Effect Of Smartphone Usage On Upper-Back Posture And Quality Of Life In Preparatory School Students

Jack K. Sadik¹, Walaa A. Abd El-Nabie², Khaled A. Mamdouh², Hoda A. El-Talawy²

¹ Specialist physical therapist at National Institute of Neuromotor System.
² Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Cairo University, Egypt.

Corresponding author: Jakkamil83@hotmail.com

ABSTRACT
Background: In the last few years, smartphone user’s numbers have progressively increased worldwide, with the increasing use of smartphone; researchers have also enhanced to investigate the musculoskeletal problems associated with the prolonged use of smartphone. Purpose: To study the effect of smartphone usage on the upper-back posture and quality of life in preparatory school male students. Methods: Ninety male students aged from 13 to 15 years, with body mass index ranged from 15.4 to 20.9 Kg/m², according to WHO indices were selected from governmental preparatory schools at Al-Waily educational administration, Cairo Governorate. Students were classified into two equal groups (45 students for each group); A and B. Student in group A had scores from 30 to 45 on smartphone addiction scale, while student in group B had scores from 46 to 60. The Postural assessment software (PAS/SAPO) was used to assess upper back posture, e.g. scapular abduction, kyphosis, lateral neck tilting ……etc (distance between C7 and left and right acromion, T7 and left and right scapula, C7 and T7 and angel between the base of the skull, the C7 vertebrae and the right and left acromion). In addition, quality of life was assessed by pediatric quality of life inventory version 4.0 (PedsQL, version 4.0). Results: There were significant differences of all measured variables of upper back posture between both groups, except the distance between C7 and T7, which was non-significant. Regarding Quality of Life, there was significant difference (p = 0.00001) between both groups, with group B more affected than group A. Conclusion: Extensive usages of smartphone negatively affect upper back posture in preparatory school students, which was concomitant with their quality of life. Keywords: Quality of life, Smartphone, Upper back posture.

I- INTRODUCTION
The popularity of the smartphone has increased rapidly in the last ten years. It is estimated that by 2020, there will be an additional 3.5 billion of new smartphone subscriptions, resulting in a total of 6.1 billion worldwide. This represents almost 70% of the global population. However, as adult users become increasingly addicted to their smartphones, their children are likely to imitate them [1]. When using a smartphone, individuals with minor neck pain tend to bend their neck slightly more than individuals without neck pain. These problems with the musculoskeletal system result from the use of a smartphone [2]. Smartphone usage can constitute a concrete threat and risk for adolescents, who are in the prime of their lives in terms of physical, psychological, social and intellectual development [3].

Proper postural alignment results in an ability to balance the head through compensation of one vertebra by other vertebrae. Additionally, the connective cartilage of the vertebral joints, in the vertebral column, provides vigor and protection against weight-bearing activities [4]. Proper posture is achieved by maintaining the musculoskeletal balance associated with minimal stress on the body and is considered an important factor in assessment of health condition. Among many factors, including vision, vestibular function, the somatosensory system and the musculoskeletal system, proprioception is considered an essential factor for the maintenance of balance. However, several factors, including neck pain and/or shoulder pain, can disrupt this balance, leading to development of a postural problem[5]. Smartphone use for prolonged periods may increase the use of the upper fibers of trapezius and erecter spine muscles, resulting in...
As musculoskeletal complaints, postural deviations, severe pain even during slight neck movements and headaches are common in all age groups; the recent rise of these complaints in younger populations deserves attention and further investigation [7]. Excessive smartphone dependence has raised many concerns, especially with the claim that it causes personal and social problems; there is a considerable debate over smartphone consequent adverse impact on health[8]. Quality of life (QOL) is a construct for quantifying well-being and evaluating the effectiveness of interventions for children and adolescents [9]. Smartphone overuse has negatively effect on the physical, mental, and social aspects of student’s quality of life[10]. Smartphone usage for a long time will lead to greater effect on posture and quality of life. However, to our knowledge, limited research has studied the effect of smartphone usage on upper back posture and quality of life. Therefore, this study was conducted for investigating the effect of smartphone usage on upper back posture and quality of life among preparatory school students.

