chronic headache, and the frequency of migraine episodes gradually decreases with age.[9] According to Global Burden of Disease Study 2015, migraine is one of the 8 chronic diseases and injury that affecting more than 10% of the world's population in 2015.[10] From the perspective of health, it is important to know the effects that smartphones have on the quality of life, pain and sleep quality of people with migraine. Researches on the effects of smartphone overuse do not provide adequate information on the quality of life, sleep quality and pain in migraine patients. The present study, therefore, aimed at investigating the effects of smartphone overuse on pain, quality of life and sleep quality in migraine patients.

Methods.

Study design. This study is a single-center, cross sectional comparative study. This study was conducted between July 2017 and September 2017.

Participants. We recruited a total of 156 smartphone users who volunteered to be monitored in the Neurology Clinic of a private hospital or who were diagnosed with migraine after presenting to a neurologist for first-time headache.

Inclusion criteria. Volunteers aged >18 years and <65 years, who use smartphones, who do not have any neurological disorders other than migraine and who consented to participate in the study were included.

Exclusion criteria. Patients with neurological, psychiatric or vascular disorders; those with hypertension and coronary artery disease; those receiving prophylactic therapy for migraine; those who are illiterate and those who use mobile phones for <30 min per day were excluded from the study. Finally, 123 migraine patients were included in the study. Flow chart of the study is shown in **Figure 1**.

Ethics Committee Approval. Our study was approved by the Atılım University Human Research Ethics Committee, with a decree number of 59394181-604.01.01-1941 and dated 22.06.2017. The study participants were informed about the study, and informed consent was obtained. The study was perform according to principles of Helsinki Declaration.

Evaluation procedure. Migraine was diagnosed by a neurologist according to the diagnostic criteria of International Classification of Headache Disorders-II and clinical evaluation.[11] Demographic data of the patients were recorded. Pain history and factors triggering migraine were recorded. Pain intensity was evaluated with Visual Analogue Scale (VAS).[12] The Migraine Disability Assessment Scale (MIDAS)[13] was used to evaluate the extent to which migraine disturbs the daily life of a person; the 24-h Migraine Quality of Life Questionnaire (24 h MQoLQ)[14] was used to evaluate the quality of life; Pittsburgh Sleep Quality Index (PSQI)[15,16] was used to evaluate sleep quality and Epworth Sleepiness Scale (ESS)[17] was used to evaluate sleepiness level. The Mobile Phone Problematic Use Scale (MPPUS)[18] was used to evaluate smartphone use frequency. In order to prevent measurement bias in the study, the evaluator was blinded to smartphone use frequency. Assessments other than MPPUS were evaluated with a different evaluator. The mean MPPUS

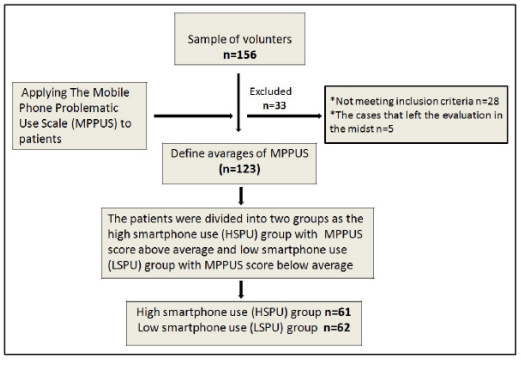

Figure 1 - Flow chart of the study.

Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

Table 1 - General characteristic of the sample of the study.

