Effect of smart phone addiction on scapular symmetry and functional level of neck and upper back

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Abstract

Background: The continuous use of a smartphone for a long time can cause various musculoskeletal problems affecting scapula, neck & upper back. The purpose was to investigate the effect of smart phone addiction on scapular symmetry and functional level of neck and upper back.

Methods: Forty-five subjects' from both genders with age ranging from 15 to 25 years were assigned to three equal groups; 15 subjects for each group. Group I: subjects with smart phone addiction level equal (15 to 30) points. Group II: subjects with smart phone addiction level equal (31to 45) points. Group III: subjects with smart phone addiction level equal (46 to 60) points according to smartphone addiction scale short version (SAS-SV). They were assessed using the functional level of neck and upper back questionnaire & scapular asymmetry was assessed by the lateral scapular slide test (LSST) using palpation meter. **Results:** There was no significant difference in scapular distance from shoulder adduction between the three groups ($p > 0.05$).At 45° and 90°shoulder abduction there was a significant decrease in scapular distance of group A compared with that of group B and C ($p < 0.05$), while there was no significant difference between group B and C ($p > 0.05$).There was a significant decrease in Neck and upper back functional index of group A compared with that of group C ($p < 0.05$), while there was no significant difference between group A and B and between group B and C ($p > 0.05$).**Conclusion:** Smartphone addiction had a significant effect on functional level of neck and upper back and leads to scapular asymmetry in highly addicted ones.

Key Words: Functional level of neck, Scapular symmetry, Smart phone addiction, Lateral scapular slide test.

Introduction

Nowadays, addiction not only refers to drug or substance abuse, but it also refers to gambling, internet, games, or even smartphones. These also fall under the category of behavioral addiction[(1)].

Smartphone addiction is defined as a state that one experiences physical, psychological or social maladjustment or deviation due to excessive smartphone use, is overly reliant on or obsessed with smartphone use, can be satisfied when they make more use of smartphones, or feels anxious when they stop using them[(2)].

Because smartphones have small monitors that are typically held downward near the laps, users must bend their heads to see the screens, increasing activity in the neck extensor muscles overloading the neck and shoulders increases muscle fatigue, decreases work capacity and affects the musculoskeletal system[(3)].The continuous use of a smartphone for a long time can cause various musculoskeletal problems. In particular, it can encourage incorrect postures such as a hunched or neck bendingpostures, and cause damage to the surrounding skeletal structures as well as to ligaments[(4)].The neck disability among smartphone users might be related to frequent neck flexion posture, which changes the natural curve of the cervical spine and increases the amount of stress on the cervical spine, leading to irritation and spasm in the surrounding skeletal structures and ligaments[(5)].

A previous study in Thailand by **Kim et al., (2015)** [(6)]found that the majority of smartphone users who reported musculoskeletal disorders adopted positions in the upper body of: neck flexion (82.74%), shoulder protraction (56.61%), elbow flexion (65.16%), wrist and hand flexion during keying (22.40%), and wrist and hand supination to support the device (21.62%).

In particular, the scapula may be affected by abnormal alignment of surrounding muscles, joints and body parts because it is not connected directly to the trunk but is fixed to the trunk mainly by muscles. Scapular asymmetry also has a bad influence on the alignment of cervical joints, causing neck pain[(7)].

Smartphone addiction scale (SAS) is an analytic scale that to differentiate smartphone addicts based on a Korean analytic program which is Internet addiction (K-scale) and the smartphone's own functions[(8)].

Kibler’s Lateral Scapular Slide Test (LSST) is used to assess scapular asymmetry by comparing right and left scapular distances, as measured from the

inferior angle of the scapula to the corresponding thoracic spinous process in the horizontal plane **(9).**

Results of previous reliability study of scapular positioning by **Danielset al., (2000)(10)**, had demonstrated that measurements of linear distance related to the scapula can be reliable. The LSST has been used to assess scapular asymmetry, which may be indicative of shoulder dysfunction. Moreover, the LSST is a relatively simple procedure that is neither time intensive nor expensive.

The Neck disability index (NDI) is a condition specific disability measure. It was devised in an outpatient physiotherapy department by Vernon and Mior in 1991 and is based on the Oswestry disability index **(11).**

Hence, the purpose of this study was to investigate the effect of smart phone addiction on scapular symmetry and functional level of neck and upper back.

Material and Methods

Study Design :

Observational, cross-sectional study.

Participants:

Forty-five subjects' from both genders with age ranging from 15 to 25 years. Subjects were randomly assigned into three equal groups according to smartphone addiction scale short version(SAS-SV) as follow:

Group I: Fifteen subjects with smart phone addiction level equal (15 to 30) points.
Group II: Fifteen subjects with smart phone addiction level equal (31to 45) points.
Group III: Fifteen subjects with smart phone addiction level equal (46 to 60) points.

