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How does smartphone usage affect the severity of neck pain, neck-pain related disability, and cervical lordosis? A pilot study

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ABSTRACT

Objective: Long-term and repetitive use of smartphones may cause musculoskeletal symptoms such as neck pain. This pilot study aimed to examine the effect of smartphone usage on neck pain, disability, and cervical lordosis.

Material and Methods: Seventy-eight patients were enrolled in this cross-sectional pilot study. The level of smartphone use was evaluated with the Smartphone addiction scale-short version (SAS-SV). Neck Bournemouth Questionnaire (NBQ), Neck Disability Index (NDI), and 100 mm Visual Analog Scale (VAS) were used to assess pain and disability. Cervical lordosis angle was measured using the Cobb method.

Results: A positive significant correlation with low correlation coefficient (r= 0.277, p=0.014; r: 0.295, p=0.009) was determined between SAS-SV and NBQ, and NDI. However, no correlation was found between SAS-SV and cervical lordosis angle (p>0.05). When applying simple linear regression modeling to predict neck pain severity, the SAS-SV total score alone explained 7.7% of the variance of the NBQ and 9.0% of the variance of the NDI total score.

Conclusion: We concluded that it would be beneficial to question the frequency and position of smartphone use, to recommend to use it less, and to avoid prolongation in neck flexion for patients with chronic neck pain.

Keywords: Neck pain, smartphone addiction, radiography, lordosis

INTRODUCTION

Smartphones have been the most popular electronic devices, especially among the young population (1). In recent years, the number of individuals who have a smartphone and the time spent on a smartphone has increased considerably due to the developments in various smartphone models (2). Smartphones are used for multi-purposes including communication, music, media, internet access, games, some applications, and professional fields (3). Until recently, a diagnostic system for smartphone addiction has not been clarified, but it is classified as 'non-substance addictions' as a psychiatric diagnosis in the Diagnostic and Statistical Manual of Mental Disorders. This paved the way for approaching other digital addictions and behavioral addictions (4).

Intensive smartphone usage is thought to cause some problems. Reportedly; using a smartphone can cause sleep disorders, stress, anxiety, decreased academic success, and decreased physical activity in previous studies (5). In addition, prolonged and repetitive use of smartphones can cause musculoskeletal symptoms in various parts of the body, including the neck, shoulders, elbows, wrists, fingers, and back (2, 6, 7). Among smartphone users with the highest prevalence compared to other body parts, the rate of neck pain ranges from 17.3% to 67.8% in many countries, including China, Canada, South Korea, and India (8).

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Also, the frequency of neck and shoulder pain between the ages of 20 and 34 has increased in the last 20 years, and the most likely cause is using a computer and smartphone (8).

The cause of neck pain is known to be multifactorial, and incorrect spinal posture is one of the common causes (9). Individuals take their heads down sharply and holding their arms in front of them reading the screen can cause excessive anterior curve in the lower cervical vertebra and excessive posterior curve in the upper thoracic vertebra (1). Prolonged neck flexion together with lack of support for the arms and repetitive movement of the fingers causes static muscular loading on the cervical muscles, especially when only one hand is used (2). In addition, cervical flexion for long time has a negative effect on cervical lordosis (10).

In this pilot study, we wanted to draw attention to the effects of intensive smartphone use on neck pain, the most common musculoskeletal symptom associated with smartphone use. We aimed to investigate not only pain severity, but also disability and radiological changes in the cervical region due to intense smartphone use. Our first hypothesis was that there is a positive relationship between smartphone use and neck pain, and disability. Second, there is a negative relationship between smartphone addiction and cervical lordosis.