General Characteristic n=123	Low smartphone use group (MPPUS<32) n=62	High smartphone use group (MPPUS≥32) n=61	*P*-value
Age (year) (M±SD)	43.77±11.21	38.17±10.46	0.204
Gender (%)			0.000*
Female	74.2 (46)	13,1 (8)	
Male	25.8 (16)	86.9 (53)	
Migraine history in the family (%)			0.366
Present	61.3(38)	63.9(39)	
Absent	38.7(24)	36.1 (22)	
Sports habit (%)			0.050
Present	43.5 (27)	60.7 (37)	
Absent	56.5 (35)	39.4 (24)	
Sports (%)			0.134
Jogging	67.7 (42)	64.3 (38)	
Soccer-volleyball	8.1 (5)	9.8 (5)	
Pilates	6.5 (4)	9.8 (5)	
Fitness	9.7 (6)	16.4 (8)	
Other	8.1 (5)	9.8 (5)	
Sports frequency			0.781
1 day a week	61.3 (38)	73.8(45)	
1-3 days a week	30.6 (19)	19.7 (12)	
Everyday	8.1 (5)	6.6 (4)	

M±SD - Mean and standart deviation, MPPUS - Mobile Phone Problematic Use Scale, *p<0.005

scores of the patients were determined. The patients were divided into 2 groups as the high smartphone use (HSPU) group with mean MPPUS score above average and low smartphone use (LSPU) group with MPPUS score below average, and the final results were compared.

Evaluation Methods. Pain assessment. The VAS is a tool used to determine pain intensity. The patient marks pain intensity on a 10-cm ruler between the 'no pain' and 'worst possible pain' anchor. It is stated that VAS is more sensitive and reliable in pain intensity measurement than other one-dimensional scales.[12]

Disability assessment. The MIDAS evaluates the extent to which headache in patients diagnosed with migraine affected their lives in the last 3 months. According to these questions, patients indicate the number of days they were unable to go to school/work, do housework and had decreased efficiency. It is graded as 'no disability' due to migraine if the total score is 0–5, 'low-level disability' for 6–10 score, 'medium-level disability' for 11–21 score and 'severe disability' for >21 score13.

Quality of life. 24-h Migraine Quality of Life Questionnaire consisting of 15 items was developed in 1995 and is composed of 3 parts. In the first part, the

Table 2 - Comparison of proportional results between groups.

Descriptive measurements n=123	Low smartphone use group n=62	High smartphone use group n=61	*P*-value
MIDAS Levels n (%)			0.993
Little or no disability(0-5)	14.5 (9)	11.5(7)	
Mild disability (6-10)	9.8 (6)	8.2 (5)	
Moderate disability (11-20)	23.0 (14)	24.6 (15)	
Severe disability	52.5(33)	55.7 (34)	
Pain frequency n (%)			0.03*
1 per week	53.2 (33)	21.3 (13)	
3 per week	37.1 (23)	60.7 (37)	
5 per week	3.2 (2)	9.8 (6)	
Everyday	6.5 (4)	8.2 (5)	
Pain duration n (%)			0.007*
0-15 minute	4.8(3)	1.6 (1)	
15-60 minute	33.9 (21)	13.1 (8)	
1-3 hour	38.7 (24)	37.7 (23)	
More than 3 hours	22.6 (14)	47.5 (29)	
Factors associated with pain n (%)	6.4 (4)	6.6 (4)	0.481
Vomiting and nausea	4.8 (3)	3.3 (2)	
Light sensitivity	4.8 (3)	6.6 (4)	
Sound sensitivity	17.7 (11)	18.0 (11)	
Light and sound	66.1 (41)	65.5(41)	
All			
PSQI n (%)			0.115
PSQI<5 Good sleep quality	8.1 (5)	4.9 (3)	
PSQI>6 Patological sleep	91.9 (57)	95.1 (58)	
ESS n (%)			<0.001*
ESS ≤10 Normal sleepness	75.8 (47)	39.5 (24)	
ESS >10 Patological sleepness	26.2 (15)	59.5 (37)	

Chi-square test, p<0.05, MIDAS - Migraine Disability Assessment Scale, PSQI - Pittsburgh Sleep Quality Index, ESS - Epworth Sleepness Scale

Table 3 - Comparison between high smartphone use group and low smartphone use group.