II. SUBJECT, INSTRUMENTATION AND PROCEDURES

Subjects
Ninetynine male students, with age ranged from 13-15 years with body mass index ranged from 15.4 to 20.9 Kg/m² according to WHO indices, were recruited from the governmental preparatory schools of Al-Waily educational administration, Cairo Governorate. They were classified into two equal groups; A and B according to smartphone addiction scale. Student in group A had scores from 30 to 45, while student in group B had scores from 46 to 60. Students were excluded if they had visual or hearing defects, neurological disorders, musculoskeletal problems or any congenital abnormalities that might affect the study.

![A flow chart of students]

Study design and ethical considerations
The current study was a Cross-sectional study, conducted from December 2020 to July 2021. The study was approved by the Ethical Research Committee of the Faculty of Physical Therapy, Cairo University, Egypt (No:P.T.REC/012/003058). A signed written consent form was obtained from children’s parents/legal guardian before starting the study.

[www.turkjphysiotherrehabil.org](http://www.turkjphysiotherrehabil.org)
Sample size:
Sample size calculation was selected on the basis of a pilot study on 20 participants. A sample size of 75 would achieve 80% power and Correlation Coefficient ($r = 0.40$ and Coefficient of Determination ($r^2$): 0.16 with a significance level ($\alpha$) of 0.05 using a two-tail exact correlation bivariate normal model. Assuming a 20% loss to follow-up, at least 45 patients were needed for each group. Sample size calculation was done using G Power and Sample Size Calculations software, version 3.0.11 for MS Windows (William D. Dupont and Walton D., Vanderbilt University, Nashville, Tennessee, USA).

Instrumentations:

A-Smartphone addiction scale
The degree of addiction to smart phone was evaluated through smartphones addiction scale short version, which was valid, self-applied scale, consisting of 10 items. Each item was scored on a 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). [11] High scores reflected high degrees of addiction to smart phones. Participants should have a score of $\geq 30$ on the smart phones addiction scale short version to be included in the present study.

B-Postural assessment software (PAS/SAPO).
Postural analysis was done by using postural assessment software (PAS/SAPO). It is accurate for measuring angles and distances, has good inter- and intra-rater reliabilities, and should be considered a useful and reliable tool for measuring posture. Data processing consists of image calibration, proper identification of the anatomical landmarks, and computation of the comparing body's angles and distances, Postural assessment software (PAS/SAPO) has been developed to assist posture assessment from digitalized pictures [12]. This software is available free online[13]. The (PAS/SAPO) software is satisfactorily reliable, when evaluated by different examiners using the same photographic recording [14].

C-Pediatric quality of life inventory version 4.0 (PedsQL, version 4.0)
The pediatric quality of life inventory version 4.0 (PedsQL, version 4.0) Contains 23 items that can be grouped into 4 domains: 1) physical functioning (8 items); 2) emotional functioning (5 items); 3) social functioning (5 items) and 4) school functioning (5 items). This scale is feasible for child self-report, including ages 5 to 7, 8 to 12 and 13 to 18 years[15]. The PedsQL 4.0 has been proposed as a valid and reliable measurement instrument that can be used for self-reports and proxy-reports in age groups ranging from 2 to 18 years and can also be used in clinical trials, research and clinical practice, in school health settings and community populations[16]. PedsQL will be evaluated based on a 5-point Likert scale.

PROCEDURES:

A- Evaluation of upper back posture
The Postural assessment software (PAS/SAPO) was used to assess upper posture from digitalized pictures from posterior view. A digital camera (Nikon D5200, 24.1megapixel, digital SLR camera, with 1855mm zoom lens, Nikon Corp., Japan) supported on a tripod, was used for capturing postural images for each participant in the two groups. Small adhesive dots were used to mark anatomical points on each student. To take picture of the student, the camera was positioned at least 3 meters away from the participant and at a height of about half of the student’s stature; Then the photos were transferred to the computer to be evaluated by SAPO software[13], of the anatomical points on the photos to measure the following:
- The distance between C7 and the left and right acromion was measured to determine shoulder protraction.
- The distance between T7 and the inferior angel of left and right scapula was measured to determine scapular abduction.
- The distance between C7 and T7 was measured to determine if the participants thoracic curvature increased (i.e.
became more kyphotic).
- The angle between the base of the skull, the C7 vertebrae and the left and right acromion to determine right lateral neck flexion.