MATERIAL and METHODS

Participants:

Patients with chronic neck pain (more than 3 months) in the young population, who applied to our outpatient clinic between January 2020 and April 2020, were included. Patients enrolled in this study were 1-) 18-35 years old, 2-) Eligible smartphone users, 3-) having chronic neck pain, 4-) literate enough to answer the questionnaire. Patients with rheumatologic diseases which may affect the cervical spine, who worked in the cervical flexion posture (desk workers), who had a diagnosis like cervical disc degeneration, cervical disc disease, cervical myelopathy, cervical trauma history, and who underwent cervical spine surgery were excluded from the study.

Study Design:

This study was a cross-sectional study. Before the beginning of this study, ethical approval was obtained from the local ethic community of our hospital (Approval time: 20.04.2020, Approval number: 86/03). All participants were informed about the study and were given an informed consent form to sign.

First; age, gender, other musculoskeletal pain, years of using a smartphone, frequency of using a smartphone, duration of using a smartphone, and position of using a smartphone were answered by the participants.

All participants were evaluated with the Smartphone Addiction Scale- Short Version (SAS-SV), Neck Bournemouth Questionnaire (NBQ), Neck Disability Index (NDI) and 100 mm Visual Analog Scale (VAS).

Smartphone Addiction Scale- Short Version (SAS-SV)

SAS-SV was used to assess the smartphone addiction level.

This 10 self- reported scale items address 5 content domains, such as: (i) daily-life disturbance, (ii) withdrawal, (iii) cyberspace-oriented relationships, (iv) overuse, and (v) tolerance; these domains were responded on a 6-point Likert scale (1= strongly disagree to 6= strongly agree). The SAS-SV score range is 10-60. Higher scores are considered a higher risk of addiction.

The cut-off score is 31 for men and 33 for women evaluating smartphone addiction (11). Noyan et al. translated this scale to Turkish in 2015 (11). In this study, we used this scale to evaluate the intensity of smartphone use, and patients were classified in two groups: Non-addicted and addicted groups.

Neck Bournemouth Questionnaire (NBQ)

The NBQ is a 7-item self-administered questionnaire evaluating pain, physical function, social activity, anxiety, depression, work-related fear avoidance, and pain control. The total score is 70 and it is reached by adding the 7 dimension scores (12). Variability and reliability of this scale were demonstrated by Yılmaz et al. in 2019 (13).

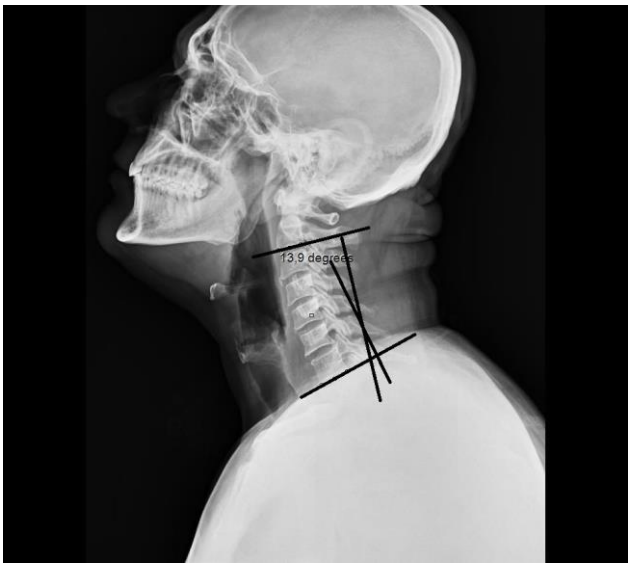
Neck Disability Index (NDI)

The NDI is mostly used to score neck pain related disability. It was published in 1991 and reviewed by the same author in 2008 (14). It includes 10 questions: Self-care, lifting, reading, work, driving, sleep, recreational activities, pain intensity, concentration and headache. Each item is scored on a scale from 0 (no disability) to 5. The total score ranges from 0 to 50: 0-4, minimal disability; 5-14, moderate disability; 15-24, severe disability; 25-34, crippled; 35-50, bedbound. Clinic properties of The Turkish translation of NDI were published in 2012 (15).

