Original Article

Postural Correction Exercises Improves Shoulder Muscular Performance Owing To Smartphones Addiction

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Abstract

The rapid advances in smartphones' technology, reflected in terms of light weight, small size, and easy portability, has rendered an inevitable rapid increase in number of smartphone users and smartphone addicts among ordinary population. Faulty use of smartphones would eventually put an overdue mechanical demand and load on shoulder and scapular muscles, that precipitate minor traumas and consequently shoulder pain and diminished performance. **Purposes** To investigate the effect of postural correction exercises on shoulder muscle performance in subjects addicting smartphones. **Subjects** Forty subjects addicting smartphones of both genders were recruited and distributed at random to the control and experimental group. Subjects' age in group (A) and (B) were (28.1±3.8) and (28.8±4) years respectively, their height was (170.1±8.9) and (170.2±8.3) cm respectively, whereas their weight was (73.6±9.5) and (71.3±10.7) kg respectively. **Materials and Methods** all recruited subjects in both control and experimental group received traditional modalities to relieve pain in the form of infrared radiation and TENS. The experimental group (Group B) including twenty subjects received postural correction exercises in addition to the traditional modalities of relieving pain. **Results** As compared to the control group, shoulder muscles' performance in the experimental group showed significant improvement. The improvement shown involved improved work, torque and work fatigue at angular velocity of 120°/sec. for shoulder flexors, extensors, abductors and internal rotators. **Conclusion** Postural correction exercises have significant effect on improving shoulder muscle performance in subjects showing postural deviation owing to smartphones addiction.

Key words :Smartphone addiction, Shoulder muscles performance, Postural correction exercises

INTRODUCTION

With the continuous rapid growth and development of smartphone technology nowadays, the percentage of subjects owning and using smartphones is seemingly increasing among all age groups and regions around the world, irrespective of their economic differences **(Xiong and Muraki. 2016).[1]** The popularity of smartphones can be attributed to their light weight, low price and ease of use **(Vahedi. 2019).[2]**

Information and communication technology has rapidly evolved during the last decades and was promoted to be portable and easily accessible such as smartphones and tablets. Such development was the precursor to an increasing use and demand on smartphones not only to talk and exchange texts, but also to go through social media, mailing services, games, music, purchase sites and other numerous tasks and facilities. Furthermore, addictive or habitual behaviours have made smartphone use even more common **(Ko et al., 2016).[3]** Such addictive behaviours have increased even more since the COVID 19 pandemic which enforced a state of social separation and demanded increased usage of digital platforms like smartphones for communication among people **(Khanna and Khanna 2020).[4]**

The excessive usage of smartphones might induce discomfort or pain in the neck, shoulder, wrist and fingers, which causes a range of medical conditions and decrease muscle performance due to pain **(Ramnaath 2020).** [5]Recently, it has been observed that cervical and shoulder complaints are noticeably increasing among smartphone users **(Jin et al., 2019).[6]** Excessive use of smartphones negatively impacts the subject's posture, as it tends to enforce a forward movement of the head and neck with increasing neck flexion while using smartphones. The faulty posture assumed for extended periods of time is significant predisposing factor to the development of pain and discomfort in the cervical region and the correlated shoulder and upper back regions **(Lee et al., 2015 [7]; Gustafsson et al., 2017).[8]**

The persistent use of smartphone leads to postural abnormalities such as forward head posture and rounded shoulder. Forward head posture, claimed to be strongly and significantly associated with smartphone addiction **(Salvi and Batin., 2018)[9],** is assessed using craniovertebral angle (CVA), with a reported normal value of >50°. Smartphone use with inappropriate posture decreases the craniovertebral angle that is evident as forward head posture **(Diab and Moustafa., 2011[10]; Shete and Shah., 2019).[11]** Rounded shoulder is as well a common postural alteration significantly related to smartphone addiction **(Shete and Shah., 2019).[11]**

