Relationships of Mobile Phone Use with the Functions and Disabilities of Neck and Upper Extremity

Zehra GÜÇHAN TOPCU[*], Ender ANGIN[**], Özde DEPRELİ[***], İlker YATAR[****],

Serpil MIHÇIOĞLU[*****], Hayriye TOMAÇ[******]

Abstract

Aim: To determine the effects of mobile phone use on fine motor functions, neck, and upper limb disability values.

Methods: Time duration of mobile phone use was recorded for a week. Rapid Upper Limb Assessment (RULA) was used to determine the risk level about posture while texting message on phones. Neck Disability Index (NDI) for neck pain and functional disability of neck on activities of daily life, Disabilities of the Arm, Shoulder, and Hand-Function/Symptom (DASH-FS) for the limitation in the functions of upper limb, Jebson Taylor Hand Function test for fine motor function.

Results: Two hundred and seventy individuals (141 women, 129 men) whose mean ages were 21,48±1,86 years were included. While a significant correlation between duration of phone use and NDI score was specified (r=0,172; p=0,005), no significant correlation was found between duration of phone use and DASH-FS scores (r=0,092; p=0,130). It was found that there was a negative significant relationship between the duration of phone use and the total function score of the left hand and throwing small objects (p<0,01). According to RULA 95,6% of individuals have unacceptable phone usage postures, but no significant relationship was found between ergonomic risk level and NDI values, DASH-FS values, and hand functions (p>0,05).

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Corresponding Author: [*] Assist. Prof., Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: zehra.guchan@emu.edu.tr ORCID https://orcid.org/0000-0001-8587-7407
[**] Assoc. Prof., Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: ender.angin@emu.edu.tr ORCID https://orcid.org/0000-0001-7962-7794
[***] Lecturer, Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: ozde.depreli@emu.edu.tr ORCID https://orcid.org/0000-0001-7456-8895
[****] Lecturer, Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: ilker.yatar@emu.edu.tr ORCID https://orcid.org/0000-0003-0498-5233
[*****] Research Assist., Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: srplmhcgl@gmail.com ORCID https://orcid.org/0000-0001-7186-324X
[******] Research Assist., Eastern Mediterranean University, Faculty of Health Sciences, Famagusta, Cyprus, E-mail: hayriye.tomac123@hotmail.com ORCID https://orcid.org/0000-0002-8245-9995

ETHICAL STATEMENT: After the approval of the Eastern Mediterranean University, Health Sciences Ethics Committee in 2019, the individuals who used smart mobile phones were informed about the written consent form before the study and were then signed (Ethical Number: ETK00-20190075).

Conclusion: Although increased duration of phone use could cause neck problems, manual ability may be positively affected. In addition, since most participants have a poor posture while using a mobile phone, it is thought that this may be a risk factor for more musculoskeletal problems in older ages.

Keywords: Mobile phone, motor skills, posture, neck, shoulder.

Cep Telefonu Kullanımının Boyun ve Üst Ekstremite Fonksiyon ve Bozuklukları ile İlişkisi

Öz

Amaç: Cep telefonu kullanımının ince motor fonksiyonlar, boyun ve üst ekstremite özürlülük değerlerine etkisini belirlemektir.

Yöntem: Bir hafta boyunca cep telefonu kullanım süresi kaydedildi. Telefonlarda mesaj yazarken duruşla ilgili risk düzeyini belirlemek için Hızlı Üst Ekstremite Değerlendirmesi (RULA) kullanıldı. Boyun ağrısı ve boynun günlük yaşam aktiviteleri üzerindeki fonksiyonel bozukluğu için Boyun Engellilik İndeksi (NDI), üst ekstremite fonksiyonlarındaki sınırlama için Kol, Omuz ve El Fonksiyonu/Belirti (DASH-FS), ince motor fonksiyonlar için Jebsen Taylor El Fonksiyon Testi kullanıldı.

Bulgular: Çalışmaya yaşları ortalama 21,48±1,86 yıl olan 270 birey (141 kadın, 129 erkek) dahil edildi. Telefon kullanım süresi ile NDI puanı arasında anlamlı bir ilişki belirlenirken (r=0,172; p=0,005), telefon kullanım süresi ile DASH-FS puanları arasında anlamlı bir ilişki bulunmadı (r=0,092; p=0,130). Telefon kullanım süresi ile sol elin toplam fonksiyon puanı ve küçük nesneleri fırlatma arasında negatif yönde anlamlı bir ilişki olduğu bulundu (p<0,01). RULA'ya göre bireylerin %95,6'sı kabul edilemez telefon kullanım duruşuna sahiptir ancak ergonomik risk düzeyi ile NDI değerleri, DASH-FS değerleri ve el fonksiyonları arasında anlamlı bir ilişki bulunmadı (p>0,05).