The study was conducted atthe Faculty of Physical Therapy, Cairo University & Al-Azhar University specialized Hospital. Inclusion criteria included:1- All the subjects were using smart phone size was medium with a screen size (4:5) inches & weight (140:160) grams according to the worldwide smart phones size(12). 2- The subjects were all Right handed.3- The subjects had a body weight (50:80) Kg & height (150:180) cm.4- All subjects had muscle strength of grade 5 for shoulder girdle muscles.Exclusion criteria included:1-Any history of pathological trauma to the shoulder girdle, thoracic spine, upper extremity or rib cage. 2- Traumatic, congenital,

or surgical condition around the spine & upper limb.3-Spinal postural deformities as hyper kyphosis & scoliosis.4- Medically unstable patients. 5- Any shoulder pathology or congenital defect of scapula e.g sprengel's syndrome.

Measurement Procedures:

1) **Lateral scapular slide test using Palpation meter(LSST)**

A palpation meter **(Figure 1)** Used to measure the horizontal distance from scapula to thoracic spine from 3 different position (shoulders adducted, 45-degree abduction, and 90-degree abduction) as follow:The inferior angle of scapula bilaterally was palpated & marked and also the corresponding spinous process to it. The PALM one tip was put on one of the marked inferior angles of scapula and the other arm was moved to reach the marked corresponding spinous process then the reading was taken and this step was repeated three times to be confirmed,

the same steps were performed to the other side . Both sides' readings were recorded and the differences between them were calculated in each position. Scoring of the lateral scapular slide test as follow: bilateral difference of 1.5 cm should be the threshold for deciding whether scapular asymmetry is abnormal. A distance 1.5 cm greater than the contralateral side in any position suggests scapulothoracic weakness with secondary scapulothoracic protraction [(9)].

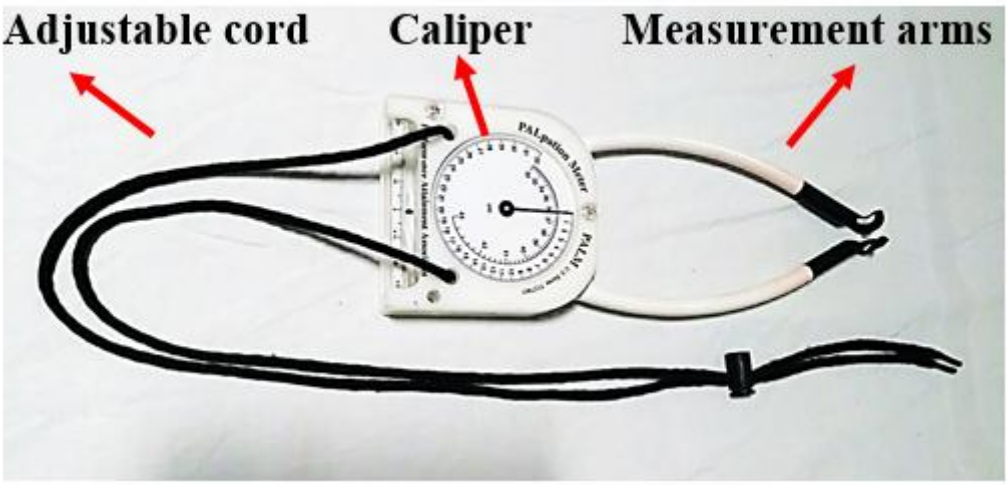

Figure (1): Palpation meter instrument (PALM).

2)Smart phone addiction scale short version (SAS-SV): The therapist asked the

Participants about the rate on a dimensional scale how much each statement relates to them, (1 “strongly disagree” to 6 “strongly agree”). Example items include ‘Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use’ [(13)].The cut-off value for boys was 31 and 33 for

girls. For those who scored higher than the cut-off values are considered as high-risk for smartphone addiction[14].

3)Neck & upper back functional scale:

It is a questionnaire about how the subject shoulder/elbow/wrist/hand has affected his/ her ability to manage in everyday life. There are four items that relate to subjective symptomatology (pain intensity, headache, concentration, sleeping) and six items that relate to activities of daily living (lifting, work, driving, recreation, personal care, reading) [15]**.** The sum of the scores obtained were doubled to give a percentage score out of 100 as follow **(Vernon and Mior 1991):**

- (0–20) normal
- (21–40) mild disability
- (41–60) moderate disability
- (61–80) severe disability
- (80+) complete/exaggerated disability

Data collection: All subjects assessed one time as a (One shot study).They were assessed using the Smart phone addiction scale short version (SAS-SV), the functional level of neck and upper back questionnaire & the scapular asymmetry was assessed by lateral scapular slide test using palpation meter.

