

Head Posture and Functional Ability of Upper Extremity in Adolescents Use Smartphone

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Abstract

Objective: This study aimed to determine the impact of smartphone use in head posture and functional ability of upper extremity in adolescents and the correlation between them.

Design: Cross sectional design.

Method: Forty adolescents divided into two groups (group I and group II) based on the smartphone time use per day. They were assessed for neck pain by Visual analogue scale (VAS), the disability of the upper extremity by Upper Extremity Functional Index (UEFI) and the head posture angles by AutoCAD photographic analysis.

Results: The results of this study represented significant differences in all measurable variables in the group (II) as compared to the group (I). Also, the results of this study represent there were significant strong relationships between the measurable variables.

Conclusion: We could conclude that the prolonged duration of smartphone use had significant effects on the head posture and functional ability of adolescents.

Keywords: *Smartphone, head posture, pain, functional ability, adolescence.*

Introduction

The smartphone is one of the most information and communication technology used recently. It provides an attractive tool for internet connection, calling, games, photos, social media and music purposes⁽¹⁾. For these advantages, young people are highly ownerships for the smartphone as they represented 76% in adolescents and young adults⁽²⁾. Smartphone users assume the flexed neck position for long duration resulting in the development of physical problems e.g. forward head position, muscle

spasm and pain^(1,3,4). Researches demonstrated several studies related to the smartphone usage that investigated the range of motion and pain for the cervical spine. Also, the hand grip and conduction velocity for nerves were investigated⁽¹⁻⁴⁾.

So, this study aimed to determine the impact of smartphone use in head posture and functional ability of upper extremity in adolescents. Also, it aimed to determine the correlation between head posture, functional ability of upper extremity and the duration of smartphone use/day in adolescents.

Subject and Method:

Subjects: Forty adolescents participated in this study from both sexes (12 males and 28 females) with age ranged from 14 to 18 years. Their body mass index ranged from 18.5 to 24.9 kg/m². They were divided into two groups (group I and group II) based on the smartphone

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time use per day⁽¹²⁾. This study was conducted in the period from October 2018 to January 2019. They were recruited from several secondary schools at Cairo, Egypt, according to the following criteria:

- Group I: Twenty adolescents from both sexes (5 males and 15 females) used the smartphone for time less than 4 hours per day.
- Group II: Twenty adolescents from both sexes (7 males and 13 females) used the smartphone for time more than 4 hours per day.
- Subjects in both groups of late childhood (adolescence).
- Subjects in both groups did not have injuries in neck, back, upper or lower limb.
- Subjects in both groups did not have a history of inflammatory joint disease, surgical intervention for neck, back, upper or lower limb.
- Subjects in both groups did not have a history of neuropediatric or developmental disorders.
- Subjects in both groups were not athletes.

Adolescent's parents had signed a consent form about the purpose of the study, its benefits and inherent risks, their committee with regard to time and money and Agreement to participate.

Instrumentations:

Tape measurement: It was used to determine the height of the subject in centimeters (cm).

Weight Scale: It was used to determine the weight for every subject in kilograms (kg).

Visual analogue scale (VAS): It was used to measure the intensity of neck pain after the use of smartphone⁽⁵⁾.

Photos recording:

Digital Camera: Samsung PL20 camera (14.2 megapixels. 5X optical zoom lens, 1280 × 720 p resolution@24 fps, 27mm wide angle and digital image stabilization) was used to take photographs for the subjects. It was placed on tripods 134.5 cm high and at a distance of 2 meters lateral to the subject.

Sheer Spots: Sheer spots with extended sticks were used to define the anatomical land marks the tragus of the ear, the spinous process of C7 vertebra, the canthus

of the eye, the sternal notch of the manubrium and the center point of the chin and acromion.

Photographic Analysis: Auto CAD program (version 2013) used to determine the craniovertebral angle (CVA), head tilt angle (HTA: gaze angle), shoulder angle (FSA: forward shoulder angle) and head position angle (HPA),⁽⁶⁾. These angles were defined as:

- Craniovertebral angle (CVA): It is the angle between the true horizontal through the spinous process of C7, with a line connecting spinous process of C7 with the tragus.
- Head tilt angle (HTA): It is the angle between the line connecting the tragus of the ear to the canthus of the eye and the horizontal line passing through the tragus.
- Forward shoulder angle (FSA): It is the angle formed at the intersection of the line between the midpoint of the humerus and spinous process of C7 and the horizontal line through the midpoint of the humerus.
- Head position angle (HPA): It is the between the tragus manubrium line and the line extending from the center point of chin to the tragus.

The Upper Extremity Functional Index (UEFI): It was used to determine the disability of the upper extremity⁽⁷⁾.

