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Smartphone Addiction, Sleep Quality and Musculoskeletal Disorders in University Students

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ABSTRACT

Objective: Smartphone addiction may lead to many health issues. Excessive smartphone usage has been linked to musculoskeletal disorders and sleep problems. We aimed to examine the correlation between smartphone addiction, sleep quality and musculoskeletal disorders. **Materials and Methods:** 60 university students were included in the study. Individuals' smartphone addiction, sleep quality and musculoskeletal disorders were evaluated with the Smartphone Addiction Scale (SAS), Pittsburgh Sleep Quality Index (PSQI) and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), respectively. **Results:** There was a weak correlation between SAS and PSQI's sleep efficiency, sleep disturbance, daytime dysfunction subscales, PSQI total score, and CMDQ's lower extremity and spine subscales (p=0.021, r=0.30; p=0.020, r=0.30; p=0.008, r=0.34; p=0.008, r=0.34; p=0.029, r=0.28; p=0.019, r=0.30). There was a well correlation between SAS and CMDQ's upper extremity subscale and CMDQ total score (p=0.001, r=0.43; p=0.001, r=0.42).
Conclusion: It was concluded that as smartphone addiction increases in students, musculoskeletal disorders increase. Smartphone addiction was particularly associated with the neck, shoulder, back, upper arm, wrist and hip regions. It was also concluded that smartphone addiction worsens sleep efficiency and general sleep quality and leads to sleep disturbance and daytime dysfunction.
Keywords: Smartphone addiction, Sleep quality, Musculoskeletal disorders, University students.

Üniverstite Öğrencilerinde Akıllı Telefon Bağımlılığı, Uyku Kalitesi ve Kas-İskelet Sistemi Rahatsızlıkları

ÖZ

Amaç: Akıllı telefon bağımlılığı birçok sağlık sorununa yol açabilir. Aşırı akıllı telefon kullanımı kas-iskelet sistemi bozuklukları ve uyku sorunlarıyla ilişkilendirilmiştir. Akıllı telefon bağımlılığı ile uyku kalitesi ve kas-iskelet sistemi rahatsızlıkları arasındaki ilişkiyi incelemeyi amaçladık. **Gereç ve Yöntem:** Bu kesitsel çalışmaya 60 üniversite öğrencisi dâhil edildi. Bireylerin akıllı telefon bağımlılığı, uyku kalitesi ve kas-iskelet sistemi bozuklukları sırasıyla Akıllı Telefon Bağımlılığı Ölçeği (ATBÖ), Cornell Kas İskelet Rahatsızlığı Ölçeği (CKİRÖ) ve Pittsburgh Uyku Kalitesi İndeksi (PUKİ) ile değerlendirildi. **Bulgular:** ATBÖ ile PUKİ'nin uyku etkinliği, uyku bozukluğu, gündüz işlev bozukluğu alt ölçekleri, PUKİ toplam puanı ve CKİRÖ'nün alt ekstremite ve omurga alt ölçekleri arasında zayıf bir korelasyon vardı (p=0.021, r=0.30; p=0.020, r=0.30; p=0.008, r=0.34; p=0.008, r=0.34; p=0.029, r=0.28; p=0.019, r=0.30). ATBÖ ve CKİRÖ üst ekstremite alt ölçeği ile CKİRÖ toplam puanı arasında iyi bir korelasyon vardı (p=0.001, r=0.43; p=0.001, r=0.42). **Sonuç:** Öğrencilerde akıllı telefon bağımlılığı arttıkça kas-iskelet sistemi rahatsızlıklarının da arttığı sonucuna varıldı. Akıllı telefon bağımlılığı özellikle boyun, omuz, sırt, üst kol, bilek ve kalça bölgeleriyle ilişkiliydi. Ayrıca akıllı telefon bağımlılığının uyku verimliliğini ve genel uyku kalitesini kötüleştirdiği, uyku bozukluğuna ve gündüz işlev bozukluğuna yol açtığı sonucuna varıldı.
Anahtar Kelimeler: Akıllı telefon bağımlılığı, Uyku kalitesi, Kas-iskelet sistemi rahatsızlıkları, Üniversite öğrencileri.