**B- Evaluation of quality of life**
The student rated each item on a 5-point Liker scale. The scoring of the scale is generally completed in three stages. A psychosocial health total score is measured out of the item scores, which firstly measure life quality, secondly physical health total score, and thirdly emotional and social school functionality scores. The items are scored on a scale of 0–100, where “never” is 100, “seldom” is 75, “sometimes” is 50, “often” is 25, and “almost always” is 0. Higher scores indicate better quality of life. In order to evaluate the quality of life and how smartphone usage affects it each student would be asked to answer the following questions as a list of things that might have been a problem for him. Then he would be asked to circle the problems that had been noticed during last month:
0 If it is never a problem
1 If it is almost never a problem
2 If it is sometimes a problem
3 If it is often a problem
4 If it is almost always a problem [17]

Five scores were produced that measure pediatric quality of life inventory in four domains: health and activity, feelings, how I get along with others, and school.

**DATAANALYSIS**
Statistical analysis was conducted using SPSS for windows, version 26 (SPSS, Inc., Chicago, IL). Prior to final analysis, data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculations of the analysis of difference. Preliminary assumption checking revealed that data was normally distributed for all measured variables, as assessed by Shapiro-Wilk test (p > 0.05). There was homogeneity of variances (p > 0.05) and covariances (p > 0.05), as assessed by Levene's test of homogeneity of variances. Accordingly, parametric statistics were used. The independent sample t-test was used to compare whether there is a difference in the dependent variable for the two independent groups. Unpaired t-test was used to compare whether there is a difference in the demographic characteristics for the two groups. The alpha level was set at 0.05.

**II- RESULTS**

**Demographic and clinical characteristics of students:**
The general characteristics of students in both groups revealed that there were no significant differences in age, height, weight and BMI (p>0.05) as shown in Table (1).

**Mean ± SD of the upper back posture in both groups:**
There were highly significance differences of; left and right shoulder protraction (ρ = 0.00001), right lateral neck flexion angle(ρ = 0.013), left lateral neck flexion angle (ρ = 0.028), right scapular abduction (ρ = 0.002) and left scapular abduction (p=0.0001) between both groups. While there was no significant difference of thoracic curvature (ρ = 0.204) between both groups as shown in Table (2).

**Mean ± SD values of pediatric quality of life inventory in both group:**
There was a highly significant difference (ρ = 0.00001) in the four domains: health and activity, feelings, how I get alone with others, and school in both groups as shown in Table (2).

When comparing four domains of QOL between both groups it was found that smartphone usage affect group B more than group A (p=0.00001).

**Table1.** General characteristics of students in both groups
### Table 2. Comparison between all measured variables in both groups A and B.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A</th>
<th>Group B</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PedsQL (Health and activity score)</strong></td>
<td>75.76 ± 18.39</td>
<td>62.36 ± 10.44</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>PedsQL (Feelingsscore)</strong></td>
<td>56.66 ± 22.73</td>
<td>37.55 ± 15.54</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>PedsQL (How I get alone with others Social score)</strong></td>
<td>66.55 ± 21.04</td>
<td>49.55 ± 12.28</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>PedsQL (School functioning score)</strong></td>
<td>63.0 ± 21.85</td>
<td>38.77 ± 13.06</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>Left shoulder protraction distance (mm)</strong></td>
<td>749.5 ± 69.33</td>
<td>668.7 ± 78.17</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>Right shoulder protraction distance (mm)</strong></td>
<td>710.86 ± 52.01</td>
<td>665.28 ± 73.13</td>
<td>0.00001*</td>
</tr>
<tr>
<td><strong>Thoracic curvature distance (mm)</strong></td>
<td>734.2 ± 177.27</td>
<td>747.42 ± 114.31</td>
<td>0.204</td>
</tr>
<tr>
<td><strong>Right lateral neck flexion angle (degrees)</strong></td>
<td>102.56 ± 5.95</td>
<td>105.44 ± 4.82</td>
<td>0.013*</td>
</tr>
<tr>
<td><strong>Left lateral neck flexion angle (degrees)</strong></td>
<td>101.49 ± 4.44</td>
<td>103.66 ± 4.74</td>
<td>0.028*</td>
</tr>
<tr>
<td><strong>Left scapular abduction distance (mm)</strong></td>
<td>405.26 ± 44.51</td>
<td>364.88 ± 49.49</td>
<td>0.0001*</td>
</tr>
<tr>
<td><strong>Right scapular abduction distance (mm)</strong></td>
<td>418.22 ± 62.67</td>
<td>373.74 ± 56.75</td>
<td>0.002*</td>
</tr>
</tbody>
</table>

- Mean; SD: Standard deviation
- P-value: probability value
- *Significant at P<0.05

**IV- DISCUSSION**

The results of this study revealed that heavily use of the smartphone negatively affects upper back posture and quality of life in preparatory school male students.

