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IMPACT OF SMARTPHONE OVERUSE ON ENDURANCE OF CERVICAL MUSCLES

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ABSTRACT
Smartphones have been the most popular electronic devices, especially among the adolescent. Smartphones are used for multi-purposes including communication, music, media, internet access, games, some applications, and professional fields. Using the smartphone frequently forces the users to adopt an awkward posture leading to an increased risk of musculoskeletal disorders and pain. **Purpose** To determine the effect of smartphone use on endurance of cervical flexor muscles**. Methods:** Sixty adolescents of both sexes ranging in age from 14 to 18 years were enrolled in this study. They were assigned randomly into two groups of equal number; group (A) used smartphone less than 4 hours/day and group (B) used smartphone more than 4 hours per/day. Participants of both groups using smartphones for at least 4 years. The pressure biofeedback was used to detect the endurance of deep cervical flexor muscles **Result:** Significant decrease was observed in endurance of deep cervical flexors muscles for both groups (A, B). high significant difference was observed in favor of group B when compared to group A. ($p < .05$). **Conclusion:** the overuse of smartphones has a negative effect on endurance of deep cervical flexor muscles.

Keywords: smart phone, pressure biofeedback, endurance of deep cervical flexor muscles.

1. Introduction

Smartphone access and ownership among children and teenagers have increased significantly in recent years, particularly in the use of several gaming applications **(Gunter, 2019).**

Because of susceptible increase in children and adolescents using smartphones, worries about the negative health outcomes of technology abuse have grown, affecting both mental and physical health **(Domoff et al., 2019).** On the other hand, prolonged and unregulated smartphone usage may be harmful to the psychological state of the wellbeing **(Sohn et al., 2019).**

Heavy smartphone usage by students causes daily life disruptions such as food disruptions, reduced productivity, social connection disruptions, and psychosocial issues accompanied by physical problems such as wrist discomfort, neck stiffness, confused vision, and sleeping pattern disruptions **(Elhai et al, 2019).**

Because of prolonged smartphone usage, muscular activity in the neck muscles, particularly the cervical erector spinae and the upper trapezius is enhanced, by forwarding translation of the head on the shoulders. Such muscles are responsible for controlling external forces and stabilizing the neck and shoulder regions whilst the head is pushed forward **(Namwongsa et al., 2019).**

This study was conducted to determine the effect of smartphone overuse on endurance of deep neck flexor muscles.

2. Material and methods

2.1. Design of the study

Cross-sectional study

2.2 Participants

Adolescents from both sexes with age ranged from 14 to 18 years participated in this study. Their body mass index was within the normal range in relation to their age according to percentile z score, they were Free from any medical disease and used smartphone not less than 4 hours per day. However, participants were excluded if they had any congenital or acquired spinal deformities, injury in the neck or upper extremity and history of joint inflammation, neurological, musculoskeletal or cardiopulmonary disease that limit their movement, cognitive disorders, vision disorders, BMI higher than the 95th percentile and if they were athletics were also excluded.

2.3. Sample-Size Determination

Sample size calculation is performed using G*POWER statistical software (version 3.1.9.2) for a comparative study between the two groups. Based on data on endurance of deep neck flexor muscles derived from a pilot study on 10 adolescents. The calculation revealed that the required sample size for this study was 30 subjects per group. Calculations were made using α=0.05, power 80% and effect size = 0.75 and allocation ratio N2/N1 =1.

2.4. Study protocol

All participants received assessment for endurance of deep neck flexor muscles by an assessor blinded to patients' allocation. Participants and their parents provided demographic and clinical information. All procedures were illustrated to the participants and consent forms were obtained from them and parents.

2.5. Outcome measures

Endurance of deep neck flexors muscle was measured using pressure bio-feedback device (Stabilizer) (Stabilizer TM, Chattanooga Group Inc., USA. Each participant was positioned in supine lying. A neutral posture was maintained for the cervical spine. Preserving a transverse plane between the forehead and the chin, and guaranteeing that the line intersecting the neck vertically that parallel to the therapeutic plinth, was visually verified. Pressure biofeedback unit was inflated to a baseline of 20 mmHg and positioned between the plinth and the posterior part of the neck immediately behind the occiput. The subjects were given enough time to perform Cranio-cervical flexion using the pressure biofeedback equipment (Jull et al., 2004). During the process any substitutional movement was corrected to ensure that all subjects completed the test. Each participant was asked to perform the neck Cranio-cervical flexion motion at five distinct levels of pressure (22, 24, 26, 28, and 30 mmHg) for ten seconds at every level. Each level was separated by a 30-second rest interval. The testing process was terminated when the participant was unable to maintain the specified level of the pressure for 10 seconds. Each subject's highest level was then recorded.

2.6. Statistical analysis

Statistical analysis was performed by utilizing SPSS for windows, type 26 (SPSS, Inc., Chicago, IL). The unpaired t-test was used to determine if the dependent variable differed between the 2 independent groups. The paired sample t-test was utilized to see if there was a variation inside the same group. The demographic features of the 2 groups were compared using an unpaired t-test to see if there was a difference at baseline. The alpha level for this experiment was set to 0.05.

3. Results:

- Demographic and clinical characteristics of adolescents:

The baseline characteristics of adolescents showed that there were no statistically significant differences existed between both groups (P>0.05) as shown in Table 1.