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INTRODUCTION

Smartphones have become a crucial aspect of daily life, and their excessive use concerns public health (Ding & Li, 2017). Although smartphones are used for socializing, spending time, and entertainment, their excessive use causes many problems (Kim, Min, Ahn, An & Lee, 2019). Smartphone addiction can be defined as insisting on using the smartphone despite all its adverse effects and not being able to control it (Mehrnaz et al., 2018). Smartphone addiction is behavioral (Cha & Seo, 2018). People with behavioral addictions repeat this behavior to obtain short-term pleasure despite knowing its harms (Grant, Potenza, Weinstein & Gorelick, 2010). As a result of uncontrolled use, physical problems, psychological problems and sleep problems may occur (Prithika, Biju, Prathipaa, Ponnusankar & Vishwas, 2022).

Smartphone addiction may lead to many health problems, and one of them is non-traumatic musculoskeletal pain. Excessive phone use is linked to repetitive joint movements, which can result in inflammatory changes within the joints (Megna et al., 2018). Forward head posture occurs during smartphone use. As a result, many postural problems, such as round shoulders and loose back, occur, which may cause pain in the musculoskeletal system. A study conducted in young people showed that moving the head, neck and shoulders forward during smartphone use may lead to increased stress in the neck area and premature tissue damage (Fares, Fares & Fares, 2017). In addition to sensitivity and decreased range of motion in the cervical region, it also causes muscle fatigue (Bueno, Garcia, Bertolini & Lucena, 2019). Poor posture resulting from phone use leads to neck discomfort and affects the proprioception of the region (Alsalameh, Harisi, Alduayji, Almutham & Mahmood, 2019; Dolan & Green, 2006).

Excessive use of smartphones continues even before falling asleep, which affects sleep quality and may lead to sleep problems. The phone screen's light can suppress the melatonin hormone secreted by the pineal gland and control the sleep and wakefulness cycle (Mehrnaz et al., 2018). Problematic use of computers and phones can affect sleep quality by reducing REM sleep, slow wave sleep, and sleep efficiency (Dworak et al., 2007). Additionally, spending the time that should be used for sleeping on the phone, the negative emotional, cognitive, and physiological effects of smartphones on the person, and the adverse effects of electromagnetic fields emitted from the phone in the bedroom at night negatively affect sleep quality (Cain & Gradisar, 2010). It is reported that sleep problems may lead to many issues, such as obesity and diabetes.

We aimed to observe the relationship between smartphone addiction, which is related to many health issues, and musculoskeletal disorders and sleep quality.

Our hypotheses are as follows:

H_0: There is no relationship between smartphone addiction, musculoskeletal disorders and sleep quality.

H_1: There is a relationship between smartphone addiction, musculoskeletal disorders and sleep quality.

MATERIALS AND METHODS

Participants

The study was conducted at Tokat Gaziosmanpaşa University. Sixty university students with smartphones were included in the study. The required sample size was calculated as 60 individuals, assuming a Type I error rate (α) of 0.05, a study power (β) of 0.85, an observed correlation coefficient (r) of 0.50 from the reference article (Mustafaoglu, Yasaci, Zirek, Griffiths & Ozdincler, 2021), and a negligible correlation coefficient (r) of 0.20 (Feise & Menke, 2001). After the participants were informed about the research, they were asked to fill out an informed consent form. In this cross-sectional study, individuals' smartphone addiction, musculoskeletal disorders and sleep quality were assessed with the Smartphone Addiction Scale (SAS), Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), and the Pittsburgh Sleep Quality Index (PSQI), respectively. The surveys were filled out by the participants through face-to-face interviews. It took participants an average of 15 minutes to fill out the surveys. Students who used smartphones and agreed to participate in the study were included in the study. Students with any diagnosed chronic disease and without a smartphone were excluded from the study.

Outcome measures

Smartphone Addiction Scale - Short Form: *It* is a scale that measures the risk of smartphone addiction (Kwon, Kim, Cho & Yang, 2013). The scale has been translated into Turkish by Akın et al. (Akın, Altundağ, Turan & Akın, 2014). The scale consists of 10 items in total and has no subscales. Each item is scored between 1 and 6, and the total score varies between 10 and 60. As the total score increases, it means that the risk of addiction increases. In the Korean sample, cut-off scores are stated as 31 for men and 33 for women (Kwon, Kim, Cho & Yang, 2013).