Postural correction exercises aim to correct postural deviations such as forward head posture and rounded shoulders. Postural correction exercises recommended for such cases may include strengthening of the deep neck flexors, prone chin tucks and isometric extension exercises, with chest stretches which showed being efficient in rectification of forward head posture and retrieval of normal craniovertebral angle **(Kisner et al., 2012).** [12] Scapular stabilization exercises regain peri-scapular muscle strength and hence normal scapular posture that eventually corrects for rounded shoulders and thus decreases the degree of forward head posture **(Shete and Shah., 2019). [11]**

Shoulder muscles' performance can be measured using various methods ranging from cost free methods such as manual muscle test, yielding inaccurate subjective data, to those yielding data with high reliability and validity such as Isokinetic Dynamometry **(Ford et al., 2022).** [13]

Accurate measurement of muscle performance is a crucial requirement to properly identify the effect of different therapeutic modalities on different physical phenomena. Isokinetic dynamometer has been introduced late 1960s to fulfill this aim, and since then is utilized as the gold standard tool of measuring and assessing muscle function and performance in research work, but was mostly used for measuring thigh muscles' performance. Parameters measured in isokinetic muscle performance are peak torque, average work and power **(Brown, 2000;[14] Wrigley & Strauss, 2000).[15]**

Clinicians nowadays use isokinetic dynamometer to objectively and reliably assess isokinetic strength of shoulder muscles. It provides a view of functional-strength profile in both patients and athletes complaining of musculoskeletal disorders of the shoulder, such as; rotator cuff impingement, anterior shoulder instability, peripheral neuropathy, or assess functional dynamic stability and shoulder muscle performance of in overhead athletes **(Edouard et al., 2011). [16]**

Isokinetic evaluation is an objective measuring device for evaluating shoulder muscles performance of healthy and injured overhead athletes. The increasing utilization of isokinetic dynamometer in studies showed a very high degree of validity, reliability and technical accuracy in measuring torque, work, fatigue and power of shoulder musculature. Reliability of isokinetic measurement could be affected by many factors including assessment position, in terms of body position in sitting or lying, shoulder position and alignment of the joint axis, and proper stabilization **(Edouard et al., 2009[17]; Saccol et al., 2010).[18]** The purpose of this study was to determine the effect of postural correction exercises on shoulder muscle performance in smartphones addicts.

Methods

The current study implemented a pre-test/post-test randomized controlled study design. Subjects were recruited from students and administrative staff of the Faculty of Physical Therapy, Cairo University and were subdivided into two equal groups; control group and experimental group. The study was conducted in the Faculty of Physical Therapy, Cairo University, Cairo, Egypt from June 2022 to September 2022. The current study was approved by the Research Ethical Committee, Faculty of Physical Therapy, Cairo University, with approval no. P.T.REC/012/003350, dated September 12th, 2021. This trial was registered in the Clinical Trial.gov PRS No (NCT05305807).

Participants

Sample size was calculated and determined using the G*Power software (version 3.0.10), which revealed a sample size of 20 subjects per group and a total of 40 subjects. All subjects signed a consent form before being recruited in the study. Forty subjects classified as smartphone addicts by smartphone addiction scale were randomly

