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Correlation between smartphone addiction and isometric scapular muscles strength among adults

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Abstract:

Purpose: to investigate how smartphone addiction affected the strength of scapular muscles in adults. The study was conducted as a cross-sectional observational analysis.

Methods: A total of 150 individuals, ranging in age from 18 to 30 (mean ± standard deviation was 34.83± 4.07years), were included in the study. The smartphone addiction scale short version (SAS-SV) was used to assess smartphone addiction, while a hand-held dynamometer was used to assess scapular muscle strength.

Results: Mann-Whitney test showed that there was significant difference between isometric scapular muscles strength at both sides except for upper trapezius (UT) at the left side. Spearman correlation showed weak negative correlation between SAS score and isometric strength of UT r =-0.17, p = 0.4, middle trapezius (MT) = -0.20, p = 0.1, lower trapezius (LT) r = -0.29, p = 0.00, serratus anterior (SA) r = -0.20, p = 0.01at the right side and isometric strength of MT r = -0.28, p = 0.00, LT r = -0.29, p = 0.00 at the left side. On the other hand, there were no significant correlation between SAS score and isometric strength of UT r = -0.14, p = 0.097and SA r = -0.13, p = 0.1at the left side.

Conclusion: Smartphone addiction doesn't cause loss of scapular muscle strength in both sides, but people may use one side more than the other that may induce scapular muscle imbalance and shoulder dysfunction.

Key words: Scapular muscles, Handheld dynamometer, SAS, Smartphone, Smartphone addiction.

1. Introduction:

Smartphones play an important role in human life because they are used for communication, accessing the internet, and gaming. The rate of smartphone usage has increased over the last decade, as has the duration and frequency of use (1, 2).

According to one study, 79 percent of people aged 18 to 44 spent almost all of their time on their smartphones, with only two hours of the day spent without one (3).

Musculoskeletal problems such as stiffness and pain in various sections of the body have developed as a result of significant reliance on

smartphones. These symptoms affect the shoulders, elbows, arms, wrists, hands, thumbs, and fingers in addition to the neck (4). The majority of young adults' everyday activities revolve around their mobile phones. They use it to do things such as browsing the internet, studying, listening to music, and playing games, especially during commutes. This could be one of the factors that leads to a rounded shoulder posture in children and, as a result, improper scapular posture (5).

Children and adolescents had higher sleep disruptions, visual changes, and musculoskeletal disorders during the corona virus disease-19 (COVID-19) pandemic than before. The most commonly reported musculoskeletal diseases related to smartphone misuse include pain in the neck, shoulders, wrists, and fingers (6).

The neck is flexed, and the elbows are unsupported, among smartphone users. This can put an undue amount of strain on the neck and shoulders (7). The use of a smartphone in an inconvenient posture was thought to cause irregular resting scapular position, scapular asymmetry, and scapular muscle imbalance and weakening.

Shoulder muscle imbalances are caused by a forward head position. The middle trapezius and serratus anterior muscles, which are involved in scapular stabilization, become weak when the craniovertebral angle rises. Excessive activation of the upper trapezius (UT) is caused by weakness of the middle trapezius (MT) and serratus anterior (SA) muscles (8).

No previous study has found a link between smartphone addiction and isometric scapular muscular strength (UT, MT, LT and SA), to the authors' knowledge. Therefore, the primary purpose of this study was to determine whether there was a link between smartphone addiction and scapular muscle weakness.