Data analysis:

Descriptive statistics and Multivariate analysis of variance (MANOVA)) were carried out for comparison of subject characteristics, phone weight and size between groups.Chi squared test was conducted for comparison of sex distribution between the three groups.MANOVA was carried out to compare IAS-Sp distance and upper back functional index between the three groups.The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, IL, USA).

Results

-General characteristics of the subjects:

-Comparing the general characteristics of the subjects of the three groups revealed that there was no significance difference between the three groups in the mean age, weight, height and BMI ($p > 0.05$).Also, there was no significant difference in the sex distribution between the three groups ($p > 0.05$). **(table1) .**

Table1. Basic characteristics of participants:

	Group A	Group B	Group C		
	$\overline{X}$±SD	$\overline{X}$±SD	$\overline{X}$±SD	F- value	p-value
Age (years)	20.13 ± 2.5	20.93 ± 2.54	19.8 ± 1.93	0.92	0.4*
Weight (kg)	64.33 ± 8.03	65.4 ± 5.42	68.66 ± 7.07	1.59	0.21*
Height (cm)	166.8 ± 9	167.06 ± 7	167.13 ± 8.41	0.007	0.99*
BMI (kg/m²)	23.15 ± 2.65	23.52 ± 2.52	24.57 ± 1.76	1.47	0.24*
Sex distribution					
Females	١1 (73%)	٩ (60%)	7 (٤7%)	(χ^2=2.22)	032*
Males	4 (27%)	6 (40%)	8 (53%)		

$\overline{X}$, Mean; SD, standard deviation; χ2, Chi squared value; p-value, level of significance; * Non-significant.

- Comparison of mean values of phone weight and screen size between groupA, B, and C:

There was no significant difference in phone weight and screen size between the three groups ($p > 0.05$).**(table 2) .**

Table 2.*Comparison of mean values of phone weight and screen sizebetween group A, B and C*

	Group A	Group B	Group C		
	$\overline{X}$±SD	$\overline{X}$±SD	$\overline{X}$±SD	F- value	p-value
Phone weight (gm)	152.26 ± 9.3	155.66 ± 14.57	151.53 ± 18.51	1.14	0.32*
Screen size (inches)	5.36 ± 0.41	5.31 ± 0.51	5.09 ± 0.6	0.34	0.71*

$\overline{X}$, Mean; SD, standard deviation;; p-value, level of significance; * Non-significant.

Comparison of scapular symmetry between group A, B and C:

There was no significant difference in IAS-Sp distance from shoulder adduction between the three groups ($p > 0.05$).At 45° and 90°shoulder abduction there was a significant decrease in IAS-Sp distance of group A compared with that of group B and C ($p < 0.05$), while there was no significant difference between group B and C ($p > 0.05$).**(table 3).**

Comparison of Neck and upper back functional index between group A, B and C:

There was a significant decrease in Neck and upper back functional index of group A compared with that of group C ($p < 0.05$), while there was no significant difference between group A and B and between group B and C ($p > 0.05$).**(table 3).**

Table3:*Mean IAS-Sp distance and functional level of neck and upper back of the group A, B and C:*

	Group A	Group B	Group C	p-value		
	$\overline{X}$±SD	$\overline{X}$±SD	$\overline{X}$±SD	A vs B	A vs C	B vs C
IAS-Sp distance (cm)						
Shoulder adduction	0.96 ± 0.42	1.39 ± 0.71	1.34 ± 0.56	0.12*	0.19*	0.9٦*
45° shoulder abduction	0.85 ± 0.53	1.36 ± 0.59	1.48 ± 0.39	0.0٢**	0.00٥**	0.78*
90° shoulder abduction	1.02 ± 0.31	1.53 ± 0.49	1.62 ± 0.43	0.006**	0.001**	0.81*
Neck and upper back functional index (%)	14.13 ± 5.73	15.46 ± 6.61	20.8 ± 7.36	0.84*	0.02**	0.08*

$\overline{X}$**, Mean; SD, standard deviation; p-value, level of significance; * Non-significant; **Significant**

- Correlations between SAS-SV score and IAS-Sp distance:

The correlation between smartphone addiction scale(SAS-SV) score and inferior angle of scapula-spinous process(IAS-Sp) distance from shoulder adduction was weak positive non significant correlation ($r = 0.24$, $p = 0.1$). **(Table4).**

The correlation between SAS-SV score and IAS-Sp distance from 45° of shoulder abduction was moderate positive significant correlation ($r = 0.43$, $p = 0.003$). **(Table4).**

