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## Does the Overuse of Smartphones have an effect on the hand grip strength among Umm Al-Qura university students?

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This study was conducted at the Physiotherapy Department, Faculty of Applied Medical Sciences, Umm Al- Qura University, Mecca, Saudi Arabia in 2018, to evaluate the effects of the smartphones on the hand grip strength, according to the hours of usage per day, and also the difference between males and females. 92 University students were randomly selected, with the elimination of pain or numbness in their hands. Demographic data were noted (age, weight, height, BMI, anthropometric measurements of the hand) and a questionnaire was given which contained the type of cell phone, the hand of dominance and hours of usage per day. The handheld dynamometer is an instrument that measures the force of muscle contraction was used to measure the hand grip strength of the dominant hand. The statistical results showed that with increased hours of usage in males there is an increase in hand grip strength, while the opposite was for females. The increase in hours of usage showed decreases in the hand grip strength. From the obtained results, it can be concluded that, male hand grip strength improved with increasing hours of smartphones usage, contrasting the females with as with increasing hours of usage the hand grip strength decreased.

**Keywords:** Smartphones, Hand Grip Strength, Umm Al-Qura University Students

### INTRODUCTION

Smartphones have become vital devices serving people of different age groups and backgrounds throughout their day. These days, it is almost impossible to function without the use of a smartphone. Smartphones have transformed the way people communicate by opening up new possibilities, and allowing users to send and receive text messages and make voice and video calls on social media networks. Like "having the world in the palm of your hand" possibly best portrays smartphones (Arab news, 2017).

Saudi Arabia is ranked third in the world, with 72.8 percent of the population using smart mobile devices, compared to 23 million smartphone users worldwide. In 2017, the number of smartphone

users in Saudi Arabia has reached 21.18 million (Statista, 2018).

In the past period, there has been a significant increase in the amount of smartphone usage. With the excessive usage of smartphones, it can lead to many health problems in the body, including the wrist due to exposure of the hand to increased stresses (Inal EE et al., 2015). With average university students spend more than 3.5 hours daily on their smartphones (Berolo et al., 2011). If students are holding their smartphones for prolonged periods they may be strengthening the hand muscles, as holding weights increases the strength of the muscle. To date little is known about the effect of smartphones on the hand and fingers.

Working on smartphones for long periods of time promotes the repetitive use of certain muscle resulting in muscle fiber injury and cumulative damage due to the acute trauma, which most often occurs in the neck and shoulders. This induced damage caused Forward Head Posture (FHP) and either referred or muscular pain in both the arms and wrists. The FHP weakens the deep cervical flexor muscle, the scapular retraction, and the mid and lower trapezius muscles. FHP also shortens the pectoralis major and neck extension muscles (Seong-Yeol Kim and Sung-Ja Koo, 2016).

Fatigue and stress in the neck and shoulders occur more easily with use of touch-screen computers than with desktop computers because small-monitor devices such as smart phones and tablet PCs causes people to look down and to slouch more. This bad habit causes negative effects, such as reduced physiological function, disruption of the autonomic nervous system, creating problems in daily life. It also affects both the visual and the musculoskeletal systems, leading to headaches and stress (Hyo-Jeong and Jin-Seop, 2015).

There are three main objectives of this study. First, since there is a paucity in regard to the relationship between smartphones overuse and its effects on the musculoskeletal system, there is a need to investigate the relationship between variables of time and duration of smart phone use and grip strength. Second, the relationship attained will be helpful in determining the associations between smartphones addiction, duration and time of use, grip and pinch strength correspondingly. Third, to gain knowledge about the overuse of smart phones and their effects this can open a path to future studies. We hypothesized with the overuse of smartphones; it may lead to the strengthening of the hand grip on the dominant side.

## MATERIALS AND METHODS

### Subjects:

Ninety two (48 female & 44 male) students were recruited from Umm Al-Qura University, Mecca, Saudi Arabia. They were included if there were in the young adult age range (18 to 30 years old), within normal BMI (18.5 to 24.9 kg/m<sup>2</sup>) and if they had the same anthropometric measurements. The subjects were excluded if they were athletic, had pain or numbness, or musculoskeletal abnormalities.

