Research Article / Araştırma Makalesi

The Effect of Mobile Phone on Hand Pain and Muscle Strength

Akıllı Telefon Kullanımının El Ağrısı ve Kas Kuvveti Üzerine Etkisi

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Abstract

Background: Aim of the study determine the effect of mobile phone on hand pain and muscle strength.
Materials and methods: The measurements were taken from hand dynamometer for handgrip strength and manual muscle tester for thumb muscle strength. The means of the right and left handgrip strength, thumb muscle strength were measured.
Results: There was a statistically significant difference in height and weight measurements between genders ($p<0.05$). We found as using of mobile phone increased, hand strength increased. However, the highest value of thumb muscle strength on the right and left sides was observed to be over 8 hours. There was a high relation between gender and muscle strength measurements ($p<0.05$; $r=0.700$). Also, 22.58% of mobile phone users complained about pain described in thumb base.
Conclusion: This study revealed that the duration of mobile phone use affects on grip and thumb flexion muscle strength.

Key Words: Hand, muscle strength, mobile phone, thumb

Öz

Amaç: Akıllı telefon kullanımının el ağrısı ve kas kuvveti üzerine etkisini incelemeyi amaçladık.
Materyal ve Metod: El kavrama kuvveti için el dinamometresinden ve başparmak kas kuvveti için kas testi cihazından ölçümler alındı. Sağ ve sol el kavrama kuvveti, başparmak kas kuvveti ölçüldü.
Bulgular: Cinsiyetler arasında boy ve vücut ağırlığı ölçümlerinde istatistiksel olarak anlamlı fark bulundu ($p<0.05$). Akıllı telefon kullanım süresi arttıkça el gücünün arttığı görüldü. Ancak sağ ve sol tarafta başparmak fleksiyon kas kuvvetinin en yüksek değerinin 8 saatin üzerinde olduğu görüldü. Cinsiyet ile kas gücü ölçümleri arasında yüksek derecede anlamlı bir ilişki olduğu bulundu ($p<0.05$; $r=0.700$). Ayrıca akıllı telefon kullanıcılarının %22.58 baş parmağın da ağrı olduğunu ifade etti.
Sonuç: Bu çalışma, akıllı telefon kullanım süresinin el kavrama kuvveti ve başparmak kas kuvveti üzerinde etkisi olduğunu ortaya koymuştur.

Anahtar Kelimeler: El gücü, kaslar, akıllı telefon, başparmak

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Introduction

The hand, which is a vital part of the body, provides direct interaction with the human environment. Hands are the main organ of the sense of touch as well as a motor and functional unit of the body (1,2). The hand which is a key role in upper extremity functions is the most active part of the upper limb and is responsible for the construction of many tools that are vital in daily life from past to present. The complex movements of the hand arise due to the good functioning of the coordination between the hand's balanced muscular system and the central nervous system. In healthy people, good muscle strength means a more active life due to better muscular function. Strength is the ability to create dynamic or static tension as a result of a maximum effort of a muscle or muscle group depending on the requirement (3–5). Actions and sportive movements in our daily life are carried out thanks to the muscles. Muscles transform chemical energy into mechanical work and create movement. Muscle strength depends on many factors. Some factors effect the muscle strength were as follows (3,4,6,7):

Type of muscle fiber: Type I fibers have a high aerobic capacity and contract without fatigue for a long time in terms of myoglobin, which acts as an oxygen tank. These are also called slow twitching, red or oxide fibers. Type II fibers are poor in terms of myoglobin and energy storage, fibrils with high anaerobic capacities and fatigue quickly. It is called white, fast twitching, glycolytic fibrils. While the force increases in the first 20 years of life, after this age, it will stay at the same level for 5-10 years and then start to decrease again. After 70-80 years of age, it was determined that the force of the arm muscles decreased by 30%.

Gender: The muscle strength value was lower in females than in men due to the higher muscle mass in men than females.

Fatigue: As the number of fibrils that respond to the stimuli decreases in fatigue, the force decreases.

Except for the reasons described above, the size and width of the cross-sectional area of the muscle, nutrition type of muscle contraction and neurophysiological mechanisms related to muscle strength such as selective participation of fiber types, central inhibition on the motor neuron, synchronization of motor units are effective on muscle strength (3,4,6,7).