assigned into two equal groups by using closed envelope randomization method. Control group (Group A) included twenty subjects and received traditional intervention to relieve pain and muscle tenderness which consisted of infrared radiation and TENS. The experimental group (Group B) included twenty subjects who received the traditional intervention of group A in addition to postural correction exercises. All subjects in both groups received their program for a duration of 4 weeks **(Shete and Shah., 2019).[11]**
Inclusion criteria included 1) age range of 25 to 35 years old **(Bodin et al., 2019),[19]** 2) subjects using smartphone for 2.5 hours/day or more during the last year or more **(Berolo et al., 2011) [20],** 3) subjects with rounded shoulders deformity identified as CVA of less than 50° **(Weon et al., 2010)**, [21]and 4) forward head posture showing a shoulder angle of less than 52° **(Vellingiri et al., 2020).[22]** Subjects showing any of the following criteria, currently or previously, were excluded from the current study; 1) neck or shoulder injury **(Samaan et al., 2018),[23]** 2) surgeries of the neck and/or upper extremity **(Samaan et al., 2018),[23]** 3) inflammatory joint diseases affecting shoulder and/or cervical facet joints **(Samaan et al., 2018), [23]**4) musculoskeletal disorders involving neck and/or upper limbs **(Kim et al., 2012),[24]** 5) neurological disorders affecting upper limb performance and function such as cervical spondylosis, spondylolisthesis, disc prolapse or thoracic outlet syndrome **(Kim et al., 2012) [24],** and 6) athletes practicing sports involving excessive demand on shoulder musculature such as boxing, rowing, volleyball, and other sports alike **(Samaan et al., 2018).[23]**

Procedures

Evaluation procedures

Subjects meeting the inclusion and free of any of the exclusion criteria, and consenting to participate in the study, received full and proper explanation regarding aim of the study, duration, and assessment and treatment procedures proceeding with the evaluation procedures. The second investigator performed all testing procedures, and ensured uniformity of performing all procedures on all patients. Body weight and height were measured and BMI was calculated for each subject. Subjects were requested to wear loose fitting, comfortable clothes during the assessment procedures to avoid interfering with the testing procedures. After testing procedures of every movement, the patient was permitted a five minutes rest before starting the next.

Isokinetic measurement procedures

In the current study the Biodex system-3 multi-joint testing and rehabilitation system (Biodex medical system, Shirly, New York, USA) was used at the Faculty of Physical Therapy, Cairo University for measuring shoulder muscle performance. For all isokinetic testing procedures, the angular velocity used was 120°/sec. with 5 maximal repetitions. To measure performance of shoulder flexors, the handpiece and lever arm were adjusted so that the elbow is in full extension and the range of motion was set from 0°to 180° of shoulder flexion. **Fig. (1)**. For shoulder abductors, range of motion was set from 0°to 180° of shoulder abduction. **Fig. (2).** For shoulder internal rotators, range of motion was set from 0°to 135° of shoulder internal rotation. **Fig. (3)**

Fig. (1): Isokinetic testing of shoulder flexors performance. **Fig. (2):** Isokinetic testing of shoulder abductors performance

Fig. (3) Isokinetic testing of shoulder internal rotators performance

Intervention procedure

Control group (Group A), included twenty subjects, received traditional intervention to relieve pain and muscle tenderness consisting of infrared radiation and TENS. The experimental group (Group B) included twenty subjects received the traditional intervention of group (A) in addition to postural correction exercises. All subjects in both groups received the program for duration of 4 weeks.

Posture correction exercises for improving shoulder muscle performance

All subjects enrolled in group B, received a four weeks program of postural correction exercises, 3 times/week **(Shete and Shah., 2019).[11]** The postural correction exercise program consisted of strengthening and stretching exercises. Strengthening exercise were performed for neck and shoulder muscles and consisted of 3 sets of 10 repetitions each and 1 to 3 minutes rest interval between sets. The exercises included; chin tucks and chin tucks against gravity exercises, isometric neck exercises, scapular retraction exercises, upright press-up exercise and resisted shoulder muscles strengthening exercise. Stretching exercises were directed to upper fibers of trapezius, pectoralis major, levator scapulae, suboccipital muscle and sternocleidomastoid muscles. All stretching exercises were maintained for 30 seconds and repeated for 3 times/session. Postural correction exercises aimed to strength weak muscles and regain normal length of shortened muscles thus regaining normal scapular posture and improving shoulder muscle performance **(Harman et al.,2005. [25]; Kisner and Colby., 2012. [12]; McAtee and Charland., 2014).[26]**

Data analysis and statistical design

Data were expressed as mean±SD. Unpaired t-test was used to compare between subjects' demographic data of the two groups. MANOVA was performed to compare within and between groups' effects for all measured variables. Statistical package for the social sciences computer program (version 20 for Windows; SPSS Inc., Chicago, Illinois, USA) was used for data analysis. P less than or equal to 0.05 was considered significant.