Cervical lordosis angle

We measured cervical lordosis angle with the Cobb method using lateral X-ray in a neutral position. In this method; cervical lordosis is measured by drawing two lines parallel to the endplate of C2 and C7, drawing orthogonal lines to these two lines, and measuring the intersection angle between these orthogonal lines (10) (Figure 1).

Figure 1: Measurement of cervical lordosis angle with the Cobb method



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Statistical analysis

Data obtained in the study were analyzed statistically using the Statistical Package for the Social Sciences (SPSS 15.0 for Windows) software. In descriptive statistics, data were expressed as mean ± standard deviation (SD) for continuous and categorical variables, and as frequencies and percentages (%) for nominal variables. The Shapiro-Wilks test and visual methods (histograms, probability plots) were used to assess the normality of data distribution. Comparison results of VAS, NBQ, NDI, and the lordosis angle between the addiction and non-addiction group was assessed with the independent sample t test. Correlations between VAS, NBQ, NDI, cervical lordosis angle, duration, frequency , and daily smartphone use and SAS-SV were analyzed with Pearson's or Sperman's correlation test where required; then, univariate linear regression analysis was performed for statistical significance. A value of $p<0.05$ was considered statistically significant.

RESULTS

Seventy-eight patients were included in this study and the mean age of the patients was 29.64 ± 6.56 years. Fifty-four (69.2%) of the participants were women and 24 (30.8 %) were men. The demographic characteristics of the patients were shown in Table 1. The most common concomitant pain was shoulder pain in patients.

Table 2 shown features of smartphone use. More than half of the patients (79.2%) had been using a smartphone for more than 6 years. The most common position when using a smartphone was the sitting position (55.1%).

Twenty-three patients (32.05%) were in the addicted group, 53 (67.94%) were in the non-addicted group. The comparison of VAS, NBQ, NDI, and cervical lordosis angles between the addicted and non-addicted groups were presented in Table 3. There was a significant difference regarding the NBQ, and NDI scores between the addicted and non-addicted groups ($p=0.03$, $p=0.02$ respectively). But yet, no significant difference was found in VAS and cervical lordosis angle between the addicted and non-addicted groups. ($p>0.05$) (Table 3).

The results of correlation analyses between VAS, NBQ, NDI, cervical lordosis angle, duration of smartphone use, daily smartphone use, and frequency of smartphone use SAS-SV were shown in Table 4.

Positive significant correlations were determined between SAS-SV and NBQ, and NDI with low correlation coefficient ($r= 0.277$, $p=0.014$; r: 0.295, $p=0.009$). Daily smartphone usage, and frequency of smartphone use were correlated with SAS-SV ($p<0.05$).

After the correlation analysis, multiple regression analyzes were used to clarify the relationship. However, there was no correlation between NDI, NBQ and age, and lordosis angle. The two measurements mentioned were only related to SAS-V.

Table 5 showed the results of linear regression analyses. When applying simple linear regression modeling to predict neck pain severity, the SAS-SV total score alone explained 7.7% of the variance of the NBQ, 9.0% of the variance of the NDI total score.

Table 1. Demographic Characteristics of Patients

n=78		N (%)
Age(years) (mean±SD)	29.65±6.46	
Gender	**Female**	54 (69.2)
	Male	24 (30.8)
Concomitant musculoskeletal pain	**Shoulder pain**	49 (62.8)
	Elbow pain	1 (1.3)
	Wrist pain	3 (3.8)
	Thumb pain	0
	Back pain	16 (20.5)
	No other pain	9 (11.5)

Table 2. Features of Smartphone Usage

		N, %
Duration of smartphone usage	*Less than 1 year*	2 (2.6)
	1 to 3 years	2 (2.6)
	3 to 6 years	12 (15.4)
	More than 6 years	62 (79.5)
Daily smartphone usage	*Less than 1 hour*	15 (19.2)
	1 to 3 hours	29 (37.2)
	3 to 5 hours	11 (14.1)
	More than 5 hours	23 (29.5)
Frequency of smartphone usage	*One in a week*	2 (2.5)
	One every three days	1 (1.2)
	One every two days	1 (1.2)
	Everyday	74 (94.8)
Position of smartphone use	*Sitting*	44 (57.1)
	Lying	5 (6.5)
	Standing	4 (5.2)
	All positions	24 (31.2)

