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Research Article

Impact of Smartphone Addiction on Craniovertebral Angle in Healthy Adults

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Abstract

The craniovertebral angle is measurable, linear measure of the curvature of the neck. Smartphone addiction can alter this angle and cause headaches, pain in one's neck and shoulders, and even difficulty breathing.

The concept of smartphone addiction and its effect on craniovertebral angle has gained increased attention in the recent years. There are many well-known studies that have shown how the use of smartphones can lead to the development of neck, shoulder and back pain as well as other health issues.

The study is of cross-sectional design where 30 participants were selected and correlation between smartphone addiction and craniovertebral angle was seen.

The aim was to explore how smartphone addiction can affect craniovertebral angle.

Keywords: Craniovertebral Angle; Smartphone Addiction; Healthy Adults

Introduction

Nowadays, people are becoming more dependent on smartphones than ever. During the day, individuals are utilizing smartphones for different tasks on a daily basis. These tasks include checking social media connections, watching videos, reading books, doing some form of work, browsing the internet and other functions [1] that may predispose to musculoskeletal deficits [2,3]. People engaging with the visual display terminal of a smartphone gradually develop forward head posture as a compensatory posture and at work; this has been put down to either poor work habits or ergonomically poor workstation arrangements [4].

The craniovertebral angle is identified as the intersection of a horizontal line passing through the C7 spinous process and a line joining the midpoint of the tragus of the ear to the skin overlying the C7 spinous process [1]. Measurement of craniovertebral angle (CVA) is one of the common methods in assessing head posture.

The craniovertebral angle can be visualized from a person's side as follows:

1. Draw an imaginary horizontal line that goes through the C7 spinous process, which is the back of the vertebra at the bottom of the neck.
2. Draw a second imaginary line from the C7 spinous process up to the tragus, which is the pointed part in front of the earhole.
3. Where these two lines join together at the C7 vertebra forms the craniovertebral angle.

As the head drifts forward, so does the tragus of the ear relative to the base of the cervical spine (C7 spinous process), which is what the craniovertebral angle measures. Smaller the craniovertebral angle, more severe the forward head posture.

The craniovertebral angle can be measured while the patient is seated or standing. Some research indicates that measuring the craniovertebral angle while standing may provide a more useful result because true forward head posture is less noticeable when sitting.

In forward head posture (FHP), the head protrudes forward from the sagittal plane and appears to be positioned in front of the body, and this condition is considered the most common postural deformity [1,2]. FHP increases extension of the atlanto-occipital joint and the upper cervical vertebrae as well as flexion of the lower cervical and upper thoracic vertebrae. Furthermore, this posture causes persistent and abnormal contraction of the sub occipital, neck, and shoulder muscles. In FHP, the center of gravity (COG) of the head shifts in the anterosuperior direction, increasing the load on the neck, which causes dysfunction of the musculoskeletal, neuronal, and vascular systems [3]. Additionally, the muscles around the head and shoulders, including the trapezius, sternocleidomastoid, sub occipital, and temporal, are affected by FHP, which further worsens postural deformity. These changes cause persistent and abnormal pressure in the muscles, fascia, and nerves of the neck and shoulders, and rounding of the shoulders occurs to compensate for this deficit, which in turn, causes a high load on the superior trapezius and levator scapula muscles [4].

Several studies have investigated the impact of using smartphones on pain created in different parts of the body, and there is a correlation between the amount of time spent using a smartphone and the severity of the symptoms [3,5,6]. Not only that, other studies have shown that prolonged cell phones usage might lead to deficient postures, such as forward head posture and rounded shoulders [7,8]. Hansraj., *et al.* found in their research that the angled weight of the head increase as the degree of the neck flexion increases, respectively, and with 60 degrees of head flexion the weight of the head reaches around 28 kg [9]. Moreover, the impact of prolonged smartphones usage may lead to respiratory dysfunction due the faulty posture of the neck [8].

There is some evidence that neck joints are becoming under more stress due to sustained hunching over smartphones [10]. There is an increasing incidence of neck pain in different age groups [3]. Usually, neck pain increases as age increases, but nowadays younger patients are reporting neck pain more than ever [6]. Sustained pressure on the neck joints [10] is causing disturbed signals to the brain that might cause balance problems and disturbed neck proprioception [5,7,11]. Proper balance and controlling head and eye movements is dependent on afferent input from different systems at the same time. These systems' information needs to be integrated depending on the task and environment, and they include vision, vestibular, and proprioception systems [12]. Cervical proprioception contributes to correct head in space and trunk orientation [13], as well as to correct body orientation and balance control [14].

Objective of Study

In upcoming dependency on the electronic devices and increase in the concept of online education have provided the base to study their effects on human body physiologically and anatomically. The objective of this study finds the correlation between the craniovertebral angle and smartphone addiction in healthy adults.

Methodology

Consent of the participants were taken to complete a demographic questionnaire and the short version Smartphone Addiction scale (SAS-SV) questionnaire (English version) to identify the excessive (score >30) and non-excessive (score < 30) smartphone users. The participants.