Results

The data presented in this chapter are related to the aim of the current study that is to investigate the effect of postural correction exercises on shoulder muscle performance in smartphone addicts.

Demographic data of patients

A total of 40 patients in the current study; and were assigned randomly into two equal groups. Table (1) shows the demographic data of the patients in the two groups in terms of their age, height, weight, BMI and gender distribution. There was no significant difference between both groups in these regards (p> 0.0.05). Group A included 10 males (50%) and 10 females (50%) females, while group B included 11 males (55%) and 9 females (45%) respectively. There was no significant difference in sex distribution between the two groups (p = 0.752)

Table (1) Subjects' demographic characteristics of both groups

	Group A	**Group B**	**t-value**	**p-value**
Age (years)	28.1±3.8	28.8±4	-0.603	0.550
Height (cm)	170.1±8.9	170.2±8.3	0.037	0.971
Weight (Kg)	73.6±9.5	71.3±10.7	0.724	0.474
BMI(Kg/m$^{2)}$	25.87±5.17	24.56±4.11	0.134	0.189
Sex distribution	No (%)	No (%)	**χ^2 value**	**p-value**
Males	10 (50%)	11 (55%)	0.100	0.752
Females	10 (50%)	9 (45%)		

Data represented as mean ±SD, χ^2 : Qi square

Normality test

Data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. Shapiro-Wilk and Kolmogorov-Smirnov tests for normality showed that all measured variables are normally distributed.

Effect of postural correction exercises on shoulder flexor performance

As shown in **Table (2)**, within group comparison comparing pre- and post-treatment values showed statistically significant difference in shoulder flexors' torque, work and fatigue of in group (B), (p-value =0.001), while for group (A) there were no statistically significant difference for the same parameters (p>0.05). The percentage of change in shoulder flexors' torque, work and fatigue post-treatment in group (A) were 3.4, 1.4 and 4% and in group (B) were 64, 57 and 34.8% respectively. Between groups comparison showed significant difference between both groups in favour of group (B) with p value of torque, work and work fatigue 0.016, 0.031, 0.007 respectively.

Table (2) Comparison between pre- and post-treatment mean values of shoulder flexor performance between and within groups

Shoulder flexor	Group A	Group B	MD (95% CI)	P value	ηp2
Torque (N.m) Pre-treatment	40.7 ± 10.7	34.9 ± 10	5.87 (-0.789, 12.5) -0.340(-0.847-0.193)0.00.10.0.0.3300.0.0.149	0.082	0.077
Post-treatment	42.1 ± 11.7	51 ± 10.5	-8.8 (-15.9, -1.7)	0.016*	0.142
(P-value)	0.272	0.001*			
% of change	3.4%	64%			
Work (Joule) Pre-treatment	294 ± 122	246 ± 91	48 (-20.8, 117)	0.166	0.050 0.666
Post-treatment	298 ± 122	387 ± 130	-89 (-170, -8)	0.031*	0.116
(P-value)	0.777	0.001*			
% of change	1.4%	57%			
Work fatigue					
Pre-treatment	22.3 ± 7.4	23.3 ± 6.8	-0.955 (-0.5.5, 3.6)	0.675	0.005
Post-treatment	21.4± 8.3	15.2 ± 5	6.2 (1.8, 10.6)	0.007*	0.177
(P-value)	0.307	0.001*			
% of change	4%	34.8%			

Data were expresses as mean ± SD, probability; η2, partial eta square; MD, mean difference; CI, confidence interval; *, significant

Effect of postural correction exercises on shoulder extensor performance

As shown in **Table (3),** within group comparison comparing pre- and post-treatment values showed statistically significant difference in shoulder extensors' torque, work and fatigue within group (B) (p-value = 0.001), there were as well significant difference in shoulder extensor fatigue only in group (A) (p= 0.043) post-treatment, and no significant difference in shoulder extensor torque and work in group A (p>0.05). The percentage of post-treatment change of shoulder extensors' torque, work and fatigue in group (A) were 2.4, 1.1 and 5.5% and of group (B) were 39.4, 47 and 42% respectively. Between groups comparison showed significant difference between both groups in favour of group (B) with p value of torque, work and work fatigue 0.003, 0.019, 0.001 respectively.