Procedures:

After parental permission, the subject conducted the following procedures:

- The tape measurement was installed on the wall by using pins. The stature was determined as the vertical distance between the floor and the top of the head and measured with the subject standing erect against the wall and looking straight ahead,⁽⁸⁾.
- The BMI was calculated as the ratio of the subject's height (in meter) and weight (in kilogram) i.e. weight/height²⁽⁹⁾. The subject was asked to mark on the visual analogue scale (VAS) and determine the degree of pain he/she felt. Then he/she was conducted to the Upper Extremity Functional Index (UEFI) questionnaire lists of 20 activities and the subject given a score to each based on the difficulty they have completing that activity⁽⁷⁾.
- Photographs were shot from the sagittal view and

while the subject was asked to assume the standing position in their relaxed normal posture at a mark on the floor, with the standardized instruction: “feet slightly apart, stand normally and relax, look straight ahead”. Two dimensional coordinates of each marker were used by Auto CAD to determine the spinal posture assessment including the distances and angles.⁽¹⁰⁾

Statistical Analysis: Unpaired t-test was calculated for variables measured during this study. We used level of significance 0.05. Pearson- a parametric test used to test the correlation between head posture and

functional ability of upper extremity in adolescents use the smartphone and their significance levels.

Results

Descriptive data of both groups: The mean values ± standard deviations of the age, height, weight, body mass index (BMI) and onset of smartphone use indicated no significant difference between both groups as P > 0.05, table (1). The distribution of males and females in the group (I) was 25% and 75%; respectively. Also, the distribution of males and females in the group (II) was 35% and 65%; respectively.

Table 1: The general characteristics of the subjects

Items	Group	N	Mean ± SD	t	Sig
Age	I	20	16.35 ± 0.988	0.295	0.772 (NS)
	II	20	16.25 ± 1.020		
Height (HT)	I	20	159.80 ± 3.381	1.131	0.272 (NS)
	II	20	160.65 ± 3.815		
Weight (WT)	I	20	54.67 ± 2.029	0.253	0.803 (NS)
	II	20	54.80 ± 2.122		
Body mass index (BMI)	I	20	21.25 ± 0.967	1.710	0.104 (NS)
	II	20	20.85 ± 1.226		
Onset of smartphone use (Years)	I	20	3.53 ± 0.224	0.643	0.528 (NS)
	II	20	3.33 ± 0.155		

SD: Standard deviation. NS: Non-significant.

Comparison between the duration of smartphone use/day, Visual analogue scale (VAS) and Upper Extremity Functional Index (UEFI) in both groups.

The mean values ± standard deviation of the duration of smartphone use/day, (VAS) and (UEFI) represented significant differences as P < 0.05, table (2).

Comparison between head posture angles in both groups: The mean values ± standard deviation of the head posture angles represented significant differences as P < 0.05, table (3).

Pearson bivariate correlation between the head posture angles, Visual analogue scale (VAS), Upper Extremity Functional Index (UEFI) and the duration of smartphone use/day: As shown in table (4), there were significant relationships between each of (VAS), (UEFI), Head posture angles and the duration of smartphone use/day which was found to have significant relationships at 5% significance level.

Table 2: Comparison between duration of smartphone use/day, Visual analogue scale (VAS) and Upper Extremity Functional Index (UEFI) in both groups

Items	Group	N	Mean ± SD	t	Sig
Duration of smartphone use/day (hrs.)	I	20	2.50 ± 0.114	12.350	0.000*
	II	20	5.90 ± 0.240		
Visual analogue scale (VAS)	I	20	1.95 ± 0.170	15.147	0.000*
	II	20	5.80 ± 0.172		
Upper Extremity Functional Index (UEFI)	I	20	67.20 ± 0.887	37.75	0.000*
	II	20	21.25 ± 0.502		

SD: Standard deviation. *: Significant.

Table 3: Comparison between head posture angles in both groups.

Items	Group	N	Mean ± SD	t	Sig
Craniovertebral angle (CVA)	I	20	52.40 ± 0.343	16.850	0.000*
	II	20	44.10 ± 0.289		
Head tilt angle (HTA: gaze angle)	I	20	14.70± 0.179	7.123	0.000*
	II	20	17.15 ± 0.327		
Shoulder angle (FSA: forward shoulder angle)	I	20	160.35 ± 0.488	26.45	0.000*
	II	20	145.80 ± 0.485		
Head position angle (HPA)	I	20	27.20 ± 0.258	24.64	0.000*
	II	20	34.10 ± .315		

SD: Standard deviation. *: Significant.

