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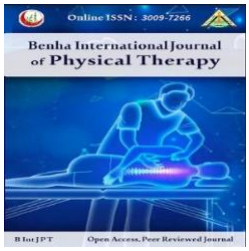

Original research

Cervical Posture Among Smart Phone Addictive with Cervicogenic Headache: Matched Case Control Study

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Abstract

Background: Musculoskeletal impairments that are associated with posture attitude and duration of smartphone usage are an important growing public health conditions especially among university students. The relation between addictive smartphone and headache episodes is established, however, there is a debate in literature about cervical alignment among addictive smartphone users with cervicogenic headache (CGH). **Objective**:Investigate the craniovertebral angle (CVA) between addictive smartphones with CGH and non-addictive ones without CGH and evaluate the correlation between CVA and clinical headache characteristics. **Methods:** In this matched case control, forty physical therapy university students were assigned into two groups: addictive smartphone with CGH and non-addictive smartphone without CGH. A smartphone addictive scale was used to differentiate between both groups; CGH was diagnosed based on International Headache Society criteria with VAS to assess headache intensity, and CVA, which determines cervical posture, was measured through AI Posture Evaluation and Correction System applications. **Results:** The unpaired t-test shows a significant difference in CVA ($p<0.012$) with a large effect size (0.83) between addictive smartphone users with CGH when compared to their matched control. Spearman's correlation coefficient reveals no significant correlations between CVA ($p > 0.767$) and any headache characteristics (intensity, duration, and frequency). **Conclusion:** However, there is no significant correlation between CVA and any clinical headache characteristics. CVA shows a statistically significant potential clinically meaningful decrease in addictive smartphone use with CGH when compared to their matched control. The clinicians should examine cervical posture and time spent on smartphones as important factors in the management of CGH.

Keywords: Craniovertebral angle, Forward head posture, Cervicogenic headache, Smartphone addiction

Introduction

Musculoskeletal impairments that are associated with posture attitude and duration of smartphone usage are important growing public health conditions. "Smartphone addiction" is considered a kind of technological addiction. The users continuously use smartphones even when there isn't an urgent need to use it[1]. In Egypt, accelerated addicting smartphone prevalence mainly universities` society ranging from 44.7% in 2020 to 59% in 2022 with addiction represents about 62.4% among physical therapy students[2].Using a smartphone for extended periods or positions attempted puts an excessive amount of

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static load with a flexed-necked posture that maximized both trapezius 'upper portion', and splenius capitis` activity, which can cause cervicalgia that irradiates to shoulders[3].The common painful complaints due to smartphones were related to neck pain, with a range of 17.3-67.8% prevalence [4].

Forward head posture (FHP) refers to "anterior vertical head postured in relation to its gravity center[5]. It is common postural pattern among university, the prevalence was about 63.96%, especially medial sectors as prevalence of FHP around 70% in physiotherapy students had FHP because of mode life style in doing most of work duties on their phones, laptops, and books[6], in addition to obtaining poor posture duo to overtime dentist work.

FHP results in raised flexion torque of cervical vertebrae, creating considerable tension on the extensors and reducing sensation of proprioception in the cervical spine [7]. Thus, increasing the compression on the cervical spine that affects the vertebral joints, ligaments, muscles and disrupting the structure and function of connective tissue through altering its length and tension relationship[8]. Moreover, FHP reduce the middle trapezius, splenii, and sternocleidomastoid muscle's EMG activity. This decreased activity was due to altered muscular length that resulted in diminished their force production capacity which decrease productivity and workability and increase disability[9].

Asymmetrical postural impairments caused by smart phone addiction are associated with extension of the upper cervical (sub-occipital) that cause dysfunction in atlantooccipital joints and articular processes of cervical results in cervicalgia and headache [10]. Current smart devices excessively affect more than 56% of students with cervicogenic headaches (CGH)[11]. A previous study investigated relationship between smartphone addiction and cervicogenic headache, they reported headache complaints those directly correlated with actual smartphone usage. Also, an obvious positive association regarding smartphone addiction scale (SAS) and cervicogenic headache[12].

International Headache Society defines CGH as a secondary form brought through cervical abnormalities or related soft tissues[13].Thus, cervical spine malalignment and cervical muscle imbalance seem to be associated factors for CGH[14]. However, some debate presented in these facts as previous studies showed the general lordosis, C2 deviations and CVA in CGH were not different from asymptomatic CGH[15 16]. On the other hand, there is a greater association of CGH with general cervical lordosis (odd's ratio=1.08)[16].