All students provided a written consent form for their participation in this study. This study was approved by the ethical committee of the Faculty of Applied Medical Sciences, Umm Al- Qura University, Mecca, Saudi Arabia.

### Instrumentation:

The Jamar hydraulic hand dynamometer was used to measure the hand grip strength and it is the industry standard for grip strength data collection. The hand grip was measured by pounds force.

The tape measurement was also used to measure the anthropometric measurements in centimeters. The anthropometric measurements included the circumference underneath knuckles, the wrist circumference, and the hand length (from the middle crease of the wrist to the tip of the middle finger).

### Procedures:

Initially, the demographic data were noted (age, weight, height, BMI, anthropometric measurements of the hand). A questionnaire was given afterwards, which contained questions regarding the type of cell phone, the hand of dominance and hours of usage per day. Then the subject was instructed to sit down on a chair, while holding the handheld dynamometer in the dominant hand. They were instructed to keep their shoulder adducted and neutrally rotated, elbow flexed 90°, forearm in a neutral position, wrist between 0° and 30° dorsiflexion and between 0° and 15° ulnar deviation. Then the subject was asked to squeeze as hard as they could on the hand dynamometer, in order to measure the strength of the hand grip on the dominant hand. Dynamometers perform quantitative measurements of maximum isometric muscle strength of the hand, and their use as a final result, which is the mean value of the strength of three successive measurements. The final results were then compared with the normative data. The normative data were collected from the Jamar handheld dynamometer manual.

### Statistical analysis:

Collected data on the demographic and other baseline characteristics was statistically treated to show the mean and standard deviation of mean for age, height and weight. The collected data were statistically analyzed using SPSS version 16.0. Paired and un-paired t-test was conducted to determine any statistically significant

differences between data collected for students regarding the hand grip strength.

**RESULTS**

The results of this study revealed that the maximum hand grip strength for the females with right hand dominance was 50 lb while with those who had left hand dominance hand was 35 lb. For the males with right hand dominance the maximum hand grip strength was 103.3 lb while the male with the left dominance was 85 lb (Table

1).

When comparing the usage hours of smartphones during the day with hand grip strength, there is an insignificant relationship among the female participants ( $P= 0.08$ ), but there is a significant relationship among the males when compared with the normative data ( $P= 0.04$ ). The female's data were compared with female normative and vice versa for the male subjects to eliminate any gender bias (Figure 1).

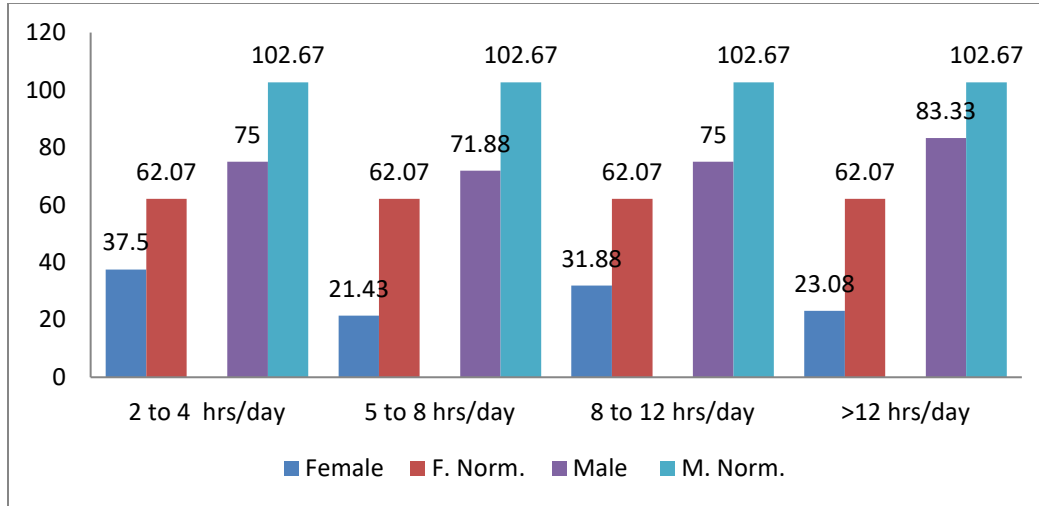


Figure 1: Mean values of hand grip strength (lbf) according to usage hours.