Table 4: Pearson bivariate correlation between the head posture angles, Visual analogue scale, Upper Extremity Functional Index and the duration of smartphone use/day

Item		VAS	UEFI	CVA	HTA	FSA	HPA
Duration of smartphone use/day (hrs.)	Pearson Correlation	0.854**	-0.896**	-0.836 **	0.589**	-0.839 **	0.840**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000

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

Visual analogue scale (VAS), Upper Extremity Functional Index (UEFI), craniovertebral angle (CVA), head tilt angle (HTA: gaze angle), shoulder angle (FSA: forward shoulder angle) and head position angle (HPA).

As shown in table (5), there were significant relationships between each of Head posture angles and (VAS). Also, there were significant relationships between each of Head posture angles and (UEFI) which was found to have significant relationships at 5% significance level. As shown in table (6), there was significant strong negative relationship between the Visual analogue scale and (UEFI) which was found to have significant relationships at 5% significance level.

Discussion

This study was conducted to determine the impact

of smartphone use in head posture and functional ability of upper extremity in adolescents and the correlation between head posture, functional ability of upper extremity and the duration of smartphone use/day in adolescents.

The age of the subjects participated in this study ranged from fourteen to eighteen years old because it was mentioned that smartphone users were 93% in the age ranged from sixteen to twenty four years old as mentioned by Ofcom on its website on 06 August 2015⁽¹¹⁾.

Table (5): Pearson bivariate correlation between the Visual analogue scale, Upper Extremity Functional Index and the head posture angles.

Item		CVA	HTA	FSA	HPA
Visual analogue scale (VAS)	Pearson Correlation	-0.869**	0.632**	-0.879**	0.918**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
Upper Extremity Functional Index (UEFI)	Pearson Correlation	0.919**	-0.723**	0.954**	-0.915**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).					
Visual analogue scale (VAS), Upper Extremity Functional Index (UEFI), craniovertebral angle (CVA), head tilt angle (HTA: gaze angle), shoulder angle (FSA: forward shoulder angle) and head position angle (HPA).					

Table (6): Pearson bivariate correlation between the Visual analogue scale and Upper Extremity Functional Index.

Item		Upper Extremity Functional Index (UEFI)
Visual analogue scale (VAS)	Pearson Correlation	-0.927**
	Sig. (2-tailed)	0.000
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).		

All subjects in both groups were assessed for neck pain by Visual analogue scale which is a valid and reliable method⁽¹²⁾ and for the disability of the upper extremity by a valid and reliable questioner called Upper Extremity Functional Index⁽⁷⁾.

The head posture angles were measured for all subjects by AutoCAD photographic analysis which considered as a valid and reliable method for angles measurements⁽¹³⁾. The results of this study represented significant differences in the duration of smartphone use/day, Visual analogue scale, Upper Extremity Functional Index and the head posture angles in the group (II) as compared to the group (I). It was indicated that the neck pain and the disability of the upper extremity were increased by increasing the time use of smartphone/day.

The craniovertebral angle was decreased by 15.84% and head position angle was increased by 25.37% in group (II) as compared to the group (I) which indicated the subjects assume more forward head position by prolonged use of smartphone/day. Head tilt angle was increased by 16.67% in group (II) as compared to the group (I) which indicated the subjects assume more extension of the head relative to the cervical spine by prolonged use of smartphone/day^(6, 14).

Shoulder angle was decreased by 9.07% in group (II) as compared to the group (I) which indicated the subjects assume more forward shoulder in relation the seventh cervical vertebra by prolonged use of smartphone/day⁽⁶⁾.

Also, the results of this study represent there were significant strong relationships between the head posture angles, Visual analogue scale, Upper Extremity Functional Index and the duration of smartphone use/day. This finding indicates that the neck pain, disability of the upper extremity and forward head position were directly proportional to the time use of smartphone/day.

These findings can be referred to assuming the flexed neck position for long duration with smartphone use and maintain the head in a forward position. So the subjects extend the atlanto-occipital (C1 to C2) joints and flex the lower cervical spines (C4 to C7) while flatten the mid cervical lordosis⁽¹²⁾. Also, the cervical spine load is increase by 6 times as increase the head flexion. These demands may cause damage to the tissues support head and neck including muscles, ligaments and joints⁽¹⁵⁾. The pain in neck and shoulder leads to displacement of the acromion forward more than⁽⁶⁾. It may also refer to the reduction in the conduction velocity of the ulnar nerves after the prolonged use of smartphone⁽¹²⁾.

Conclusion

We could conclude that the prolonged duration of smartphone use had significant effects on the head posture and functional ability of adolescents.

Conflict of Interest: Author (s) have not declared any conflict of Interest.

Ethical Clearance: The ethical clearance was taken from by an Ethics Committee of the Cairo University.

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