Sonuç: Artan telefon kullanım süresi boyun problemlerine neden olabilse de el becerisi olumlu etkilenebilir. Ayrıca çoğu katılımcıda cep telefonu kullanırken kötü bir duruş saptandığından bu durumun ileri yaşlarda daha fazla kas-iskelet sistemi sorunları için bir risk faktörü olabileceği düşünülmektedir.

Anahtar Sözcükler: Cep telefonu, motor beceriler, postür, boyun, omuz.

Introduction

Mobile phones, which are a product of developing technology, and mobile phones that have multiple different features that emerged afterwards have become an important part of life[1]. Today, the mobile phone, which is used not only for communication but for many different purposes, has become a pocket computer[2,3]. According to the statistical data, it has been reported that the number of mobile phone users worldwide today surpasses four billion and will continue to grow in the next years[4]. Although mobile phones make daily life easier, they cause some problems[5]. The user needs to look at the screen for a long time to send messages, access the internet, play games, or perform other functions[6]. As the duration of use of activities such as writing messages and playing games with mobile phones increases, musculoskeletal problems occur[6-8]. The repetitive

movements of upper extremity in static postures cause uncomfortable muscular contractions, pain, and decrease in motor functions[6].

Mobile phone users complain of discomfort and pain in at least one area, including the upper extremities, back or neck[8]. Considering the frequency of upper extremity problems in mobile phone users in a study conducted with 1500 university students, it was noted that the most problem was in the thumb (52%). This was followed by the elbow (14,6%), wrist (13%), fingers (11,9%), hand (10,3%), forearm (7,1%), shoulder (6,7%) and arm (5,5%). In the same study, pain (61,7%) and fatigue (44,3%) were the most frequently reported symptoms by the participants[9]. Continuous and long-term gripping, repetitive pushing, and repetitive movements with the thumb cause problems in the forearm, thumb and fingers[10]. Excessive use of the message sending function causes constant mechanical stress on tendons, muscles, and tissue, which increases problems in the neck and spine, as well as the fingers and forearms[11,12]. Using the mobile phone for a long time without interruption may cause more serious problems including arthritis / subluxation problems in the joints and injuries in the nerves[9].

Thumb takes the most important role on hand functions. Since the most frequent musculoskeletal problems are seen in thumb, hand functionality which is important for an individual's performance in daily life is negatively affected in the prolonged use of mobile phones[5]. Staying stationary for hours with the same hand and elbow movements while using mobile phones not only disrupts the posture of the individual but also causes inefficiency at work[13]. Thus, their prolonged use significantly affects the quality of life as well as the activities of daily life of the individual[14,15].

Since mobile phones often have small screens, users need to bend their head down to see the screens. Increased activity in the neck extensor muscles overloads the neck and shoulders, increases muscle fatigue and pain in the cervical region[16,17]. Using a mobile phone in a static position and with an unsupported arm causes abnormal alignment of the neck and shoulders[18,19]. Due to these reasons, neck and shoulder symptoms are also frequently encountered in mobile phone users[20].

Smart mobile devices have an important place today. The reviewed literature highlights the high biomechanical risk of mobile phone use for individuals. It is noteworthy that there are few studies that examine the effects of mobile phone use on motor functions and posture in detail. In addition, no study has been found that evaluates the effects of mobile phone use on these parameters, particularly the effects of texting with mobile phone were not investigated.

The hypothesis of the paper is that there is no correlation among the duration and ergonomic level of smartphone use, and neck, shoulder, and fine motor skills. Accordingly, the aim of this study was to determine the duration of mobile phone use and risk level of posture taken while texting

message on mobile phone and then correlate them with musculoskeletal problems of neck and upper limb as well as the hand functions.

Material and Methods

Study Design

This study has a descriptive, correlational, and cross-sectional design.