Cornell Musculoskeletal Discomfort Questionnaire: It evaluates the feeling of pain and discomfort and the severity and impact of this feeling on the body parts (Hedge, Morimoto & Mccrobie, 1999). The questionnaire has been adapted to Turkish by Erdinç et al. (Erdinc, Hot & Ozkaya, 2011). CMDQ evaluates pain, ache, or discomfort in 12 parts of the body (neck, shoulder, upper back, upper arm, lower back, forearm, wrist, hip/buttocks, thigh, knee, lower leg, and foot) over 1 week. It examines the pain, ache and discomfort in these areas in terms of frequency, severity and interference with work. The score that can be obtained for each part of the body varies between 0 and 90 points. As the score increases, it

indicates that the severity of the problem increases. CMDQ total score is obtained by summing the scores of all sections.

Pittsburgh Sleep Quality Index: The index is used to assess sleep quality (Buysse, Reynolds, Monk, Berman & Kupfer, 1989). PSQI measures sleep quality over a one-month period. The scale, which consists of 24 questions, includes 19 self-report questions followed by 5 questions to be answered by the spouse or roommate. While the score of the scale is evaluated by calculating 18 items, items answered by the spouse or roommate are not included in the calculation. The scale consists of seven components: "Subjective sleep quality", "sleep latency", "sleep duration", "sleep efficiency", "sleep disturbance", "use of sleep medication" and "daytime dysfunction". Each item is evaluated between 0 and 3 points. The total score from the seven components determines the total score of the scale. The total score that can be obtained from the scale varies between 0 and 21. A total score of ≤5 indicates "good sleep quality", while a total score of >5 indicates "poor sleep quality". Its cultural adaptation into Turkish was tested by Ağargün et al. (Ağargün, Kara & Anlar, 1996).

Statistical analysis

Statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 22.0. Statistical data with normal distribution are presented as mean ± standard deviation, and statistical data with non-normal distribution are presented as median (25th-75th percentile). The Pearson and Spearman tests calculated normally and non-normally distributed data correlations, respectively. The Kolmogorov-Smirnov test was used for normality analysis. The Pearson correlation coefficient was interpreted as follows: 0.81 to 1.00 indicates excellent correlation, 0.61 to 0.80 very good correlation, 0.41 to 0.60 good correlation, 0.21 to 0.40 poor correlation, and 0 to 0.20 no correlation (Feise & Menke, 2001).

Ethic approval

Study permission was received from Tokat Gaziosmanpaşa University Social and Human Sciences Research Ethics Committee (date: 30.01.2024, session number: 02, decision: 01-65). The study complies with the principles of the Declaration of Helsinki. The data was collected between 01.02.2024 - 01.04.2024.

RESULTS

The demographics of the participants are shown in Table 1.

There was no correlation between SAS and PSQI's subjective sleep quality, sleep latency, sleep duration and use of sleep medication subscales (p=0.219, r=0.16; p=0.098, r=0.22; p=0.118, r=0.20; p=0.302, r=0.14). There was a weak correlation between SAS and PSQI's sleep efficiency, sleep disturbance, daytime dysfunction subscales, PSQI total score, and CMDQ's lower extremity and spine subscales (p=0.021, r=0.30; p=0.020, r=0.30; p=0.008, r=0.34; p=0.008, r=0.34; p=0.029, r=0.28; p=0.019, r=0.30). There was a well correlation between SAS and CMDQ's upper extremity subscale and CMDQ total score (p=0.001, r=0.43; p=0.001, r=0.42) (Table 2).

Table 1. The demographics of the participants.

	Mean±SD
Age (years)	22.33±1.19
Height (m)	1.69±0.10
Weight (kg)	67.98±14.46
BMI (kg/m^2)	23.54±3.68
Daily smartphone usage time (hours)	5.95±1.86
Age of starting to use a smartphone (years)	14.10±1.63
	n (%)
Gender	
Male	26(43.30)
Female	34(56.70)
Smoking	
Yes	19(31.70)
No	41(68.30)
Alcohol use	
Yes	1(1.70)
No	59(98.30)

BMI: Body mass index

Table 2. Correlations of SAS with PSQI and CMDQ.