Table (3) Comparison between pre- and post-treatment mean values of shoulder extensor performance between and within group.

Shoulder extensor	Group A	Group B	MD (95% CI)	P value	ηp2
Torque (N.m) Pre-treatment	53.6 ± 14.6	50 ± 14	3.5 (-5.6, 12.6) -0.340(-0.847-0.193)0.00.10.0.0.3300.0.0.149	0.440	0.016
Post-treatment	54.9 ± 14.8	69.7 ± 14.8	-14.8 (-24.3, -5.3)	0.003*	0.208
(P-value)	0.484	0.001*			
% of change	2.4%	39.4%			
Work (Joule) Pre-treatment	385 ± 181	361.8 ± 152	23.3 (-84, 130)	0.662	0.005 0.666
Post-treatment	389.4 ± 181	532 ± 186	-143 (-261, -25)	0.019*	0.137
(P-value)	0.799	0.001*			
% of change	1.1%	47%			
Work fatigue Pre-treatment	20 ± 7.4	19.3 ± 3.9	0.740 (-0.3, 4.56)	0.698	0.004
Post-treatment	18.9± 7.3	11.2 ± 4.3	7.7 (3.8, 11.6)	0.001*	0.300
(P-value)	0.043	0.001*			
% of change	5.5%	42%			

Data were expresses as mean ± SD, probability; η2, partial eta square; MD, mean difference; CI, confidence interval; *, significant

Effect of postural correction exercises on shoulder abductor performance

As shown in **Table (4),** within group comparison comparing pre- and post-treatment values showed statistically significant difference in shoulder abductors' torque, work and fatigue within group (B) (p-value = 0.001), there were no significant difference in group (A) for post-treatment values of torque, work and fatigue (p>0.05). The percentage of post-treatment change of shoulder abductors' torque, work and fatigue in group (A) were 3.8, 2.2 and 1.2% and of group B were 22, 55 and 37.4% respectively. Between groups comparison showed significant difference between both groups in favour of group (B) with p value of torque, work and work fatigue 0.004, 0.007, 0.001 respectively.

Table (4) Comparison between pre- and post-treatment mean values of shoulder abductor performance between and within groups

Shoulder Abductor	Group A	Group B	MD (95% CI)	P value	ηp2
Torque (N.m)			5.6 (-0.68, 11.8)	0.079	0.079
Pre-treatment	39.5 ± 9.9	43 ± 9.6	-0.340(-0.847-0.193)0.00.10.0.0.3300.0.0.149		
Post-treatment	41 ± 10.7	52.5 ± 10.8	-11.5 (-19, -3.9)	0.004*	0.198
(P-value)	0.354	0.001*			
% of change	3.8%	22%			
Work (joule)				0.183	0.001
Pre-treatment	250.8 ± 107	248.7 ± 105	2.13 (-66, 70)		0.666
Post-treatment	256.4 ± 108	385.9 ± 127	-129 (-222, -37)	0.007*	0.175
(P-value)	0.749	0.001*			
% of change	2.2%	55%			
Work fatigue					
Pre-treatment	24.8 ± 6.8	21.9 ± 6.7	2.9 (-1.4, 7.2)	0.183	0.046
Post-treatment	24.5± 8.4	13.7 ± 5.5	10.7 (6.2, 15.3)	0.001*	0.376
(P-value)	0.611	0.001*			
% of change	1.2%	37.4%			