Regarding, the association between the times spend using smartphone and neck pain reported that the distribution of musculoskeletal symptoms or pain of any severity was most common in the neck, followed by the upper back and then the shoulders. This agrees with these results reported by Berolo et al., [18] that the total time spent using a smartphone was significantly associated with any pain in the neck and shoulder. Most smartphone tasks require users to stare sharply downwards or to hold their arms out in front of them to read the screen, which makes the head moves forward and causes an excessive anterior curve in the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae to maintain balance and places stresses on the cervical spine and neck muscles.

Muscle fatigue and weakness in the cervical erector spinae and the upper trapezius which lead to lateral neck flexion which agree with So and Woo [19], who assessed the effect of short term usage smartphone for 20 min and effect of smart usage upon neck pain. They found when smartphone users have pre-existing neck muscle pain; the use of a
smartphone further increased muscle fatigue and tenderness in the neck and reduced pressure pain threshold and the cervical range of motion.

The results of the current study regarding effect of smartphone usage on upper back (regarding left and right scapular abduction) posture is supported by the finding of Cochrane et al.[20] who studied the short-term effect of smartphone usage on the upper-back postures of university students and the results of the study indicate that the distance between the 7th thoracic vertebrae and the inferior border of the scapula increased significantly on the left and the right sides, which corroborates the measurement from the C7 to the acromion process.

The current result concerning shoulder protraction is supported by the finding of Gold et al.[21] found that the prolonged experience of discomfort may lead to musculoskeletal dysfunction and disorders which increased shoulder protraction results in dysfunction of the scapula during upper limb movement which agree with this study that found highly significant difference.

Additionally, the current study regarding effect of smartphone usage and upper back posture supported by the finding of a study conducted by Jung et al., [22] that there were a strong relationship between the postural deviation developed from posterior view and smartphone usage this comes in agreement with the study conducted by who concluded that using a smartphone for a long time could negatively affect posture.

Excessive use of smartphone may lead to inadequate muscle contractions, weakness of postural muscles and fatigue which intern explain the current result of the effect of smartphone on upper back posture. This is supported by the work of Chany et al., [23], who studied the effect of smartphone usage on upper extremity discomfort and muscle fatigue. They found that maintaining an unideal posture may result in the development of postural syndromes such as excessive thoracic kyphosis and a poking chin, which in turn will result in inadequate muscle contractions, weakening of postural muscles and fatigue.

The results of the current study regarding effect of smartphone usage on QOL is supported by the finding of a study conducted by Hatice [24], who suggested that the dimensions of physical and psychological health, as well as overall QOL, are negatively correlated with smartphone addiction in Turkish high school students. Therefore, school counselors should help their students to improve QOL in order to effectively prevent smartphone addiction risk among high school students.

The results of the current study regarding effect of smartphone usage on QOL is supported by the finding of Mascia et al. [25], who studied the role of smartphone use and QOL among Italian students attending middle school. The results confirmed that self-regulation affects of QOL of students but its role varies according to the degree of smartphone addiction, which agrees with our study’s findings of negative relationship between smartphone addiction and feelings.

Excessive use of smartphone may lead to unpleasant relationship between students and teachers which agree with Spencer[26] who found a high tendency for smartphone addiction when students experience unpleasant relationships with teachers and peers and stresses related to school and classes, peer relationships, and school environment that are not properly managed.

The current study was limited to boys with age group from 13 to 15 years old and some students refusing to participate in the study as they didn't like to photograph without clothes. Recommendations for future research are conducting the same study on a large sample size, make assessment and treatment, measure pre and post treatment and compare between the results.

V- CONCLUSION

Heavy usage of the smartphone negatively affects upper back posture and quality of life in preparatory school students.

REFERENCES


www.turkjphysiotherrehabil.org