	SAS	
	p	**r**
PSQI - Subjective sleep quality	0.219	0.16
PSQI - Sleep latency	0.098	0.22
PSQI - Sleep duration	0.118	0.20
PSQI - Sleep efficiency	**0.021**	**0.30**
PSQI - Sleep disturbance	**0.020**	**0.30**
PSQI - Use of sleep medication	0.302	0.14
PSQI - Daytime dysfunction	**0.008**	**0.34**
PSQI - Total Score	**0.008**	**0.34**
CMDQ - Upper Extremity	**0.001**	**0.43**
CMDQ - Lower Extremity	**0.029**	**0.28**
CMDQ - Spine	**0.019**	**0.30**
CMDQ - Total	**0.001**	**0.42**

Spearman test, SAS: Smartphone Addiction Scale, CMDQ: Cornell Musculoskeletal Discomfort Questionnaire, PSQI: Pittsburgh Sleep Quality Index

There was no correlation between SAS and CMDQ's lower back, forearm, thigh, knee, lower leg and foot subscales (p=0.371; p=0.108; p=0.065). There was a weak correlation between SAS and CMDQ's neck, upper back, shoulder, wrist, upper arm and hip/buttocks subscales (p=0.011; p=0.006; p=0.030; p=0.024; p=0.002; p=0.008) (Table 3).

Table 3. Correlations of SAS with CMDQ body parts.

	SAS	
	p	**r**
CMDQ – Neck	**0.011**	**0.33**
CMDQ – Shoulder	**0.006**	**0.35**
CMDQ – Upper back	**0.030**	**0.28**
CMDQ – Upper arm	**0.024**	**0.29**
CMDQ – Lower back	0.371	0.19
CMDQ – Forearm	0.108	0.21
CMDQ – Wrist	**0.002**	**0.39**
CMDQ – Hip/buttocks	**0.008**	**0.34**
CMDQ – Thigh	0.065	0.24
CMDQ – Knee	0.999	0.00
CMDQ – Lower leg	0.171	0.18
CMDQ – Foot	0.418	0.11

Spearman test, SAS: Smartphone Addiction Scale, CMDQ: Cornell Musculoskeletal Discomfort Questionnaire, PSQI: Pittsburgh Sleep Quality Index

SAS, PSQI and CMDQ scores are shown in Table 4.

Table 4. SAS, PSQI and CMDQ scores.

SAS	28.5(22-37.75)
PSQI - Subjective sleep quality	1(1-2)
PSQI - Sleep latency	1(1-2)
PSQI - Sleep duration	1(0-2)
PSQI - Sleep efficiency	0(0-0)
PSQI - Sleep disturbance	1(1-2)
PSQI - Use of sleep medication	0(0-0)
PSQI - Daytime dysfunction	1(0-2)
PSQI - Total Score	6(3.25-8)
CMDQ - Upper extremity	3.75(0-18)
CMDQ - Lower extremity	0(0-7.5)
CMDQ - Spine	7.5(4.5-21.13)
CMDQ - Total	16.5(6-46.13)

SAS: Smartphone Addiction Scale,
CMDQ: Cornell Musculoskeletal Discomfort Questionnaire, PSQI: Pittsburgh Sleep Quality Index

DISCUSSION

In the present study, the relationship between smartphone addiction, sleep quality and musculoskeletal disorders in students was examined, and it was seen that there may be a relationship between them. It was determined that as students' smartphone addiction increases, musculoskeletal disorders may increase and sleep quality may deteriorate. There has been a remarkable increase in smartphone usage over the last decade. This brings with it some physical and cognitive health problems. It was reported that excessive use of smartphones causes pain and discomfort, mainly in the neck, back and wrists. Mustafaoglu et al. in their study with young individuals, reported that the most discomfort was in the neck, back and wrists due to smartphone use (Mustafaoglu, Yasaci, Zirek, Griffiths & Ozdincler, 2021). Yang et al. in their study on adolescents, emphasized a correlation between smartphone use and neck, shoulder and back pain (Yang, Chen, Huang, Lin & Chang, 2017). Forward head posture, which frequently occurs when using a smartphone, may cause discomfort in the neck and back, and keeping the wrists in a fixed position for a long time may cause discomfort in the wrists. Similarly, in the current study, discomfort in the neck, back and wrists was associated with smartphone addiction. In addition, it was observed that disorders in the shoulder, hip and upper arm increased due to smartphone addiction. The position of the neck and back and the protraction of the shoulders due to the forward head posture may also cause discomfort in the shoulders and upper arms. Additionally, this poor posture may affect the spine and cause weakness in the abdominal muscles. Hip flexors may work harder than necessary to compensate for weakened abdominal muscles to provide stabilization. This mechanism may explain the relationship between smartphone addiction and hip disorders. Long-term smartphone use causes increased sedentary behavior. Sedentary lifestyle can also cause hip pain by causing the mentioned posture changes. A study reported that sedentary behavior reduces hip mobility and may cause hip-related morbidities (Javaid et al., 2022).