The knowledge regarding hand muscle strength parameters may be essential for many clinical practices (8-10). Prolonged use of computers and mobile phones promotes the repetitive use of certain muscles, causing acute trauma to the muscle fibers (11). Many, especially youngsters use their phones to text and play games a lot. First carpometacarpal joint's overuse is one of the common risk factors. An excessive mobile phone use results the excessive using of thumb. Also, the excessive exposure to electromagnetic field and the signaling of mobile phone may also play a significant role. Because long term mobile phone use may increase the risk for some health problems such as brain tumors (12).

Mobile phones are strong communication devices, first established in 1973, and released commercially available from 1984. In the last few years, mobile phones have become an integral part of our lives. There were more than seven billion users worldwide (13,14). Rising of mobile phone using cause physical problems such as eye problems (dry eyes, computer vision syndrome), muscular pain, or weakness of thumb and wrist, neck pain and rigidity, increased frequency of De Quervain's tenosynovitis and psychological problem such as tactile and auditory delusions, intellectual capabilities, work efficacy, auditory sleep disturbances (14,15). Musculoskeletal problems, pain and psychological factors also affect hand grip strength (16).

The aim of this study was to determine the effects of using the mobile phones on the activity of hand grip and thumb muscle strength.

Materials and Methods

The study was conducted with 190 subjects (Female (F), 116; Male (M), 74) between 18-25 years in the academic years of 2019–2020.

Inclusion criteria for this study were none of trauma, pathology in upper extremity, fracture, neuromuscular or musculoskeletal disorder and subjects used mobile phone for at least two years.

The experimental procedures were conducted in conformity with the Declaration of Helsinki. The relevant guidelines and regulations were strictly followed when conducting the study. The study was approved by the Ethics Committee of Çukurova University (EC: 95; 10.01.2020). All subjects provided informed consent. Demographic parameters (age, weight and height) were recorded. Handgrip values (hand dynamometer Lafayette model 78010) and thumb flexion muscle strength (Nicholas Manual Muscle Tester (NMMT) were taken to detect effects of the using phone.

Thumb muscle strength: The examiner supports the subject's hand in the forearm supination position and the hand dorsal face is on the table. Metacarpophalangeal joint, hand and wrist are fixed by the examiner. The thumb is pulled up towards the flexion position while interphalangeal joints are brought to the flexion position. If the subject completes a normal range of motion and the examiner applies the resistance. The subjects its in the suitable position for measurement. NMMT is placed on the subject as described above. The subject pushes against the examiner as hard as he/she can. The examiner records the force exerted on the dynamometer to quarentee that the dynamometer remains still. Value in Newtons is recorded on the tool screen. Subjects are allowed to rest for approximately 30 seconds. (8).

Handgrip strength test: After the dynamometer needle is zeroed, the person to be measured is asked to squeeze the dynamometer from the dominant side for at least 2 seconds without touching the instrument to her/his body, and the value shown on the needle is taken as a reference (17).

Statistical Methods

Software package program (SPSS version 22.0) was used for all analyses. According to the Kolmogorov-Smirnov test, a statistical test was chosen (normal distribution ($p > 0.05$) or not normal distribution ($p<0.05$). Parametric test (One way ANOVA) was applied. Moreover, Pearson correlation analyses were used to determine relation between muscle strength measurements. Also, significance value was set at $p < 0.05$.

Results

We assessed the measurements of 190 subjects (61.05% females, 38.95% males) in this study. The mean values of age, weight and height were 19.94±2.26 years, 57.40±9.30 kg, 163.55±5.60 cm, respectively, in females, whereas the same values were found as 19.92±1.78 years, 73.50±10.99 kg, and 179.26±7.03 cm, respectively, in males (Table 1).