Participants and Procedures

A total of 270 people were included in this study. The university students from the Faculty of Health Sciences between 18 and 25 years old and who have mobile phone with android operating systems were included in the study. Due to the paid program in iOS software, participants using iPhone were not included. Also, who have neurological problem and/or cognitive problem were excluded from the study. The sample size was determined as 197 participants with a significance level of 0,05; 95% power (G*Power Version 3.1.9.2) and 246 participants with a 25% loss (24 hour phone result) according to the correlation analysis.

Ethical Consideration

After the approval of the Eastern Mediterranean University, Health Sciences Ethics Committee in 2019, the individuals who used smart mobile phones were informed about the written consent form before the study and were then signed (Ethical Number: ETK00-20190075).

Data Collection

Data was collected in the Fall semester of 2019-2020 academic year. Firstly, the age, gender, dominant side, and presence of musculoskeletal pain were questioned and recorded. The following procedures were then conducted.

Duration of Mobile Phone Usage

Individuals were asked to download "My Phone Time" application to their phones. The application recorded the phone usage of the individuals for 1 week and the total usage time was recorded.

Rapid Upper Limb Assessment (RULA)

The RULA tool was used to assess the risk of the individuals' postures while using their mobile phones. Participants were asked to write a same sentence in a message box for 1 minute on their mobile phones, a photo was taken at this time, and then the total score was recorded by RULA analysis. RULA consists of two basic parts. These sections are Arm and Hand, Wrist Assessment and Neck, Body, and Leg Assessment[21]. According to the final score, there are 1 or 2 levels mean

"acceptable posture", 3 or 4 levels require "further investigation, change may be needed", 5 or 6 requires "further investigation and change soon" and level 7 means "investigate and implement change"[21]. Turkish validity and reliability of the RULA were carried out by Öztürk and Esin[22].

The Jebsen-Taylor Hand Function Test (JTHFT)

The Jebsen-Taylor Hand Function Test was used to comprehensively evaluate the fine and gross motor skills of the hand. The test consists of 7 subtests which includes various hand functions; writing a sentence consisting of 24 letters (the old man looks tired), turning cards (4 pieces, 8 x 13 cm), collecting small objects (2 paper clips, 2 coins and 2 soda caps), placing checkers on top of each other (4 pieces), feeding simulated with a spoon and beans, putting large, light objects on the board; and placing large, heavy objects (450 grams) on the wood. During the test, the tester was seated in a chair with a table in front of him. Each part of the test was started with the dominant hand while the non-dominant hand was put on the table. Duration was recorded in seconds for each task[20]. Its reliability and validity were shown[23].

Neck Disability Index (NDI)

The index was used to evaluate the neck related problems of the individuals. The questionnaire consists of ten parts: pain intensity, individual care, lifting, reading, headache, concentration, working, driving, sleeping and entertainment. Each section scores from 0 to 5. If all questions are answered, the percentage is calculated by adding the points and multiplying by 2. If the questions are answered incompletely, the points are added up again and the percentage is calculated by dividing the number of questions answered by 5. 0 to 4 points indicate no disability, 5 to 14 points indicate mild disability, 15 to 24 points moderate disability, 25 to 34 points severe disability, and 35 or more total disability. The Turkish validity and reliability study of this index was conducted by Aslan et al.[24].

Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire

DASH which is a self-answer questionnaire was used to measure physical problems and symptoms in all upper extremity disorders. The questionnaire consists of three parts. The first part consists of 30 questions; 21 questions assess the patient's difficulties during daily life activities, 5 questions evaluate symptoms (pain activity-related pain, tingling, stiffness, weakness), and each of the remaining 4 questions assess social function, work, sleep and patient self-confidence. The first part determines the patient's function / symptom (DASH-FS) score. In addition to the 30 questions in the first part, there are two more parts, which are business model (DASH-W) and Sports-Musicians model (DASH-SM). In this study, individuals were asked to fill the first part containing 30 questions and the points obtained were recorded. In all questions, the individuals marked the appropriate answer in the 5-point Likert system (1: no difficulty, 2: mild

difficulty, 3: moderate difficulty, 4: extreme difficulty, 5: not being able to do it at all). A total score between 0-100 was obtained and recorded which higher scores mean more disability. The Turkish validity and reliability of the questionnaire has been shown[25].