Outcome measures n=123	Low smartphone use group (MPPUS <32) n=62	High smartphone use group (MPPUS ≥32) n=61	*P*-value
MPPUS	21.26±4.74	42.46 ±10.25	<0.000*
MIDAS	10.17±10.10	11.57±17.73	0.559
PSQI	16.08±4.6	14.26±5. 6	0.049*
24 h MQoLQ	43.88±14.22	30.65±12.52	0.000*
ESS	6.40±4.39	12.31±5. 6	<0.000*
VAS	4.09±1.89	7.11±1.73	<0.000*

Independent T test, *p<0.05, SD - Standard Deviation, MPPUS - Mobile Phone Problematic Use Scale, MIDAS - Migraine Disability Assessment, PSQI - Pittsburgh Sleep Quality Index, ESS - Epworth Sleepness scale, 24 h MQoLQ - 24-hour Migraine-Specific Quality of Life Questionnaire, VAS - Visual Analog Scale

Table 4 - The correlations between the score of MPPUS and other scale scores.

MPPUS (n=123)	X±SD	r	P-value
VAS	6.99±1.66	0.715	0.00*
MIDAS	10.88±14.41	0.029	0.75
24 h MQoLQ	36.12±14.68	-0.508	0.00*
ESS	9.42±5.87	0.675	0.00*
PSQI	15.18±5.21	-0.367	0.00*
Pain frequnecy		0.158	0.157
Pain duration		0.308	0.01*

Pearson correlation *p<0.05, MPPUS -Mobile Phone Problematic Use Scale, MIDAS - Migraine Disability Assessment, PSQI - Pittsburgh Sleep Quality Index, ESS - Epworth Sleepness Scale, 24 h MQoLQ - 24-hour Migraine-Specific Quality of Life Questionnaire, VAS - Visual Analog Scale

symptoms accompanying migraine are inquired. In the second part, the limitations on the person's life caused by these symptoms are evaluated. In the final part, how these symptoms affect the person psychologically and socially is evaluated. An increase in the total score indicates an increase in the quality of life. The cultural validity and reliability of the questionnaire were evaluated by İltuş et al[14] in 2007.

Sleep quality. The PSQI was developed by Buysse et al[15] evaluates total sleep time, sleep quality and sleep disorders over a 1-month period. It comprises 7 components: subjective sleep quality, sleep latency, sleep duration, sleep activity, sleep disorders, medication use and daytime functions. Each component is rated on a scale of 0–3 points. The total PSQI score is calculated as the sum of all component scores. An increase in the total PSQI score indicated a decrease in the sleep quality. The validity and reliability of the Turkish scale were evaluated by Ağargün et al.[16]

Assessment of daytime sleepiness level. The ESS evaluates general daytime sleepiness of the person. It determines the possibility of falling asleep or dozing off in 8 different daily-life situations. The ESS is a 4-point Likert-type scale. It is scored from 0 to 3, and a high score indicates sleepiness. The ESS is a valid and reliable tool for the evaluation of general sleepiness level and that can be used in Turkish studies regarding sleep and sleep disorders.[17]

Smartphone use frequency. The MPPUS was developed by Bianchi and Philips, and the validity and reliability of the Turkish version were evaluated in 2012. The effects of mobile phone use frequency and overuse on social relationships are determined using this scale.[18] The MPPUS has also been used in smartphone users in the litarature.[19] The scale consists of 3 parts: 9 questions for addiction, 7 questions for social relationships and 10 questions for the consequences. Each item is rated on a scale of 0–4. In the first 2 parts, 0=strongly disagree, 4=strongly agree; in the final part, 0=not at all and 4=very frequently. The total score ranges from 0 to 104 and indicates the degree of smartphone overuse of a person.[18]