Table 1. Demographic data of subjects in this study

Demographic data	Female (N:116) Mean ± SD	Male (N:74) Mean ± SD	p
Age (years)	19.94±2.26	19.92±1.78	0.947
Height (cm)	163,55±5.60	179.26±7.03	0.000
Weight (kg)	57.40±9.30	73.50±10.99	0.000

SD; Standard Deviation

Table 2. Gender related comparison of the strength measurements

Gender (n)	Hand strength right Mean ± SD (kg) (min-max)	Hand strength left Mean ± SD (kg) (min-max)	Thumb flexion right Mean ± SD (º) (min-max)	Thumb flexion left Mean ± SD (º) (min-max)
Female (116)	27.42±9.38 (15-43)	25.00±5.66 (10-45)	10.40±2.21 (5.70-14.50)	9.82±2.39 (5.80-16.40)
Male (74)	42.62±5.75 (25-67)	38.58±9.40 (25-64)	14.90±3.01 (8.50-23.00)	13.40±3.71 (8.10-25.00)
Total	33.34±10.46 (15-67)	30.29±9.88 (10-64)	12.15±3.36 (5.70-23.00)	11.22±3.44 (5.80-25.00)
p	<0.001	<0.001	<0.001	<0.001

Min; minimum, Max; maximum, SD; Standard Deviation

Table 3. The muscle strength values according to the phone usage time

The phone usage time (n)	Hand strength right (kg) Mean ± SD (min-max)	Hand strength left (kg) Mean ± SD (min-max)	Thumb flexion right (º) Mean ± SD (min-max)	Thumb flexion left (º) Mean ± SD (min-max)
1-2 hours (48)	31.98±9.27 (15.00-60.00)	27.46±7.11 (15.00-45.00)	11.64±3.13 (6.00-22.40)	11.10±3.33 (6.40-24.80)
3-4 hours (73)	33.29±10.67 (19.00-67.00)	30.88±10.84 (15.00-64.00)	12.15±3.30 (6.80-23.00)	11.12±3.16 (6.30-25.00)
5-6 hours (34)	33.62±9.92 (16.00-55.00)	30.53±9.55 (10.00-56.00)	12.17±3.07 (5.70-19.50)	11.31±2.95 (6.40-16.10)
7-8 hours (17)	33.94±9.76 (20.00-51.00)	30.77±8.44 (19.00-50.00)	11.95±3.10 (7.60-18.10)	10.31±3.28 (5.90-16.00)
Above 8 hours (18)	37.06±13.96 (19.00-65.00)	34.50±12.73 (10.00-60.00)	13.72±4.66 (6.70-22.40)	12.64±5.38 (5.80-24.80)
p	0.539	0.109	0.280	0.357

Min; minimum, Max; maximum, SD; Standard Deviation

Table 4. The correlation analysis of the hand and thumb strength

Parameters	Hand strength right (r)	Hand strength left (r)	Thumb strength right (r)	Thumb strength left (r)
Gender	0.711	0.672	0.655	0.509
Weight	0.508	0.454	0.490	0.390
Height	0.585	0.599	0.599	0.449
The telephone use time	0.091	0.159	0.115	0.063

The mean values of muscle strength and handgrip strength were given in Table 2. As the using of phone increased, the increase in pain means a decrease in functionality and hand

strength increased, however, the highest value of the duration of using the phone was appared above 8 hours in both thumb flexion strength right and left sides. The muscle strength values according to the phone usage time were given in Table 3. There was a significant relation between gender and thump muscle strength measurements. Although, 22.58% of mobile phone users complained about pain described in thumb base. Also, mean and standard deviation of the measurements were calculated. Coefficient correlation was showed in Table 4. Also, we found All muscle strengths were highest in men and significant differences in all parameters between gender. The concordance between NMMT and hand dynamometer test results found be high.

Discussion

Mobile phones play an important role in human lives. Mobile phones allow humans especially youngs to make calls, send e-mails, chat applications such as texting or play games (18). Mobile phones are widely used in our daily lives, but the study examining the effect of mobile phones on thumb muscles and grip strength is quite limited. This study is the first study assessing the effects of the mobile phones on hand grip (Hand Dynamometer) and thumb flexion muscle strength (Nicholas Manual Muscle Tester). The mean values of muscle strength and hand strength were higher in males than in females. As the using of the mobile phone increased, hand grip strength increased, however, the highest value of the duration of using the phone was appared above 8 hours in same meaurements. Also, the highest value was obtained in thumb flexion muscle strength of right and left sides in smartphone using above 8 hours. Although, %22.58 of smartphone users which was texting and play games complained about pain described in thumb base.