The recent positive evidence correlates CGH attacks with smartphone addiction[12]belongs to the prolong flexed static upper body posture that resembles FHP postural deviations, and substantial cervical correlated to extended usage of smartphone[17]. Up to the researcher's acquaintance, null published research addressing a relation between FHP among both conditions' addictive smartphone usage with CGH. In addition, the literature that addressed cervical and/or upper body posture in internet addiction and handheld smart device users evaluated using subjective methods [18]. Meanwhile, the evidence regarding FHP as a risk factor for CGH is debatable.

Therefore, the current study has two objectives; the primary objective was to evaluate forward head posture in cervicogenic headache between addictive and non-addictive smartphone usage among university physical therapy students. The secondary objective was to estimate CVA linkage with clinical headache characteristics. The current study findings may provide clinicians with evidence supporting the actual value for neck malalignment management among CGH individuals.

Methods

Trial design

This trial` matched group case control to define actual angular differs in craniovertebral regarding addictive with CGH and non-addictive smartphone usage without CGH. In addition to investigate the correlation between CGH characteristics and craniovertebral angle of addictive smartphone with CGH group. Approval of Physical Therapy Faculty at University of Cairo ethical committee (P.T. Rec/012/005103). This clinical trial has followed the Observational trials report Strengthen statement (STROBE).

Participants

A sample size estimated via G*POWER software (ver.3.1.9.2; Franz Faul, Universität Kiel, German) following prior trials` findings[19], of which CVA was set as the primary outcome, effect

size (1.66) that indicates the size of the difference of CVA between addictive and non-addictive, at level of significance 0.05, expected 80% power. The required population size for the current study was eighteen. Forty students were recruited to represent each group adequately and control statistical variance between groups.

Recruitment and eligibility criteria

A convenient sample was enlisted at Physical Therapy Faculty at Merit University, Egypt. The students were divided into, Study partition (n=20) was addictive smartphone usage with CGH while the control one (n=20) was non-addictive smartphone without CGH matched in age and gender with a study group. The inclusion criteria were university students, aged 18- 24 years old, body mass index range18-25kg/m^2, with experience of using a smartphone minimum of one year[20]. Participants were ruled out in case of neck trauma, cervical radiculopathy, inborn alterations, history of spine injury, serious neurological diseases of upper limb injuries, and musculoskeletal surgeries[18].

Procedure

After screening for inclusion criteria and exclusion criteria, the purposes of the research were demonstrated to the potential subjects, then gathered their signed consents ensured their willing. Eligible students were subjected to interviewing assessments that included their demographic data, and CGH history. CGH individuals were asked about headache intensity, frequency, and duration.

To identify participants with addictive smartphones, they were endorsed to fill out the short Arabic version of SAS; its range is 10- 60, and male cut off value was 31, female one` 33[21].

craniovertebral angle assessment

Smartphone application AI Posture Evaluation and Correction System (APECS) V6.2.0. was used to assess CVA. In study present study, CVA cut off value < 50 that considered FHP[22]. Reflective positioned marking over C7 spinous process, and ears` tragus to determine CVA horizontally. To measure CVA, the participant was standing and from a lateral view the angle was measured using smart phone application (APCES). The smartphone application has a construct validity with 0.75-0.95 ICC, where reliability inter-rater was 0.9-0.99 ICC[23].

Cervicogenic Headache Examination

Cervicogenic headache was investigated through criteria set by International Classification of Headache Disorders-III criteria [13]. The neck extension range, and flexed-rotating test were measured by mobile application clinometer V2.4(16052510). For cervical extension range evaluation, in a standing position from a side view, the mobile was fixed at the level of the vertex, and the participant was asked to extend his neck [24]. In the flexion rotation test, from the supine lying position, the neck was positioned in full flexion then head rotation range was measured. the primary investigator rotated the participant's head while another therapist (research assistant) measured the range using a mobile device with a clinometer application. Three trials were measured on each side. An average of three trials was recorded. The affected side was the more limited range of motion with a positive cut off < 32°[25] .

Headache characteristics were determined through a visual analogue scale used for headache intensity. Headache duration was its mean hours weekly. Its episodes addressing frequency weekly[26].