- Baseline comparison between both groups:

Statistically significant differences were noticed regarding the baseline assessment between the two groups in the measured variables (P>0.05), as shown in Table 2.

Table1. General characteristics of adolescents in both groups

	Group A (n=30) x̄ ± SD	Group B (n=30) x̄ ± SD	MD	P- value	SIg
Age (Years)	14.56 ± 1.54	15.13 ± 1.79	-0.56	0.195NS	NS
Height (cm)	157.76 ± 5.13	159.33 ± 5.62	-1.56	0.264NS	
Weight (kg)	53.56 ± 4.36	53.33 ± 3.74	0.23	0.825NS	
BMI (kg/m2)	23.08 ± 4.32	22.69 ± 4.94	0.38	0.747NS	
Gender					
Boys	24 (80%)	21 (70%)	X 2= 0.80	0.522NS	
Girls	6 (20%)	9 (30%)			

P-value: probability value; *Significant at P<0.05, MD, mean difference, NS: non-significant, X 2: Chi-squared test

Table 2. Comparison between both groups in all measured variables.

Variable	Group A x̄ ± SD	Group B x̄ ± SD	MD	P- value
Craniovertebral angle (CVA) (degrees)	33.06 ± 4.36	39.01 ± 8.19	-5.94	0.001*
Deep neck flexor muscles endurance (mmHg)	26.80 ± 1.54	24.46 ± 1.70	2.33	0.00001*
Quick-DASH questionnaire (scores)	4.46 ± 1.52	18.85 ± 4.96	-14.38	0.00001*

x̄: Mean; SD: Standard deviation, MD: mean difference, P-value: probability value; *Significant at P<0.05

4. Discussion

This study was conducted to determine the effect of smartphone overuse on the endurance of deep neck flexors muscles in adolescents The mean values of age for adolescents participated at this study were 14.56 ±1.54 and 15.13 ± 1.79 for group (A) and group (B) respectively. Choosing the age to be ranged from 14 to 18 years was because adolescents within this age group of 14 to 18 years use smartphones extensively for communication and studying purposes. This come in accordance with **Hanphitakphong et al., (2021)** who revealed that there is an increase in the usage of smartphone in adolescents at this age.

The results of this study demonstrated a significant difference when comparing the mean values of endurance of deep neck flexor muscles for both groups, The mean values for group (A) and group (B) were (26,80±1.54) and (24.46±1.70) respectively which may be due to using a smartphone for a prolonged time The effect of using a smartphone for a prolonged time which lead to serious musculoskeletal problems in the cervical region from positioning the head in flexed position.

This is supported by the results of a study done by **Park et al., (2015)** who demonstrated that about 55% of normal subject had an average range of endurance for their cervical neck flexors about 26 mmHg and normal range between 26 to 30 mmHg while seen group B in our study was 24 mmHg this proved the negative effect of smartphone on endurance level of cervical neck muscles.

Also, **Kenneth and Hansraj (2011)** reported that the use of smartphone is closely related to increased fatigue of the neck and the arm muscles, causing musculoskeletal problems.

The results of this study come in agreement with **Namwongsa et al., (2018)** who stated that the most common and frequent posture chosen by smartphone users is flexion of the neck; people tend to adopt this posture whenever viewing their phones for long periods.They added that excessive usage of mobile phones with flexed neck postures may induce discomfort and pain in the cervical region.

This agrees with **Grujicic et al., (2010)** who reported that the significant musculoskeletal defect and increased musculoskeletal activity for longer time could cause fatigue when flexing the head forward at varying degrees. The forces experienced by the cervical spine considerably increase and leading to cervical curve loss, which may cause neck pain and fatigue in cervical muscles.

The results of the study confirm the finding of **Park et al., (2015)** who suggests that poor cervical postures keep the deep cervical short flexors in a biomechanically disadvantageous position, which lead to lesser endurance in them.

Furthermore, smaller smartphone screen sizes may have an indirect influence on the use of various neck postures to improve the viewing of the screen. Smaller displays may cause greater forward neck bending, to shorten the distance between the screen and the user's eyes **(Ning et al., 2015).**

Alshahrani et al., (2021) explored an increase in EMG activity of neck muscles and attributed this to be due to compensatory forward neck flexion affecting the endurance of the deep neck flexor muscles in adolescent over using mobile phones.

Our finding come in consistency with a finding of a study done by **Xie et al., (2016)** who found a link between muscle activation in the erector spinae and the grade in which a smartphone screen was positioned under eye level. Also, **VanGelder et al., (2013)** stated that the persistent flexed posture and contraction of the cervical muscles results in shearing and compressive loading on the cervical spine discs and muscles.

Mobile phone usage can result in recurrent repeated stress to the musculoskeletal components, resulting in pain. The modification of the length-tension relation in the neck muscles causes this recurrent microtrauma which cause weakness and fatigue in cervical muscles (**Mork and Westgaard ,2006).** As a result of this pain changes in muscle fiber types lower the endurance of cervical muscles, particularly the deep neck flexors **(Leary et al., 2007).**

Conclusion:

The overuse of smart phone has a negative effect on endurance of deep neck cervical flexor muscles.

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Conflict of Interest:

The Authors declare that there is no conflict of interest.

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