Statistical analysis. Statistical analysis of the data was performed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) for Windows 18.0 software package. Kolmogorov–Smirnov/Shapiro–Wilk test was used to analyse normally distributed continuous variables. The descriptive statistics were given as mean±standard deviation or median (minimum–maximum) for continuous variables and as number and percentage (%) for categorical variables. The aim was to determine the sample size required for the study, and the G *Power (G*Power Ver. 3.0.10, Franz Faul, Kiel University, Germany) software package was used.[20] It was calculated that a sample size of 128 patients (64 patients in each group) would achieve 80% power (d=0.50 effect width, α=0.05 type I error, β=0.20 type II error). Because of patients who were excluded, 123 patients were included in the analysis, yielding a power of 79%. The differences between 2 measures were evaluated with independent sample t-test and chi-square test. The relation between measurement findings was evaluated using Pearson's correlation coefficient.[21] A correlation coefficient (r) of ≥0.75 is considered good to excellent; 0.50–0.75 as moderate to good; 0.25–0.50 as fair and 0.00–0.25 as little to no relationship. A p-value of <0.05 was considered statistically significant.[22]

Results. Of the participants, 99 were females (80.5%) and 24 were males (19.5%). Descriptive findings are presented in **Table 1**.

The disability level was severe in 54% and moderate in 23.8% of the patients, according to MIDAS, and

there was no difference between the groups in terms of disability (p=0.993). However, when evaluated in terms of pain frequency and duration, there was a significant difference between the groups (p<0.05). The pain duration and frequency in the HSPU group was higher than those in the LSPU group. Comparison of proportional results between groups are shown in **Table 2**.

The mean MPPUS score of the patients was 32.00. The patients were divided into 2 groups as HSPU group with a mean MPPUS score of above average (MPPUS ≥ 32.00) and LSPU group with a mean MPPUS score of below average (MPPUS<32.00). According to the LSPU group, the quality of life and sleep quality were lower and daytime sleepiness was higher in the HSPU group. There was a significant difference between the groups in terms of these parameters (p<0.05). The severity of pain, as evaluated by VAS, was higher in the HMPU group than in the LPMU group, and there was a significant difference between the groups (p<0.05). Comparisons of measurements between the HSPU and LSPU groups are shown in **Table 3**.

There was a negative correlation (r=–0.367, p<0.05) between the MPPUS score and sleep quality in migraine patients, whereas there was a strong positive correlation (r=0.675, p<0.05) between the MPPUS score and daytime sleepiness. In addition, there was a negative correlation (r=–0.508, p<0.05) between the MPPUS score and 24-h MQoLQ score. Correlations between the MPPUS score and other scale scores are shown in **Table 4**.

Discussion. In this study, we observed that in migraine patients, the intensity of headache increases, pain duration and frequency are affected, quality of life and sleep quality decrease and daytime sleepiness increases with smartphone overuse.

Migraine negatively affects daily life and can cause functional disability in work and social lives. Mayda Domaç et al[23] have shown that the frequency and intensity of migraine attacks are some of the most important factors of disability related to migraine. In our study, the disability level was severe in 54% and moderate in 23.8% of the patients, according to MIDAS, and there was no difference between the groups in terms of disability. However, when evaluated in terms of pain frequency and duration, there was a significant difference between the groups. The pain duration and frequency were higher in the HSPU group than in the LSPU group, indicating that smartphone use increases the duration and frequency of headache in migraine patients. Similarly, Demirci et al[7] have shown that headache complaints, headache duration and attack frequency are higher in university students with smartphone overuse than in those with no overuse. Moreover, it was reported that response to analgesic medication is higher in those with smartphone overuse than in non-users. In our study, pain intensity according to VAS was higher in the HSPU group, and there was a significant difference between the groups; however, pharmacological evaluation was not included in our study.

A study evaluating the type and incidence of subjective symptoms regarding smartphone use in Polish users has shown that headache is significantly more frequently reported by people who talk more frequently and longer, that 26% of the participants reported continuous headache and that headache lingers for >6 h after the end of a phone call.[23] In a study conducted by Demirci et al,[7] headache complaints were shown to be related to the degree of smartphone use. Researchers have suggested that during or after smartphone use, the changing conditions during mobile phone use such as exposure of the blood–brain barrier and dopamine–opioid systems to radio frequency, psychological factors, temperature change, noise and various combinations of these may cause headaches.[5,24,25]

Migraine negatively affects the life of patients who exhibit symptoms such as nausea, phonophobia, photophobia, blurred vision and vomiting. Thus, their quality of life is also negatively affected.[26-28] In a study that evaluated headaches particularly caused by smartphone use, it was stated that 4 days of pain per week develops migraine characteristics such as photophobia and nausea and those can be aggravated by routine physical activity.[29,30] However, in terms of migraine-related findings in our study, there was no statistically significant difference between the groups. This result suggested that smartphone overuse does not have an effect on factors accompanying migraine. However, further studies are required in this regard.