Analyzing Data

The Windows IBM/SPSS 26.0 software utilized for analysis. Used Un-paired t-test for comparing groups` mean features, also Chi-square for defining sex distribution. The results were expressed in Mean ± standard deviation (SD). Utilized Shapiro-Wilk to assess normal assumption distribution. Outliers and variance were detected through the box plot and Levene's test. Statistical differs of CVA was calculated using t-test in-between. Spearman correlation (0.00/ mini–0.25/null; 0.26-fair–0.50; 0.51/moderate–0.75good, as well 1.00/excellent relation) was used to measure headache features correlation to CVA in addictive smartphone usage with CGH.

The $p < 0.05$ addressed significant. Cohen's d effect size was addressing groups differs` value, where interpretation as trivial ≤0.19/ trivial; 20-.49/ small; 0.50–0.79/ moderate; and ≥0.80/large.

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Results

Tab. 1; there is no remarkable demographic differs (> .05). However, SAS obvious differs (< .05) between both groups.

Tab. (1): Demographic data.

	Non-addictive without CGH Mean/ SD	Addictive with CGH Mean/ SD	Comparison	
			t-value	P-value
Age (Ys)	21.2 ± 6.5	20.7 ± 5.5	-0.408	0.686
Body mass (Kg)	69.8 ± 1.9	70 ± 2.4	-0.48	0.634
Height (cm)	172.4 ± 5.94	172.5 ± 5.5	1.181	0.244
Gender n (%)				
Females	6 (30%)	6 (30%)	0.634	
Males	14 (70%)	14 (30%)		
Sas score	26.10 ± 2.1	43.15± 4.98	14.091	0.000

3.1. Difference between both groups in craniovertebral angle

Shapiro-Wilk test showed that craniovertebral angle were normally distributed (> 0.2). Unpaired t-test; Smartphone addictive group CVA with CGH is significantly lower than matched control one (< 0.012) Tab. (2).

Tab. (2): CVA of both groups

		Addictive group with CGH	**Non addictive group without CGH**
CVA	Mean ±SD	52.54± 4.7	56.52±4.8
	P-value	0.01	
	size Effect	0.83	

***** < .05 Significant. **SD:** Standard deviation. **CI:** Confident interval. **P-value:** Probability.

3.2 Correlations between craniovertebral angle with headache characteristics

Shapiro-Wilk test shows that headache characteristics of intensity (< .006), duration (< .00), as well frequency (<.004) were not normally distributed. No significant correlations between CVA (p > 0.767) with any headache characteristics. As shown in Tab. (3).

Tab. (3): Correlation and Significance of craniovertebral angle with Headache features

1	**2**	R value	P-value
Cranio vertebral angle	Headache intensity	-.43	.085
	Headache duration	-.17	.22
	Headache frequency	-.071	0.76

R- value: Correlation coefficient factor *< .05 Significant 0.05

Discussion

The current trial investigated the relation between craniovertebral angle between addictive smartphone usage with CGH and non-addictive smartphone without CGH. Our findings support that CVA is statistically significant lower in the addictive group with CGH than non-addictive group without CGH. The mean difference between both groups indicates a large clinical meaningful (effect size=0.83). Up to researcher's acquaintance, non-prior has addressed cervical posture among addictive smartphone usage with CGH. However, there are some studies that measured cervical alignment either in smartphone addiction population or headache patients.

the finding of current study is similar to previous study that reported obvious CVA differs

within addictive and non-smartphone usage with mean difference of around 7 degrees (effect size = 1.6)[19]. Moreover, cervical posture changes while using smartphone in unilateral and bilateral texting, reported that unilateral texting resulted in more cervical rotational asymmetry while bilateral texting associated with more cervical flexion angle[27].

On the other hand, current findings are inconsistent with the result of Park et al., 2015, they reported no difference in CVA between heavy and low smartphone usage while there is a difference in head position angle that indicates FHP as well[28]. Maybe this difference owing to the method of assessment of these angles that include the visual method using Plumbline and Adobe Acrobat software. In addition to cutoff score of the smartphone addiction proneness Scale that distinguishes heavy from low-frequency usage is different than the questionnaire that was used in the current study.

Regarding cervical posture alternations in CGH, there is a debate in the literature. A previously reported cervical posture variables (C2 deviations, upper cervical lordosis, and general cervical lordosis) could not distinguish asymptomatic form CGH ones, while overall lordotic neck have a real correlated to CGH, but authors argue that the confidence interval for that odds ratio shows cervical lordosis is unable to differentiate CGH as an isolated clinical sign and assumed that CGH symptoms may not be related to upper cervical postural variations[16].