Data was expresses as mean ± SD, probability; η2, partial eta square; MD, mean difference; CI, confidence interval; *, significant

Effect of postural correction exercises on shoulder internal rotator performance

As shown in **Table (5),** within group comparison comparing pre- and post-treatment values showed statistically significant difference in shoulder internal rotators' torque, work and fatigue within group (B) (p-value = 0.001), there were as well significant difference in shoulder internal rotators' fatigue of group (A) (p= 0.008), and there were no significant difference in group (A) for post-treatment values of torque and work (p>0.05). The percentage of post-treatment change of shoulder internal rotators' torque, work and fatigue in group (A) were 3, 5.5 and 6.2% and of group B were 43.7, 56 and 45.5% respectively. Between groups comparison showed significant difference between both groups in favour of group (B) with p value of torque, work and work fatigue 0.017, 0.002, 0.001 respectively.

Table (5) Comparison between pre- and post-treatment mean values of shoulder internal rotator performance between and within groups

Shoulder Internal rotator	Group A	Group B	MD (95% CI)	P value	ηp2
Torque (N.m)			5.4 (-3.7, 14.6)		
Pre-treatment	48.8 ± 15	43.4 ± 13.4	-0.340(-0.847-0.193) 0.00.10.0.0.3300.0.0.149	0.239	0.036
Post-treatment	50.3 ± 15.7	62.4 ± 14.8	-12.1 (-21.9, -2.3)	0.017*	0.142
(P-value)	0.349	0.001*			
% of change	3%	43.7%			
Work (joule)			27.3 (-25.9, 80.5)	0.305	0.028
Pre-treatment	282 ± 96	254.9 ± 66			0.666
Post-treatment	297.6 ± 107	398 ± 82	-100.5 (-161, -39)	0.002*	0.226
(P-value)	0.229	0.001*			
% of change	5.5%	56%			
Work fatigue					
Pre-treatment	22.6 ± 6.4	20 ± 4	2.6 (-0.8, 6.1)	0.129	0.060
Post-treatment	21.2± 6.4	10.9 ± 4.1	10.3(6.8, 13.8)	0.001*	0.489
(P-value)	0.008	0.001*			
% of change	6.2%	45.5%			

Data was expresses as mean ± SD, probability; η2, partial eta square; MD, mean difference; CI, confidence interval; *, significant

Discussion

The current study was developed aiming to investigate the effect of postural correction exercises on shoulder muscles' performance in subjects addicting smartphones use. For this aim to be accomplished Biodex system-3 multi-joint testing and rehabilitation system was used (Biodex medical system, Shirly, New York, USA). Muscle performance was measured in terms of muscle torque, work and work fatigue.

Statistical analysis of the current study showed statistically significant difference in muscle performance expressed as torque, work and work fatigue within group (B) as compared to group (A) for the four movements tested; shoulder flexion, extension, abduction and internal rotation. There was also significant difference between post-treatment values of both groups for all tested parameters measured for the four movements tested, in favour of group (B). The percentage of changes of shoulder flexors' performance; torque, work and work fatigue, were 3.4, 1.4 and 4% for group (A) and 64, 57 and 34.8% for group (B) respectively. The percentage of changes of shoulder extensors' performance; torque, work and work fatigue, were 2.4, 1.1 and 5.5% for group (A) and for group B were 39.4, 47 and 42% respectively. The percentage of changes of shoulder abductors' performance; torque, work and work fatigue, were for group (A) were 3.8, 2.2 and 1.2% and for group (B) were 22, 55 and 37.4% respectively. The percentage of changes of shoulder internal rotators' performance; torque, work and work fatigue, were for group (A) were 3, 5.5 and 6.2% and for group (B) were 43.7, 56 and 45.5% respectively.

Kong et al., 2017, [27]reported in his study that prolonged smartphone use and desk-based job lacking appropriate postural ergonomics constitutes a potent risk factor for developing forward head posture, which imposes an increased load on shoulder and scapular musculature that might induce pain and reduced muscular performance.