According to the literature, chronic migraine patients report difficulty in maintaining sleep with less sleep time compared with others and the majority wake up feeling tired.[31,32] Problems falling asleep and maintaining sleep have been described in one-third of migraine patients. Smartphone users experience problems falling asleep and lack of sleep, with prolonged use affecting the quality of life.[33] Using smartphones before sleep increases sleep disorders.[34] Loughran et al[35] have reported adverse effects of electromagnetic fields emitted from mobile phones in sleep electroencephalograms. Elhai et al[36] state that use of a smartphone has led to sleep problems due to reasons such as blue light emitted from smartphones can interfere with sleep and increasing work demands to stay digitally connected can cause stress and burnout.

Excessive smartphone use at night, could keep one awake late, thus impairing sleep, and influencing stress and depression. Cain and Gradisar[37] have explained the relationship between electronic media use and poor sleep by the relationship among electronic media and cognitive, emotional or physiologic stimuli, effects of light emission from the device, keeping mobile phone in the bedroom and sleep interruption by untimely messages and calls.

Demirci et al[34] have shown a strong relationship between smartphone overuse and sleep quality, sleep disorder and daytime dysfunction in healthy people. Additionally, they have shown that daytime dysfunction, which is related to poor sleep quality, is higher in the HSPU group than in the LSPU group. In our study, there was a negative correlation between the MPPUS score and sleep quality in migraine patients, whereas there was a strong positive correlation between the MPPUS score and daytime sleepiness. As smartphone overuse increases in migraine patients, sleep quality decreases and daytime sleepiness increases.

In our study, we showed that smartphone overuse is related to sleep quality and daytime sleepiness, but according to PSQI's cut-off value, there was no significant difference between the groups because sleep quality was affected at a pathologic level of >90% in both groups; when evaluated in terms of daytime sleepiness, pathologic sleepiness was higher in the HSPU group. This result showed that it is necessary to consider that decreased sleep quality and increased daytime sleepiness due to smartphone use, besides the already existing sleeplessness problem in migraine patients, can cause additional problems. However, Lemola et al[38] have shown that smartphone use is related to sleeping at a later hour but is unrelated to sleep disorders.

Daytime sleepiness is seen more frequent in migraine patients than in the general population, and this increases with an increasing frequency of migraine attacks.[31] Considering the possible side effects of smartphone overuse demonstrated in migraine patients in the present study, smartphone use must be carefully addressed in this particular patient group.

Moreover, sleep quality has been shown to be a determining factor for depression and anxiety, In addition smartphone use has been shown to be associated with anxiety and depression in the literature.[39] Unfortunately, we did not assess symptoms of depression and anxiety in our study. Further studies are needed on symptoms of depression and anxiety caused by smartphone use in migraine patients.

In a study including 90 migraine patients, 46 of whom had chronic migraine, quality of life was impaired in chronic migraine patients compared with that in others.[40] In our study, there was a negative correlation between the MPPUS and 24-h MQoLQ scores. The quality of life is impaired with increasing smartphone use; it was lower in the HSPU group than in the LSPU group, and the difference between the groups was statistically significant. This shows that smart phone addiction negatively affects the quality of life in migraine patients. This also shows that migraine patients must be advised to limit and consciously use smartphones while developing recommendations to prevent worsening of the quality of life in migraine patients that is already affected by the disease.