Table 3. Comparison of VAS, NBQ, NDI, and cervical angles between the addicted and non-addicted group

	Non-addicted n=53 mean±SD	Addicted n=25 mean±SD	P
VAS (0-100mm)	67.93±15.24	74.01±18.71	0.14
NBQ	37.87±12.58	47.49±12.99	**0.01**
NDI	12.89±7.50	17.37±6.97	**0.02**
Cervical lordosis angle (%)	13.13±9.25	15.30±10.04	0.36

SD: Standard deviation, VAS: Visual Analog Scale, NBQ: Neck Bournemouth Questionnaire, NDI: Neck Disability Index, p values were calculated with independent sample t test, bold values shows statistical significance (p<0.05).

Table 4: Results of correlation analyses between Visual Analog scale, Neck Bournemouth Questionnaire, Neck Disability Index, cervical lordosis angle and Smartphone Usage

n=78	SAS-SV r (p)	Lordosis Angle r (p)	VAS r (p)	NBQ r (p)	NDI r (p)
Lordosis angle	**145 .205**	-			
VAS	**111 .334**	**-.090 .432**	-		
NBQ	**.277 .014**	**-.153 .181**	**.518 .000**	-	
NDI	**.295 .009**	**-.025 .827**	**.408 .000**	**.674 .000**	-
Duration of smartphone usage (years)	**.222 0.053**	**.-.095 0.414**	**.084 0.470**	**.051 0.661**	**.032 0.784**
Daily smartphone usage(hours)	**.479 0.001**	**.223 0.051**	**.056 0.620**	**-.176 0.120**	**-.031 0.783**
Frequency of smartphone usage	**.298 0.008**	**.008 0.944**	**.076 0.513**	**.044 0.718**	**-.200 0.083**

SAS-SV: smartphone addiction scale-short version, VAS: Visual Analog Scale, NBQ: Neck Bournemouth Questionnaire, NDI: Neck Disability Index, Correlations were analyzed with Spearman Correlation test, bold values shows statistical significance (p<0.05).

Table 5. Results of liner regression analyses

	n=78			
	B	**Std. error B**	**Beta (P)**	**R2**
NBQ/SAS-SV	.333	.133	.277 (.014)	.077
NDI/SAS-SV	.204	.074	.300 (.008)	.090

SAS-SV: smartphone addiction scale-short version, NBQ: Neck Bournemouth Questionnaire, NDI: Neck Disability Index.

DISCUSSION

According to the results of this pilot study, the severity of neck pain, and neck-pain related disability were significantly higher in patients with smartphone addiction comparing the participants without smartphone addiction. It was determined that, as the level of smartphone usage increased, the severity of neck pain, and disability increased. However, no effect was found smartphone addiction on cervical lordosis. Daily smartphone usage, and frequency of smartphone use were associated with smartphone addiction. Smartphone addiction was found an independent risk factor on neck pain, and neck-pain related disability.

The frequency of smartphone addiction among the young population has been increasing. The rates of smartphone addiction vary between 36.5 % and 62.4% in different studies (2). In Turkey, this rate was found to be 43.9 % among university students (3). The neck is a common area where problems can arise due to the overuse of smartphones.