As proposed by **Chaffin et al., 2006** [28]assuming prolonged and frequent shoulder and wrist abduction, as observed during smartphone use, would eventually lead to lack of synovial fluids in the tendons' synovium and bursae and hence increases the friction between tendons and muscles which end up in pain, limited motion and decreased muscle performance.

The continuous activation of specific muscle fibers, through assuming static neck or shoulder patterns or performing prolonged stereotyped tasks, probably result in chronic pain and reduced muscle performance. Such condition is classical in using computers and/or smartphones for extended periods of time. This pain, secondary to low level static muscle contraction, might be attributed to reduced muscle microcirculation and metabolism as well as inadequate recovery between work periods **(Szeto et al., 2005)**.[29]

Bodin et al., 2019,[19] conducted a study on twelve right-handed subjects, and bilaterally measured surface EMG activity of upper trapezius muscles and lower arm muscles during performing e-mail work on their smartphones. They reported significantly high EMG activity recorded from upper trapezius and arm muscles during smart phones use ($p < 0.05$) that eventually affected shoulder muscle performance.

The findings of the current study came in line with the previous study of **Kang et al., 2018,[26]** who investigated the effect of scapular stabilization exercises as postural correction exercises on shoulder muscles performance and claimed these exercises to be an effective tool improving shoulder muscle performance during activities of daily livings. Such improvement was referred to regaining normal posture and decreasing abnormal scapular posture in patients with forward head posture which was evident as pain intensity reduced and muscle performance improved.

Our finding agrees with the study of **Kim et al., 2015**,[31] who conducted an eight weeks postural correction exercises and found improvement in balance, and muscles relaxation, which consequently relieved musculoskeletal pain and improved muscle performance. Therefore, it is highly valuable to develop and implement suitable exercise programs to induce and augment improvement in physical and mental health of subjects and society.

An eight weeks McKenzie, Kendell and self-stretch exercises program was conducted to investigate their independent effect on forward head posture expressed in terms of craniovertebral angle (CVA) and scapular posture, has revealed a significant improvement in forward head posture in the McKenzie group, which conclude being effective in improving postural deviations in smartphone users, through regaining good posture of the subject and improving muscle performance **(Do et al., 2017). [32]**The results of the current study concur with this study, but with consideration of the exercises program period, which was longer in the Do's study.

A study applied isometric exercises to investigate their effect on back pain and muscle performance, came to the conclusion that isometric exercises significantly decreased back pain after the exercise program which was expressed in terms of improved walking ability and ability to sit on a hard chair, and handicap reduction. Gymnastic and stretching exercises performed in standing, were as well found to correct posture, reduced pain, and improved muscular performance and quality of life **(Tse et al., 2005). [33]**The results of this study correlate postural correction to muscle performance, and emphasize the impact of regaining normal posture on muscle performance.

Hassan et al., 2022,[34] conducted a study on seventeen subjects using their smartphones for an average of 3 hours per day and have postural abnormalities including forward head posture and rounded shoulders. They reported a positive outcome of postural correction exercises including stretching and strengthening exercises in the management of forward head posture and rounded shoulders in asymptomatic subjects that shows effective on subjects' performance. However, strengthening exercise showed better improvement on CVA and shoulder angle comparatively.

In addition to the previously mentioned studies concerning postural correction exercises, **Fathollahnejad et al., 2019 [35]**added manual therapy to stabilization exercise program in subjects with forward head posture, and have reported both to be effective in improving pain and function, but the addition of manual therapy to stabilization exercises, showed a more favourable outcomes compared to stabilization exercise alone. Pectoralis major muscle stretching and scapular stabilizers strength exercise as performed in their study concur with the results of the current study and are important in improving rounded shoulder posture, decrease pain and improve functional ability of the subjects.

Conclusion

Postural correction exercises have a significant effect in improving shoulder muscle performance in subjects addicting smartphones.

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