2. Patients and Methods:

2.1. Participants

This is a cross-sectional study using an analytical observational design to see if there was a link between smartphone addiction and isometric scapular muscle strength on the right and left side in adult persons. The study was carried out in accordance with the 1964 Declaration of Helsinki's ethical criteria and was authorized by the Faculty of Physical Therapy, Cairo University, Egypt's ethical committee (No:P.T.REC/012/003436). A total of 150 persons, both male and female, were included in this study. The Arabic version of the smartphone addiction scale (short version) was used to assess the subjects for smartphone addiction. (10).The scapular muscles' isometric strength was measured using a dynamometer (HHD). Participants were administered the Arabic version of the Smartphone Addiction Scale (Short Version) (SAS-SV). They were requested to fill out the scale as well as provide their contact information. They also disclosed whether they were suffering from a medical, musculoskeletal, or neurological problem. Prior to the evaluation, all of the selected individuals completed a consent form indicating their willingness to participate as volunteers in the current study. The outcomes of the assessment technique were kept a secret from all of the subjects, but they were revealed to them at the end of the study.

Inclusions criteria:

This study comprised healthy volunteers between the ages of 18 and 30 who needed to use a smart phone.

Exclusions criteria:

Patients were ruled out if they had any medical condition that could cause shoulder pain (such as impingement, subacromial bursitis, rotator cuff damage, or traumatic or degenerative supraspinatus tendonitis). In addition, anyone with a positive Neer sign, a positive Hawkins sign, discomfort during shoulder elevation, pain at the location of the rotator cuff tendon, pain with resisted isometric shoulder abduction, or a history of pain in the C5 dermatome was ruled out. Any individual who had previously suffered a musculoskeletal injury or surgery that could have influenced the measurement was also eliminated.

2.2. Procedures of the study:

Smartphone addiction assessment:

The SAS-SV was used to measure smartphone addiction. The SAS-SV has an excellent internal consistency as indicated by a value of Chronbach's alpha of 0.91. Participants were asked to react on a 6-point Likert scale ranging from 1 to 6 (strongly disagree). Daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented connections, overuse, and tolerance are the six factors on this 10-item self-reported measure. It has a male cut-off value of 31 and a female cut-off value of 33 (9).

Isometric muscles strength assessment:

The isometric scapular muscular strength was measured using a hand-held dynamometer (Baseline Pull- Push Dynamometer, Model 12–

0343, Fabrication Enterprises Inc., NY, and USA). The intrarater test-retest reliability of employing HHD to quantify scapular muscle strength has been reported to be outstanding (.89 to .96) (11).

The HHD was placed over the superior portion of the shoulder to perform an isometric UT muscle test. The participant was instructed to perform scapular elevation against the dynamometer's resistance and hold for 5 seconds (12).

With each subject lying prone, isometric MT muscular strength was tested. The subject's arm was rotated externally and abducted 90 degrees with the thumb pointing upward. After that, the examiner put downward pressure on the subject's forearm, just proximal to their wrist and hold for 5 seconds (13).

The patient was placed in prone position to undertake isometric LT muscle strength testing. The thumb is pointing upward, and the arm has been abducted to 145 degrees (external rotation of the humerus).To keep the cervical spine in a neutral position, a towel roll was placed beneath the participant's forehead. The examiner supplied manual fixation by placing one hand just inferior to the participant's contralateral scapula during the test to avoid compensations. The examiner put downward pressure on the subject's forearm, just proximal to their wrist and hold for 5 seconds (13).

The participant was tested for isometric strength of SA in a supine lying posture with the arm in 90° of forward flexion. The examiner placed the HHD in the palm of the subject's hand and pressed it against the bench. The individual was instructed to do a protraction movement with the elbow extended for 5 seconds (14).

Data analysis:

The information gathered was analyzed using descriptive statistics such as mean and standard deviation. The Shapiro-Wilk test and the Kolomgrov-Smirnovb test were used to determine the data's normality. The Mann-Whitney test was performed to examine the difference between isometric scapular muscular strength on the right and left sides due to the irregular distribution of the data. The association between SAS score and isometric scapular muscular strength was evaluated using the Spearman product-moment correlation coefficient. For all calculations, the level of significance was fixed at 0.05.