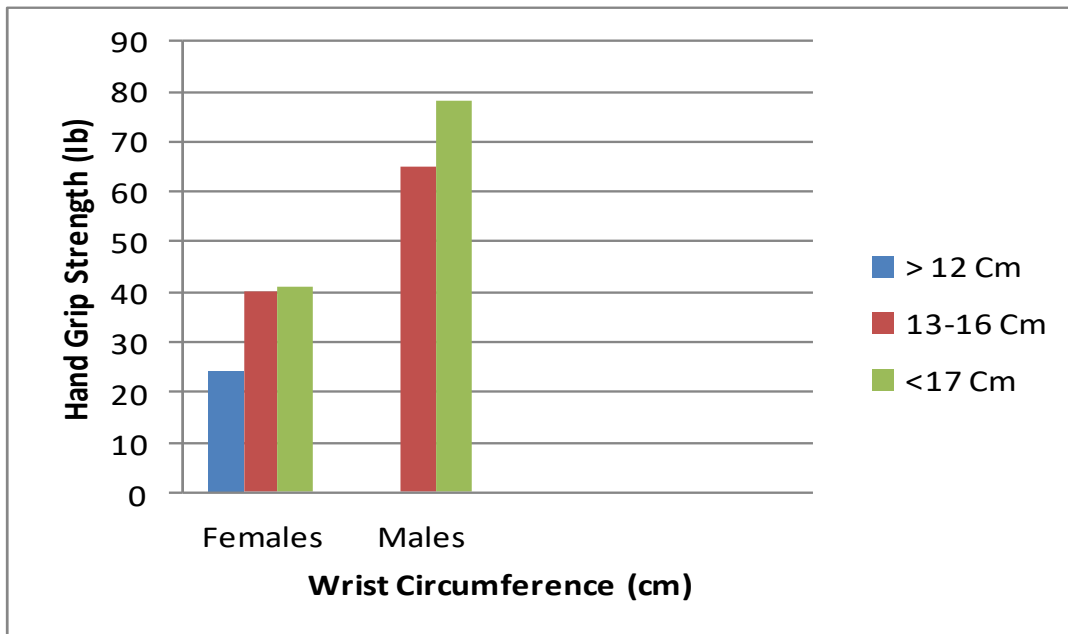


Figure 2: Wrist circumference and hand grip strength in all students.

**Table 1: Maximum hand grip strength of the dominant hand for all students.**

Dominant hand	Female		Male	
	Right	Left	Right	Left
Maximum hand grip strength (lb)	50	35	103.33	85
Normative hand grip strength (lb)	62.07±12.60		102.67±21.93	

There was a significant correlation between the hand grip strength with wrist circumference for females ( $P=0.04$ ), while it was non-significant among males ( $P=0.16$ ). This means that whenever the wrist circumference was increased the hand grip strength will increase for female students, but the male's hand grip strength will not be affected by their wrist circumference (Figure 2).

## DISCUSSION

The hand grip strength interferes with many activities of daily living, thus many studies proved that by preserving the normal hand grip strength it facilitates independence. The grip strength reduces the need of someone's help and support, and the individual who has a better ability to manage activities (Gopinath et al., 2017). The hand grip strength is the main component for activities of daily living (Samson et al., 2000).

Hand grip strength is affected by individual's activity, profession, hand dominance and anthropometric features like body mass index (BMI), height, weight, wrist circumference, hand length and hand width (Guerra et al., 2015). There was a significant difference between male and female anthropometric measurements of the hand that influences the hand grip strength and muscle activity (Bohannon, 2003). In a previous study, they noted that high socioeconomic status may cause a decrease in the level of physical activity like using smartphones and that may lead to lower hand grip strength levels (Fernanda et al., 2011).