Wrists remain extended, elbows bent, and head forward for extended periods when using smartphones (Yang et al., 2017). These poor posture may cause tension in muscles, tendons, and discs, causing neck, shoulder, elbow, and wrist/hand pain (Kim, Cho, Park & Yang, 2015). In the current study, it was determined that the upper extremity, lower extremity, spine and total scores of CMDQ were associated with smartphone addiction. The increasing duration of smartphone use is a threat for lower back and lower back pain caused by sedentary behavior (Yang et al., 2017). Prolonged immobilization and incorrect posture are important risks for developing low back pain (Balagué, Troussier & Salminen, 1999). As a result of their study on university students, Alsalameh et al. reported that the most common pain due to smartphone addiction was in the neck, shoulder and lower back regions (Alsalameh et al., 2019). In the current study, there is no relationship between smartphone addiction and lower back discomfort. Our study group consisted of young people who were university students. Depending on their young age, the bad posture that has just been formed may not have existed long enough. For this reason, they may not be experiencing back pain at the moment. They may also experience lower back pain in the future due to prolonged poor posture caused by smartphone addiction. It has been reported that people use their smartphones more at night, which causes a decrease in sleep quality. Prithika et al. found that students with more smartphones had worse sleep

quality (Prithika et al., 2022). Nikolic et al. emphasized that there is a relationship between lousy sleep and smartphone addiction in medical students (Nikolic, Bukurov, Pavlović & Grujicic, 2023). In the current study, there was a relationship between students' smartphone addiction and their sleep quality. As smartphone addiction increases, sleep efficiency, sleep disturbance, daytime dysfunction and general sleep quality worsen. Due to smartphone use, bedtime may be delayed, and sleep time may decrease. Using smartphone instead of sleeping may reduce sleep efficiency by increasing time spent in bed but decreasing sleep time. Decreased sleep efficiency may cause the person to not be able to renew enough energy during sleep, causing difficulty in staying awake during the day, decreasing enthusiasm for daily activities, and ultimately causing daytime dysfunction. The habit of checking the phone repeatedly in smartphone addicts also activates the reward center and can negatively affect sleep quality (Hysing et al., 2015). It is also reported that long-term smartphone use may cause musculoskeletal disorders, which may negatively affect sleep quality (Thomée et al., 2011). Our study also showed that smartphone use may be associated with musculoskeletal disorders. In addition, the light emitted by the phone can disrupt the circadian rhythm and affect sleep patterns (LeBourgeois et al., 2017). All these reasons worsen the overall sleep quality. Additionally, excessive smartphone use may predispose to various psychological problems (e.g. depression) that are known to be related to sleep problems (Demirci, Akgönül, & Akpınar, 2015).

Limitations and Strengths

The current study has several limitations. Firstly, the study has a cross-sectional design; therefore, changes in smartphone addiction, musculoskeletal discomfort, and sleep quality over time were not observed. Secondly, as the study was conducted in a single center, our results cannot be generalized to the population. Further multicenter follow-up studies with larger sample groups are needed. The strength of the study is that, to our knowledge, it is the first study to examine smartphone addiction, sleep quality and musculoskeletal disorders together.

CONCLUSION

It was concluded that as smartphone addiction increases in students, musculoskeletal disorders increase. Smartphone addiction was particularly associated with the neck, shoulder, back, upper arm, wrist and hip regions. It was also concluded that smartphone addiction worsens sleep efficiency, sleep disturbance, daytime dysfunction and general sleep quality.

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Conflict of Interest

The author report there are no conflicts of interests to declare.

Author Contributions

Plan, design: EE; **Material, methods and data collection:** EE; Data **analysis and comments:** EE; **Writing and corrections:** EE.

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Ethical Approval

Institution: Tokat Gaziosmanpaşa University Social and Human Sciences Research Ethics Committee
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