Statistical Analysis

SPSS 18.0 (Statistical Package for the Social Sciences) package program was used for the statistical analysis of the study. Descriptive findings were presented as average (x), standard deviation (SD), frequency (f) and percentage (%), minimum-maximum (min-max) values. The compliance of the data to normal distribution was evaluated by the Shapiro Wilk Test. Since the variables were not distributed normally according, two tailed Spearman's Correlation Analysis was used to correlate these variables. Values below $p<0.05$ were considered significant.

Results

Two hundred and seventy individuals (141 females, 129 males) with a mean age of 21,48 ± 1,86 years were included in the study. When the dominant side of the participants was questioned, there were 28 (10,4%) left-handers and 242 (89,6%) right-handed people (Table 1).

Table 1. Sociodemographic features of the participants

	n	**%**
GENDER		
Male	141	52,2
Female	129	47,8
DOMINANT SIDE		
Right	242	89,6
Left	28	10,4
Total	**270**	**100**

Looking at the average phone usage time of the individuals, it was found to be 29,56 hours/week. In other words, the average daily usage time was 4,22 hours/day. While the average DASH-FS score of the individuals was 8, the average neck disability index score was 5,85. The RULA level was found as 3,57 (Table 2). According to the Table 3, %95,6 of the individuals took incorrect postures while using their phones.

Table 2. Neck and Upper Extremity Disability and Ergonomic Risks

n=270	Mean ±SD
RULA score	3,57±0,85
NDI	5,86±4,95
DASH-FS	8±8,08
JTHFT total (Right)	41,83 ± 8,8
JTHFT total (Left)	65,15 ± 22,85

RULA: Rapid Upper Limb Assessment

NDI: Neck Disability Index

DASH-FS: Disabilities of the Arm, Shoulder, and Hand-Function/Symptom

JTHFT: Jebsen-Taylor Hand Function Test

Table 3. RULA results

	n	%
Acceptable posture	12	4,4
Further investigation, change may be needed	215	79,6
Further investigation and change soon	37	13,7
Investigate and implement change	6	2,2

RULA: Rapid Upper Limb Assessment

As seen in Table 4 below, neck disability index scores were found to be higher in individuals with more phone use times. A significant correlation was found between the duration of phone use and the neck disability index score (r = 0,172; p = 0,005). No significant correlation was found between phone usage time and DASH-FS scores. No significant correlation was found among the RULA, the NDI and the DASH scores (Table 4).

Table 4. Relationships among disabilities of neck and arm and mobile phone use

Duration of Mobile phone use	NDI	DASH-FS	JTHFT total (R)	JTHFT total (L)
r	**,172****	,092	-,086	**-,253****
p	**,005**	,130	,160	**,000**
RULA scores	NDI	DASH-FS	JTHFT total (R)	JTHFT total (L)
r	,027	,075	-,021	-,061
p	,657	,220	,725	,315

**Correlation is significant at the 0,01 level (2-tailed).

RULA: Rapid Upper Limb Assessment

NDI: Neck Disability Index

DASH-FS: Disabilities of the Arm, Shoulder, and Hand-Function/Symptom

According to the Jebson Taylor Hand Function test, when the times of throwing small objects into the can were examined with the duration of mobile phone use, a significant negative correlation was found for both right (r=-0,238) and left (r=-0,166) sides (p<0,05) (Table 5). In addition, there was a significant negative correlation between total JTHFT score of left side and duration of mobile phone use (r=-,253; p<0,001) (Table 4). It was determined that there was no correlation in subtitles other than this (p>0,05) (Table 5).

Table 5. Correlation between the mean duration of mobile use and manual functions

Duration of mobile use	**r**	**p**
Writing (R)	-,111	,069
Writing (L)	-,104	,060
Simulated page turning (R)	,012	,850
Simulated page turning (L)	-,104	,089
Picking up small objects (R)	-,238**	**,000**
Picking up small objects (L)	-,166**	**,006**

Simulated feeding (R)	,056	,361
Simulated feeding (L)	,010	,869
Stacking checkers (R)	,106	,082
Stacking checkers (L)	-,045	,466
Picking up large light objects (R)	,070	,026
Picking up large light objects (L)	,252	,675
Picking up large heavy objects (R)	,014	,052
Picking up large heavy objects (L)	,818	,392

**. Correlation is significant at the 0.01 level (2-tailed).

R: Right, L: Left

JTHFT: Jebsen-Taylor Hand Function Test

Discussion

Mobile phones are frequently used in daily life and physically affect users in many ways[1,5]. In this study, it was determined that those who used the phone for longer periods had more neck problems. Moreover, one parameter from manual skills and total score of manual skills of left side was found to be better in people who have longer mobile phone duration. The other important finding of this study is that most of the users (95,6%) had a wrong posture while writing and text with their mobile phone.