Hand muscle strength measurement procedure should be reliable and applicable. These tests make the best clinical decisions about diagnosis and the treatment plan (1-8). Also, most of the studies in the literature stated that the mobile phone addiction and inability to use it in an appropriate position. (19–21). This affects muscles and joints negatively. As a result of, the myotonia and myalgia can develop, mostly forward head posture (16,22,23). Hand grip strength is very important for most of the daily life activities to be performed (24). In the literature, it has been stated that factors such as gender, height, body weight, age, and dominant hand have effects on hand grip strength and thumb flexion strength (9). Peolsson et al. reported that the dominant hand has higher grip strength than the non-dominant hand (25). Also, many studies investigated relation between the intrinsic hand muscle strength and gender showed that male had higher grip strength than females (26–31). Our muscle strength results (in females) were found as hand grip muscle strength, 27.42±9.38 kg (right) and 25.00±5.66 kg (left); thumb muscle strength, 10.40±2.21 kg (right), 9.82±2.39 kg (left); in males hand grip muscle strength 42.62±5.75 kg (right), 38.58±9.40 kg (left); thumb muscle strength 14.90±3.01 kg (right), 13.40±3.71 kg (left) were similar to these studies. In a study performed with Turkish healthy population by Polat et al, thumb muscle strength in right and left side were found as 10.81 kg and 9.99 kg in females respectively, whereas, the same measurements were 13.42 kg and 12.67 kg in males, respectively (32). Gustafsson et al. evaluated thumb stances, thumb movements, and muscle activity when using mobile phones for messaging. In young adult population maximal thumb flexion (°) were found as females 44 degrees in females, 44 degrees males and this results showed that, entering a message placed the thumb in an abducted and flexed posture (33). In another study by Schreuders et al., the participants were divided into two groups as non-injured and injured. As a result of the observations made by three observers, respectively, the thumb flexion the non-injured group was found as 108.7 N (11.08 kg), 103.3 (10.53 kg), 99.4 (10.14 kg) respectively, and 51.2 (5.22 kg), 52.6 (5.36 kg), 52.2 (5.32 kg) in the injured group, respectively (10). In the studies on using of mobile phone, a significant increase in muscle fatigue was observed with increasing phone using time (34,35). The studies showed muscle fatigue consist of more easily with use of mobile phones and touch-screen computers than with desktop computers. Because muscle fatigue is common in the use of mobile phones and touchscreen computers, as people constantly look down and their heads droop. (36,37). Lee and Song studied pain violence according to using of mobile phone, and they reported significant differences in reading, concentration, and headaches in peaople using of mobile phone (38). The use of mobile phones is becoming an increasingly psychological problem. Hu et al., conducted a study examining whether there is a relationship between smartphone addiction and white matter integrity. As a result of the analyzes, it was stated that the integrity of the white matter was low and that smartphone addiction would be associated with behavioral disorders (39). the study of Güloğlu et al. showed that addiction to using of mobile phone is associated with neck pain and disability in healthy young adults (40).

The limitations of this study are that the population is limited and a certain segment. We think that this study, which we want to keep the population within certain limits since it is the first study in this field, can be done as a new study by expanding the populations and comparing them with each other in the future.

When the previous studies are examined, this is the first study investigating the effects of using of mobile phones on hand grip strength and thumb muscle strength. There was a significant relation between gender and muscle strength values. As the duration of using the phone increases, the increase in pain causes a decrease in functionality and an increase in hand strength, so it is important to establish a balance during usage times. Therefore, mobile phone usage times should be restricted and usage positions should be regulated. We think that the increasing technology and therefore the addiction to using the smartphone will negatively affect the human anatomy in the future, especially due to ergonomically inappropriate positions. In this study, there was an incease in muscle strength due to mobile phone usage.

But, the effects of long term mobile usage on muscle strength are no known. So, many studies are needed to analyze the muscle strength. Also, the pain and numbness is the most negative effect of mobile usage.

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