The results of this study showed that male participants have a higher hand grip strength, and that due to sex/ gender variation, many studies correspond that males have greater hand grip strength than Females (Luna-Heredia et al., 2005). The gender is the main influencing factor of hand grip strength between men and women, previous studies showed that men are 70% higher than women (Rodríguez-García et al., 2017). This is due to increasing muscle mass and the height of body among males, which is directly correlated with the grip strength in both males and females, unlike BMI, which has no correlation with hand grip strength in females, and it's negatively

correlated with hand grip strength in males (Luna-Heredia et al., 2005).

There is also another study proved that the body height has the greatest correlation between anthropometric measurements with hand grip strength. Also factors such as occupation and nutrition had a weak relation with hand grip strength (Rodríguez-García et al., 2017). As well as the different sizes and shapes of the hand and smartphone affect the muscle activity, users with small hands need to activate more muscles to grip the phone than others with large hands. This means that there is a load on the muscles may cause pain in wrist and neck, muscles fatigues or disorders of the hand and thumb and lack in activities of daily living (Ínal EE et al., 2015).

Therefore, this study suggests: the proper use of smartphones, with suitable weight and measurements of the device with acceptable time spent on the phone will maintain or improve the hand grip strength. There was another observational study for the addiction of the smartphones and its relation to the grip strength, provided that higher smartphone users have stronger grips (Motimath et al., 2017). On the other side, there are many bad influences have been mentioned in previous studies, such as the improper muscle effort may lead to discomfort and local muscle fatigue which will cause pain (Hee Ahn et al., 2016).

There is a strong relation between the hours of improper usage of smartphones and the extent, type of pain that may be caused. The most significant pains can result from the extreme smartphone use were established as in headache, ear and vision problems. Also, most fingers disorders, including the tip, middle and base of the thumb. The excessive smartphone usage may also result in hand, thumb and finger numbness (Qasim et al., 2017).

The musculoskeletal symptoms distribution have been noted in the upper back, neck, shoulders, elbows and hands due to increasing the hours of smartphone usage, and that could lead to De Quervain's syndrome and first carpometacarpal joint osteoarthritis. There was no information from the occupational literature that

reinforces an available association between repetitive thumb movement from mobile use and pain on the hand (Berolo et al., 2011).

One of the most common cervical abnormalities caused by smartphones overuse is forward head flexion, which predisposes a person to many pathologies, like headache, neck pain, TMJ disorders, vertebral diseases and it also alters the strength and length of soft tissues and may cause scapular dyskinesia and a lower hand grip strength (Jung et al., 2016). Increasing hours of usage of smartphones affect the hand grip strength, by altering the hand function and it may cause pain in the hand and thumb (Kalra, 2017).

It has been noted that university students spend, on average, more than 3.5 hours/day internet browsing, e- mailing, texting, and scheduling on their phones, and they frequently have pain in their hand (Berolo et al., 2011 ). Also another study results showed significantly lower activation levels on both right and left neck muscles during reading tasks. Typing and gaming tasks have higher muscle activation but it was not statistically significant (Ning et al., 2015). A South Korean study approved that prolonged smartphone usage might negatively affect posture and respiratory function as well (Jung et al., 2016).

## CONCLUSION

Excessive smartphones usage could cause serious musculoskeletal issues in the long term. Hand grip strength is one of the important aspects on each activity of daily living. There is also a strong relation between the hand grip strength and hours of usage. The study found that increasing hours of smartphones usage among male participants within 12 hours will increase their hand grip strength in contrast in female students. The anthropometric measurements (wrist circumference, hand length, and underneath knuckles circumference) might affect the hand grip strength especially for the male students. Consequently, using smartphones by properly and for an acceptable number of hours per day may improve the hand grip strength.

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

## ACKNOWLEDGEMENT

The authors thank all participants who participated in this study.

## AUTHOR CONTRIBUTIONS

SME designed, wrote and reviewed the manuscript. OK, MA, and WA performed subject selection, evaluation, data collection, data analysis, and wrote the manuscript. All authors read and approved the final version.

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