In the study, it was found that the average daily mobile phone use time was 4,22 hours. There is different information in the literature about the effects of mobile phones on the musculoskeletal system and the duration of use. Accordingly, in a study conducted with Canadian university students in 2011, it was found that they used mobile phones to send e-mails and use the internet for an average of more than 3,5 hours a day, and they often reported pain in their thumbs[8]. In another study, the use of only 300 seconds of mobile phones causes abnormal posture[26]. In the study of Park et al., using mobile phone for 20 minutes causes muscle fatigue[27]. Like the literature, our study showed that longer use of mobile phone results in more neck problems. Young adults whose phones recorded longer time use reported worse in neck functions.

Studies in the literature emphasize that as the duration of mobile phone use increases, pain complaints increase. As people need to look at the text on the phone screen, neck disability is a

commonly reported problem of mobile phone users[27]. It was stated that the natural course of the cervical vertebra was disrupted by changing the posture to see the images and the increased amount of stress, defects in the surrounding skeletal structures and ligaments, spasm and inadequate proprioception[19]. In this study, the literature is supported by determining that the neck problems observed in individuals increase as the duration of mobile phone use increases.

As a result of studies conducted in the literature, it is reported that many factors affect hand functions. In the study by Trudeau et al., it was stated that the performance of thumb and hand can be affected using mobile phones[28]. Factors such as prolonged flexion of the wrist and repetitive use of the thumb can affect the median nerve and other structures in the hand[14,15]. In addition, because of examining the relationship between hand skills and telephone use time, with the thought that motor skills may improve or vice versa. As the duration of phone use increased, total score of manual skills of left side significantly increased, whereas total score of right side did not show this correlation. This can be considered as the participants whose dominant side is mostly right already improved their right-hand skills in most of activities of daily living, whereas left side is not used as much in those activities. When mobile phone is used with longer durations, non-dominant side may positively be affected by this use. Since there is no similar study on fine motor skills in the literature, it is expected that it will guide further studies.

There are studies in the literature in which various ergonomic interventions about the neck region such as prism glasses are performed to prevent neck flexion[29,30]. Although the number of studies evaluating the ergonomic risk level during mobile phone use is limited, Namwongsa et al., similar to our study, included 30 individuals with an average age of 21, and recorded the RULA score during phone use and noted that the total scores took a high risk value between 6-7[31]. They also showed a significant relationship with neck problems as a different result from our paper as did not found a correlation between ergonomic risk level of mobile phone use and neck problems. The reason for this different data from our study can be thought to be due to the difference in the sample size. According to other correlations with ergonomic risk levels, no correlation was found for upper limb disability and manual skills.

Increase in the use of mobile phones with today's technology poses a great risk, especially in young adults. Therefore, individuals should be aware of the dangers that may arise from excessive use of mobile phones. As a result of this study, it was found that as the duration of phone use increases, some fine motor skills can develop, but they negatively affect neck region and its functionality. Other important result is that only 4,4% of young adults use an acceptable posture while texting with phone and this should be considered as a risk factor of developing musculoskeletal problems in further ages. Since the diversity of technology and smart mobile devices change rapidly, up-to-date research is needed in this area with different age populations.

There are some limitations of the paper. Firstly, since the program "My Phone Time", that is one of the methods for our data collection, is charged in iOS software, people using android software phones are included in order not to force people economically. Secondly, the study is carried out among the young population so the findings cannot generalize for all age groups. Especially older ages will probably show more tendency to have musculoskeletal system disorders and they will probably affect more with high ergonomic risks due to years so further papers should be designed to examine the effects of mobile phone use in older age groups.

Conclusion

According to the hypothesis of the paper, it was not accepted as some significant correlations were shown. The duration of phone use was not correlated with shoulder problems, whereas more neck problems were seen among people who used phone with longer durations. Moroever, most individuals used their mobile phones with a high risk level of ergonomic condition. In conclusion, since mobile phones are essential devices of all adults today, appropriate ergonomic interventions including duration and posture should be planned and investigated in further papers.

Ethics Committee Approval: The approval was obtained from the Eastern Mediterranean University, Health Sciences Ethics Committee in 2019 (ETK00-20190075)

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