The correlation between SAS-SV score and IAS-Sp distance from 90° of shoulder abduction was moderate positive significant correlation ($r = 0.54$, $p = 0.0001$). **(Table4).**

- Correlations between SAS-SV score and neck and upper back functional index:

The correlation between SAS-SV score and neck and upper back functional index was weak positive significant correlation ($r = 0.33$, $p = 0.02$). **(Table 4).**

Table 4. Correlations between SAS-SV score and IAS-Sp distance.

		r value	p value
SAS-SV score	**IAS-Sp distance from shoulder adduction (cm)**	0.24	0.1
	IAS-Sp distance from 45° of shoulder abduction (cm)	0.43	0.003
	IAS-Sp distance from 90° of shoulder abduction (cm)	0.54	0.0001
	Neck and upper back functional index (%)	0.33	0.02

r-value: Pearson correlation coefficient value p value: probability value NS: significant
S: significant

DISCUSSION

In the present study, Results showed that the degree of smartphone addiction was significantly correlated with scapular asymmetry especially in loaded positions. Significantmoderate positive correlationbetween SAS-SV score and IAS-Sp distance from 45° of shoulder abduction (r = 0.43, p = 0.003) and from 90° of shoulder abduction was moderate positive significant correlation (r = 0.54, p = 0.0001).

Also, smartphone addiction scale showed a higher score-indicating addiction to smartphone use, along with it the scores of neck and upper back functional level showed mild positive significant correlation (r = 0.33, p = 0.02).

The study revealed that the possible explanation of the significant correlation between the smart phone addiction and scapular asymmetry in the loaded positions (45^0 & 90^0 shouder abduction) is the over stress and fatigue of the neck, back and shoulders musculatures that connected to the scapula and affects its performance due to slouch and looking down to the small monitors of smart phone for long periods of time and that appears obviously especially in loaded positions as the sample was of young age and has a good healthy musculature which explains the non signisicant correlation between smart phone addiction and scapular asymmetry in static position of zero degree shoulder adduction. Moreover, the significant correlation between the smart phone addiction and functional level of neck and upper back goes to the frequent neck flexion posture, which changes the natural curve of the cervical spine

and increases the amount of stress on the cervical spine, leading to irritation and spasm in the surrounding skeletal structures and ligaments.

The findings of the present study were supported by **Gyu et al., 2012**[16] to investigate the effect of the use of smartphones on the upper extremity. Forty healthy young adults (18 male, 25 female) took part in this study which found feasible relationships between smartphone use and musculoskeletal symptoms of the upper extremity and neck and identified physical differences between the smartphone uses.

The results of the present study was in agreement with **Priyal and Megha(2018)**[17]who's results showed that the degree of smartphone influence was significantly correlated with musculoskeletal discomfort in the participants. Significant moderate positive correlation between both smartphone addiction scale and neck disability index ($p<0.001$). Moreover, SAS showed a higher score-indicating addiction to smartphone use, along with it the scores of neck disability index (NDI) showing moderate disability (30-48%-moderate disability).

A study by **Selvaganapathy et al., (2017)** [5] showed a correlation between SAS and NDI scores as the results concluded that the excessive use of smartphones can lead to habitual repetitive and continuous movements of the head and neck toward the screen throughout the day. Such movements are associated with a high risk of chronic neck pain and may explain the strong association between SAS and NDI scores in the present study.

Berolo et al.,(2011)[18] investigated the distribution of the musculoskeletal disorders of upper extremity, upper neck and back, as well as the relationship between musculoskeletal disorders and smartphone addiction on muscle. Results of this study revealed that 84% of participants reported pain in at least one part of the body, so they suggested that there is a relationship between musculoskeletal disorders & smartphone addiction on muscle.

Based on the results of a study conducted by **Park et al., (2015)** [19]which showed thata total of 20 students were divided into 10 students in heavy user group (high duration) Smartphone and 10 students in the non-heavy user group (low

duration) Smartphone. Both groups studied the threshold of pain relief on the trapezium muscle, sternocleidomastoid, craniovertebral angle, head angle position, and depression level. The results indicated by this study was in aggrement with our present study that the use of a heavy Smartphone (high duration) can produce considerable pressure on the cervical spine, thus changing the cervical curve and increasing pain threshold from the muscles around the neck.

Results of the conducted study together with those of other previous researchers & studies reviewedthat there is a significant relationship between the smart phone addiction, scapular symmetry and functional level of neck and upper back**.**

Conclusion

On the basis of the study, we can conclude that smartphone addiction affects the functional level of neck and upper back and also the scapular symmetry especially in the loaded positions and this supports the need for informing people especially the young age about the physical risks associated with excessive use of smartphones.

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