There are some limitations in our study. The information obtained with our measurement methods is acquired from self-reports of patients. In order to reduce the negative effects of this situation, physiological measurement methods such as actigraphy, blood pressure and heart rate should be included for sleep measurements in future studies. There is need for further longitudinal studies with different age groups, especially in the geriatric population. Sleep duration can be affected by smartphone use but we did not investigation sleep duration. This is another limitation of the study. Furthermore, no classification between episodic and chronic migraine was made while including migraine patients, and sufficient data are not present in the literature on the effects of smartphone use in migraine patients.

In conclusion, this study showed that headache, sleep quality, daytime functions and quality of life are affected depending on the extent of smartphone use in migraine patients. To prevent the harmful effects of smartphone use, its effects on health should be monitored with more detailed and long-term studies. Our study can pave way for future studies on migraine patients who are smartphone users and on the necessary behavioural and medical interventions for these patients.

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References

1. Chen YF, Katz J. Extending Family to School Life: College Students Use of the Mobile Phone. ***J Int Human-Computer Studies*** 2009; 67: 688-694.
2. Leena K, Tomi L, Arja R. Intensity of mobile phone use and health compromising behaviors -how is information and communication technology connected to health-related lifestyle in adolescence? ***J Adolesc*** 2005; 28: 35-47.
3. Hocking B, Westerman R. Neurological changes induced by a mobile phone. ***J Occup Med*** 2002; 52: 413-415.
4. Roosli M, Moser M, Baldinini Y, Meier M, Braun-Fahrlander C Symptoms of ill health ascribed to electromagnetic field exposure-a questionnaire survey. ***Int J Hyg Environ Health*** 2004; 207: 141-150.