Smartphone addiction has been found to be an independent significant factor on neck pain (2) and the question 'Why does use a smartphone cause neck pain?' has been investigated in many studies. The frequency, duration, and purpose of using a smartphone, the degree of neck flexion during use, and repetitive movements of the upper extremities were found to be associated with neck pain (8). Overuse of smartphones can cause the head and neck to move habitually and constantly towards the screen throughout the day. When using smartphones, people often flex their necks down to look at the lowered object and keep their head in a forward position for a long time (2, 16). In a study conducted; cervical flexion postures lasting longer than 10 minutes alter erector spine muscle activation, causing elongation of posterior cervical tissues, decreasing the excitability of receptors and reducing neural conduction activity (17). Such movements were associated with a high risk of chronic neck pain (18).

A study involving 799 smartphone users found that neck pain was the most common musculoskeletal problem and shoulder pain was the second most common problem (9).

In this study, we wanted to answer how much smartphone use affects neck pain, like other authors in the literature. We found a positive correlation between smartphone use and neck pain, and neck pain-related disability. Our findings supported previous studies showing that smartphone addiction causes musculoskeletal problems, especially in the neck and circumference, in young adults (1, 19, 20).

In a meta-analysis including 6 studies, a significant relationship was found between the duration of smartphone use and musculoskeletal symptoms such as shoulder, neck, and low back pain in 3 studies, while no significant relationship was found in other tree studies (8). While some of the cross-sectional studies did not show a significant dose-response relationship (21, 22), others showed that more smartphone use was associated with musculoskeletal symptoms (23-25).

In another study including 249 smartphone users, 65.9% of their participants had neck pain among the last one-year, and they found that; smartphone addiction scores in participants with neck pain were significantly higher than participants without pain. Duration of owing smartphone, and duration of smartphone use a typical day were correlated with smartphone addiction (26).

According to the results of our study, there was a difference between smartphone addiction and both NDI and NBQ in the evaluation made on SAS-SV scales. Consistent with the results in the literature, we found a relationship between intensity of smartphone use and clinical symptoms. The other result our study similar the literature; there was a positive relationship between features of smartphone use like as; frequency or hours used daily, and smartphone addiction.

Cervical lordosis is the first physiological curvature of the human spine and is a dominant disc herniation site due to its load-bearing function. It maintains the stability of the spine and is an essential part of normal spinal biomechanics (27, 28). The average of the cervical lordosis angle is between 20-35 (10). Cobb and Harrison's Tangent methods are two main different methods used to measure the cervical lordosis angle on sagittal radiography (10). In this study, we evaluated cervical lordosis using the Cobb angle measurement method. Cervical lordosis can be affected by many factors and the change in cervical lordosis can cause neck pain. Gao et al. evaluated the images of 3261 patients with cervical spondylosis and 1886 (57.8%) were found with abnormal cervical curvature (29). In other studies, no significant correlation was found between the sagittal alignment of the cervical spine and clinical symptoms (30, 31). In our study, no significant relationship between cervical lordosis and neck pain, and disability was found.

In this pilot study, our first hypothesis was confirmed, and there were a positive relationship between smartphone use and neck pain, and disability.

However, we could not find a significant relationship between cervical lordosis and the intensity of smartphone use. This situation may be related to the age group of our participants, and the effects of smartphone use on the skeletal system may not yet be seen.

Elderly participants in whom degenerative changes can often be seen were not included in this study. So this condition restricted our number of participants. The lower sample size of our study is a limitation of this study. In addition, existing posture disorders, personal habits or the purpose of using the smartphone (long-term activities such as playing games) which could affect the relationship between smartphone use and measured parameters, were not taken into account. Finally, this pilot study is a cross-sectional study, so studies with more participants and follow-up periods are needed to understand the relationship more clearly.

CONCLUSIONS

Neck pain is the most common musculoskeletal problem among smartphone users. As the time spent with the smartphone increased, the concept of smartphone addiction, which is classified as behavioral addictions, emerged. Preventive approaches are as important as therapeutic approaches in the management of neck pain. We think that questioning the frequency, and position of smartphone use, recommending less use of it, and avoiding prolonged neck flexion may be helpful for our patients with chronic neck pain.

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Ethical issues: All authors declare originality of research.

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