3. Results:

A total of 150 people were involved in this study, with 69 men (46%) and 81 women (54%)

Variable	N	Mean	Standard deviation
Age	150	24.83	4.0
Body mass index (BMI)	150	26.67	4.90
Average of mobile phone use in hours	150	4.40	2.40
SAS Score	150	30.89	10.93

respectively. The participants' general characteristics were displayed in (**table 1**).

Table (1): Demographic data of the study group.

Table (2) shows the mean and standard deviation of isometric scapular muscular strength. For statistical analysis, data on isometric scapular muscular strength was standardized to body weight and expressed as a percentage.

Table (2): Mean and standard deviation of isometric scapular muscles strength.

Muscle	N	Mean (%)	Standard deviation
Right UT	150	10.17	2.64
Left UT	150	9.95	2.53
Right MT	150	3.69	1.37
Left MT	150	3.49	1.39
Right LT	150	3.69	1.62
Left LT	150	3.38	1.43
Right SA	150	8.68	2.37
Left SA	150	8.87	2.54

The Mann-Whitney test demonstrated a significant difference between SAS Score and isometric strength of UT (P= 0.01), MT (P= 0.047), LT (P= 0.001), SA (P= 0.01) on the right side and MT (P=.001), LT (P= 0.001) and SA (P= 0.04) on the left side, as shown in **table (3).** On the other hand, in the left side, there was no significant difference between SAS Score and UT isometric strength (P= 0.15).

Correlation between smartphone addiction score and isometric scapular muscles strength at the right side:

As shown in **table (4)**, the SAS score and isometric scapular muscles strength on the right

side had a negative weak correlation. r = -0.17, p = 0.04, r = -0.20, p =.01, r = -0.29, p = 0.00, and r = -0.20, p = 0.01 for UT, MT, LT, and SA.

Table (3): Mann-Whitnney of isometric strength of Scapular muscles at both sides.

Muscle	N	Mann-Whitnney	Wilcoxon	Z-value	P-value
Right UT	150	2281	5131	-1.99	0.046
Left UT	150	2427.5	5277.5	-1.47	0.15
Right MT	150	2284.5	5134.5	-2.52	0.01
Left MT	150	1898.5	4748.5	-3.44	0.001
Right LT	150	19332	4782	-3.13	0.001
Left LT	150	1933.5	4783.5	-3.30	0.001
Right SA	150	2141	4991	-2.52	0.01
Left SA	150	2261	5111	-2.07	0.04

Correlation between smartphone addiction score and isometric scapular muscles strength at the left side:

As shown in **table (5),** there was no significant correlation between SAS score and isometric scapular strength for UT (r = -0.14, p = 0.097) and SA (r = -0.13, p = 0.1) on the left side, but there was a weak negative correlation between SAS score and isometric strength of MT and LT on the left side; MT, r = -0.28, p = 0.00, and LT, r = -0.29.

4. Discussion:

The purpose of this study was to investigate if there was a correlation between smartphone addiction and isometric scapular muscle strength in adults aged 18 to 30.

The current study's findings revealed that there was a significant difference between SAS score and isometric strength of UT, MT, LT, and SA on both sides, but no significant difference between SAS score and isometric strength of UT on the left side.

Furthermore, Spearman correlation revealed a weak correlation between SAS score and isometric strength of UT, MT, LT, and SA on the right side and isometric strength of MT, LT on the left side (non-dominant), but no significant relationship between SAS score and isometric strength of UT, SA on the left side.

The current study's findings corroborated those of Yasa et al. (15) who found a link between decreased shoulder girdle muscular strength on the dominant side and the electromagnetic field of smart phones. The electromagnetic field of a smartphone interferes with action potential propagation to nerve axons, resulting in insufficient acetylcholine release and muscle membrane depolarization, causing muscle weakness and tone (16).

Furthermore, the findings of this study were partially compatible with those of Mohammed et al. (17) Who found that extended smart phone use for more than 4 hours in young adults causes rhomboids to shrink and trapezius strength to diminish on the dominant side due to persistent hyperactivity?