5. Chu MK, Song HG, Kim C, Lee BC. Clinical features of headache associated with mobile phone use: a cross-sectional study in university students. ***BMC Neurol*** 2011; 11: 115.
6. Lee JI, Song HS. The correlation analysis between hours of smartphone use and neck pain in the Gachon university students. ***The Acupuncture*** 2014; 31; 99-109.
7. Demirci S, Demirci K, Akgonul M. Headache in Smartphone Users: A Cross-Sectional Study. ***J Neurol Psychol*** 2016; 4: 5.
8. Kwon M, Joon-Yeop L, Wang-Youn W, Jae-Woo P, Jung-Ah M, Changtae H, et al. Development and validation of a smartphone addiction scale (SAS). ***PloS One*** 2013; 8: e56936.
9. Diamond S. A fresh look at migraine therapy. ***Postgrad Med*** 2001; 109: 49-54.
10. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. ***Lancet*** 2016; 388: 1545-1602.
11. Headache Classification Subcommittee of the International Headache Society. The international classification of headache disorders, 2nd edn. ***Cephalalgia*** 2004; 24: 9-160.
12. Cline ME, Herman J, Show F, Marton RD. Standardization of the visual analoque scale. ***Nurs Res*** 1992; 41: 378-379.
13. Ertaş M, Siva A, Dalkara T, Uzuner N, Dora B, Inan L, et al. Validity and reliability of the Turkish Migraine Disability Assessment (MIDAS) questionnaire. ***Headache*** 2004; 44: 786-793.
14. Ituş F, editor. The reliability and validity of the 24-hour migraine quality of life questionnaire. Unpublished thesis type. İzmir (Turkey): Ege University Health Sciences Institute; 2007. From: https://toad.edam.com.tr/sites/default/files/pdf/migrende-24-saatlik-yasam-kalitesi-olcegi-toad.pdf
15. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. ***Psychiatry Res*** 1989; 28: 193-213.
16. Ağargün MY, Kara H, Anlar Ö. The Validity and Reliability of the Pittsburgh Sleep Quality Index. ***Turkish Journal of Psychiatry*** 1996; 7: 107-115.
17. Ağargün MY, Çilli AS, Kara H, Bilici M. Validity and Reliability of the Epworth Sleepiness Scale. ***Turkish Journal of Psychiatry*** 1999; 10: 261-267.
18. Şar AH, Işıklar A. Adaptation of problem mobile phone use scale to Turkish. ***J Hum Sci*** 2012; 9: 264-275.
19. Van Deursen AJ, Bolle CL, Hegner SM, Kommers PA. Modeling habitual and addictive smartphone behavior: The role of smartphone usage types, emotional intelligence, social stress, self-regulation, age, and gender. ***Comput Hum Behav*** 2015; 45: 411-420.
20. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. ***Behav Res Methods*** 2007; 39: 175-191.
21. Hayran M, editors. Basic statistics for health research. Ankara (TR): 2011. p. 30-35.
22. Green SB, Salkind NJ, editors. Using SPSS for Windows and Macintosh, Books a la Carte. 8th Edition. TX (USA): Pearson; 2016.
23. Mayda Domaç F, Boylu E, Adıgüzel T, Özden T, editors. Evaluation of disability in migraine cases with MIDAS. ***Duzce Med J*** 2012; 14: 1.
24. Szyjkowska A, Gadzicka E, Szymczak W, Bortkiewicz A. The risk of subjective symptoms in mobile phone users in Poland-an epidemiological study. ***Int J Occup Med Environ Health*** 2014; 27: 293-303.
25. Redmayne M, Smith E, Abramson MJ. The relationship between adolescents' well-being and their wireless phone use: a cross sectional study. ***Environ Health*** 2013; 12: 90.
26. Leonardi M, Steiner TJ, Scher AT, Lipton RB. The global burden of migraine: Measuring disability in headache disorders with WHO's classification of Functioning, Disability and Health (ICF). ***J Headache Pain*** 2005; 6: 429-440.
27. Terwindt GM, Ferrari MD, Launer LJ. The impact of headache on quality of life. ***J Headache Pain*** 2003; 4: 35-41.
28. Holroyd KA, Drew JB, Cottrell CK, Romanek KM, Heh V. Impaired functioning and quality of life in severe migraine: the role of catastrophizing and associated symptoms. ***Cephalalgia*** 2007; 27: 1156-1165.
29. Olesen J, Bousser M, Diener H, Dodick D. New appendix criteria open for a broader concept of chronic migraine. ***Cephalalgia*** 2006; 26: 742-746.
30. Aurora SK, Kulthia A, Barrodale PM. Mechanism of Chronic Migraine. ***Curr Pain Headache Rep*** 2011; 1-7.
31. Selekler HM, Şengün E, Altun N. Sleep Quality and Depression in Episodic and Chronic Migraine Sufferers. ***Arch Neuropsychiatry*** 2010; 47: 196-200.
32. Bıçakcı Ş. Comorbidity of Migraine. ***Noro Psikiyatr Ars*** 2013; 50: S14-S20.
33. Van den Bulck J. Adolescent use of mobile phones for calling and for sending text messages after lights out: Results from a prospective cohort study with a one-year follow-up. ***Sleep*** 2007; 30: 1220-1223.
34. Demirci K, Akgönül M, Akpinar A. Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. ***J Behav Addict*** 2015; 4: 85-92.
35. Loughran SP, Wood AW, Barton JM, Croft RJ, Thompson B, Stough C. The effect of electromagnetic fields emitted by mobile phones on human sleep. ***Neuroreport*** 2005; 16: 1973-1976.
36. Elhai JD, Dvorak RD, Levine JC, Hall BJ. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. ***J Affect Disorders*** 2017; 207: 251-259.
37. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: A review. ***Sleep Med*** 2010; 11: 735-742.
38. Lemola S, Perkinson-Gloor N, Brand S, Dewald-Kaufmann JF, Grob A. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. ***J Youth Adolesc*** 2015; 44: 405-418.
39. Rozgonjuk D, Levine JC, Hall BJ, Elhai JD. The association between problematic smartphone use, depression and anxiety symptom severity, and objectively measured smartphone use over one week. ***Comput Hum Behav*** 2018: 87; 10-17.
40. Meletiche DM, Lofland JH, Young WB. Quality-of-life differences between patients with episodic and transformed migraine. ***Headache*** 2001; 41: 573-578.