However, our finding of decreased CVA in the study group ensured other trials support CVA differs, or cervical spine alignment in CGH. It was reported that the average CVA in CGH patients was significantly lower than those in asymptomatic subjects[29]. Moreover, an inverse painful intensity correlation with value of CVA[30]. The average of CVA in the current study (52.54) is nearly similar to another study's CVA average (50,29), the authors showed that CVA in CGH was in positive a significant relationship with pain pressure threshold measured at C2[31].

Another study demonstrated that dominant C1/2 always with symptomatic CGH. C2 segment dysfunction in CGH indicates that FHP (decrease in CVA) could affect C2 root mechanosensitive through shortening of the suboccipital muscles[32]. In this regard, Amiri and his colleagues. revealed actual pain pressure threshold reduction over C2 than upper trapezius among FHP persons [33].

Integrating both conditions of smartphone addictions and CGH gives the current study a different insight than previous studies. Smartphone usage plays a significant role in affecting CVA. The shifted head forward position while using the smartphone in various tasks, reduces lower cervical lordosis. To maintain gaze level, upper torso dorsal curve develops, ultimately decreasing CVA, resulting in alternations in length and tension of the upper trapezius. It was reported increase in upper trapezius activities among FHP [34].

In addition, significantly higher tone and stiffness and lower elasticity in the bilateral upper trapezius during smartphone use than in resting condition[35]. Upper trapezius trigger point sensitivity is considered a diagnostic test for CGH. Therefore, decreased CVA which is present in most smartphone tasks, contributes to CGH either through mechanical stress on C2 or muscular activity alterations[36].

B- Correlation between craniovertebral angle with headache characteristics among addictive smartphone usage with CGH

Up to researcher's acquaintance, current one is the prime trial evaluated CVA correlation with headache clinical characteristics among smartphone addictive with CGH. The current findings illustrate that no statistical correlation between CVA with any characteristics of CGH. The possible explanation for these findings' may be related to the mean CVA of the smartphone addiction with CGH group (52.54± 4.7) was still within normal limits when compared with values presented in the literature of CVA ranged from 43.80° to 54° with average = 51.42° [36], consequently the correlation couldn't reach to statistical significance level. However, the difference was detected between study group and their matched controls because of CVA mean of their matched control (56.52±4.8), thus study group could be considered as mild affected CVA.

The result of the non-significant correlation of CVA with any CGH clinical variables are partially inconsistent with another study, the author ensured an inverse CVA relation to pain complains among CGH. This difference may relate to in this work they divided the sample into 5 categories of pain severity and method of CVA measurement through MRI. Although inverse relationship that was detected, no difference in CVA values

between asymptomatic group and mild pain CGH group [30].

Moreover, other studies are not consistent with the present finding's [38,39] .they reported that chronic tension-type headache showed a negative correlation between CVA and headache frequency as greater CVA, less frequency of headache. Furthermore, suboccipital muscle among extended tension-headache participants had active or latent trigger points, and those with active trigger points had massive headache, frequency, plus FHP over latent triggers. The difference with these findings of the aforementioned studies may belong to the selection criteria of chronic tension-type headache and CGH, although both conditions may be similar to a certain extent, the current criteria of the International Headache Society seem to distinguish these two headaches. In addition, the difference in means of CVA between the current study and these studies (45.3° ± 7.6°) in which their CVA was considered in lower normal limits while while CVA mean in our study group demonstrated upper normal limits.

limitations

1- The findings of the current study are limited to active young subjects.
2- Certain data were not taken into consideration as they might affect or give some explanation to the findings, method of text entry on the smartphone either unilateral or bilateral, common position while using the smartphone sitting or lying down, and weight of the used smartphone.
3- the cervical posture could be considered as compensation or contributes to the genesis of the headache un able to be determined as the nature of the study was a one-shot assessment.

Conclusions

The study results confirmed that CVA is statistically significant lower in the addictive group with CGH than non-addictive group without CGH. As well as no statistical correlation between CVA with any characteristics of CGH.

Authors' contributions:

The authors have determined that all individuals indicated as authors are eligible for authorship. The content and similarity index of the paper are the responsibility of all authors who have critically evaluated and approved the final version.

Availability of data and materials

The collected and analyzed data during the study are available upon reasonable request and following institutional approval from the corresponding author.

Conflict of interest

This article has no potential for a conflict of interest

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