Furthermore, it has been observed that extended usage of smartphones causes the non-dominant side's scapular muscles to get stronger as a result of overactivation while holding the phone (17).

The loss of scapular muscular strength associated with prolonged smartphone use could be attributed to protracted periods of improper posture. Long-term use of various activities such as calling, texting, or writing was linked to prolonged scapular protraction. Scapular dyskinesis can occur as a result of this persistent bad posture, which disrupts the dynamic pattern of normal scapular motion. Furthermore, according to Janda's classification, this protracted scapular position causes muscle imbalance, resulting in tension of the pectoralis major and minor, as well as weakening of the lower trapezius, serratus anterior, and rhomboids (18).

Another explanation for this is that holding the smartphone in one hand while texting or conversing with the other puts the shoulder in an elevated position, leading the UT muscle to become overactive. Inhibition of SA, LT, and MT may be linked to hyperactivation of UT. These muscles are required for scapular upward rotation, and they must be contracted in a coordinated manner in order to achieve proper shoulder elevation. Long-term smartphone use may cause an aberrant scapular force coupling, obstructing normal shoulder elevation and resulting in shoulder impairment.

The discrepancy in results between the dominant and non-dominant sides could be attributed to a difference in shoulder flexion angle when using a cellphone. When compared to 30o

and 45o shoulder flexion, Tapanya et al. (19) found that using a smartphone with an excessive shoulder flexion posture (60ºshoulder flexion angle) resulted in the highest shoulder muscle loading (Anterior deltoid and LT muscles) and greater cervical extensors (CES) and UT muscle

Table (4): Correlation between smartphone addiction score and isometric scapular muscles strength at the right side.

		SAS score	Isometric strength of Rt UT	Isometric strength of Rt MT	Isometric strength of Rt LT	Isometric strength of Rt SA
SAS score	Spearman correlation	1	-.17*	-.20*	-.29**	-.20*
	Sig. (2-tailed)		.04	.01	.00	.01
	N	150	150	150	150	150

****Correlation at the 0.01 level (2-tailed)** *** Correlation at the 0.05 level (2-tailed)**

Table (5): Correlation between smartphone addiction score and isometric scapular muscles strength at the left side.

		SAS score	Isometric strength of Lt UT	Isometric strength of Lt MT	Isometric strength of Lt LT	Isometric strength of Lt SA
SAS score	Spearman correlation	1	-.14	-.28**	-.29**	-.13
	Sig. (2-tailed)		.097	.00	.00	.1
	N	150	150	150	150	150

****Correlation at the 0.01 level (2-tailed)** *** Correlation at the 0.05 level (2-tailed)**

Activity. Due to adjustment of shoulder elevation to increase screen readability, a low shoulder flexion posture (15ºshoulder flexion angle) with the neck in neutral (0º neck flexion angle) generated the most CES and UT muscle activity.

Despite we used a large sample in our study, we could not find a correlation between SAS scores and isometric scapular muscles strength. This may be because the current study was conducted on people with various vocations that may contain multiple working demands that may impair scapular strength. As a result, it is more important to look into the link between smartphone addiction and scapular muscle strength in various occupations.

Moreover, because the participants in this study were healthy smartphone users, the findings cannot be applied to other smartphone users with shoulder pain, and the study did not assess how long the individuals used their phones. It depends on how SAS (Short version) is used to determine smartphone addiction.

More research is needed to look into the link between smartphone addiction and rotator cuff muscle strength, subacromial space measurement, electromyographic activities of the rotator cuff and scapular muscles while using a smartphone, and different shoulder angles while holding a phone and their effects on shoulder girdle muscle strength.

5. Conclusion:

Heavy smartphone use can't affect scapular muscular strength on both sides, but people may use one side more than the other causing scapular muscle imbalance and shoulder dysfunction.

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Conflict of Interests

Authors declare no potential conflicts of interest.

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