Heights and weights were measured and recorded, then used to calculate the body mass index (BMI). The SAS-SV questionnaire (English version) is a tool for assessing smartphone addiction level [3]. This 10-item self-reported scale addresses 5 content areas or domains, as follows: (i) daily-life disturbance, (ii) withdrawal, (iii) cyberspace-oriented relationships, (iv) overuse, and (v) tolerance. Participants responded on a 6-point Likert scale ranging from 1 ("strongly disagree") to 6 ("strongly agree") based on self-reporting. The total score in the SAS-SV is 60, with an average score of 30. The participants who scored above 30 were considered addicted to smartphone while the participants who scored less than or equal to 30 were not considered to be smartphone addicted.

The craniovertebral angle was measured by instructing the participants to stand in an anatomical position with the head erect. The tripod and smartphone camera were set 1m away from the participants. The landmarks (the tragus of the participants' ear and the 7th cervical vertebrae) were marked clearly with adhesive markers; this was done by instructing the participants to flex and extend their neck. The participants' photographs were taken laterally with a smartphone camera.

The photographs were imported into Artificial Intelligence Postural Evaluation and Correction system (APECS) software version 6.2.0 using a smartphone. To measure the cranio-vertebral angle, the right lateral photo of the participants was imported to the APCES app in the head-neck option was the cranio-vertebral angle was measured and recorded.

Study design

Cross-sectional survey.

Sample size

30.

Inclusion criteria

- Ability to give informed consent.
- Age 18 - 25 inclusive.
- Ability to speak, read and write English and Hindi.

Exclusion criteria

- People with history of shoulder or neck pathology.
- People with psychiatric disorders.
- Active substance abuse.
- People with serious impaired hearing.
- Subject with any predisposing factor to poor head posture.

Result

The mean BMI, age, height and weight of the participants was 23.73 ± 2.96 kg/m^2, 20.69 years, 1.4 ± 0.03m, 62.87 ± 8.3 kg respectively (Table 1).

The mean craniovertebral angle of excessive smartphone user was 38.2^o and the mean addiction level of the participants to smartphones was 37.66 which were calculated by the scores of SAS-SV work sheet (Table 2).

	Male (n=15) mean ± SD	Female (n=15) mean ± SD
Age (years)	20.79 ± 2.12	20.59 ± 2.02
Height (m)	1.45 ± 0.05	1.35 ± 0.02
Weight (kg)	68.52 ± 9.02	57.23 ± 7.59
BMI (kg/m^2)	25.01 ± 3.30	22.46 ± 2.63

Table 1: Evaluation of male demographic data of male and female participants.

	Males	Females
Addiction (level)	39.98	35.34
CVA (^{o})	42.71	40.68

Table 2: Evaluation of mean SAS-SV score and CVA angle in male and female participants.

Discussion

Smartphones require to hunch over because of the way they are designed. The design, which keeps our eyes close to screen, forces the spine to arch backwards, causing neck and back pain.

As observed from the results of this study, there was no significant difference in the smartphone addiction level of male and female participants. This implies that both sexes use smartphones equally. This might be because of the exposure of both sexes to the same level of education and the same academic environment. The result of this study is consistent with that of Fahad., *et al.* [19] who noted no significant difference in mobile phone addiction between male and female college students.

This study found a significant difference in the craniovertebral angle of male and female participants. This results in agreement with that of Hakala., *et al*. [21-23] who noted that high craniovertebral angle in female individuals can be party associated with psychosocial issues such as stress.

There was a higher percentage of participants found to be addicted to smartphone and people not addicted to smartphones were less, this is due to increase demand of smartphone use.

A significant relationship was observed between smartphone use and craniovertebral angle: participants who were excessive smartphone users had a low (abnormal) craniovertebral angle and non-excessive smartphones users had a high (normal) craniovertebral angle. This result is because excessive smartphones use invariably causes a reduced craniovertebral angle. Forward head posture causes weakness of the cervical flexor muscles and middle trapezius and rhomboids.

This might be a result of rate of smartphone use by the participants, which may predispose them to developing abnormalities in the scapular region. Increase in the craniovertebral angle causes weakness of the mid trapezius and serratus anterior muscle associated with scapular stability. Weakness of these muscles causes activation of upper trapezius.

The age of an individual might be a contributing factor to smartphone addiction. However, the result of this study shows no relationship between age and smartphone addiction, which may be because the study involved young adults within the age range (18 years and older). Excessive users of smartphone might exhibit a sedentary lifestyle, which predisposes them to weight gain. From the results of this study, there was no statistically significant relationship between smartphone addiction, weight, and BMI. This might be because academic and job-related stress works against weight gain in this population.

No relationship was observed among craniovertebral angle, age, and weight of participants. However, a significant relationship existed among craniovertebral angle, height, and BMI in male participants. This might be because the male participants were taller than females which could be a contributing factor to the low craniovertebral angle among the male participants.

Limitations of the Study

This research, however, is subject to several limitations that could be addressed in further research. Firstly, there is insufficient sample size; the small sample size can lead to misleading conclusions and findings. It also prevents from obtaining statistical significance. Larger sample size can be used in future for more accurate and reliable results.

Secondly, lack of access to laptops for research limits the information that can be found online and made it difficult to access accurate information quickly. Textbooks and articles are not always available or up-to-date.

Pictures were captured using a smartphone not a digital camera, no denying that smartphone cameras are getting better day by day. However, digital cameras still have their own advantage such as better picture quality and more control over the picture.

The time constraint in research is a huge problem as it is difficult to provide scientific findings in a timely manner, or even with consistency.

Conclusion

Smartphone addiction is growing in most countries. People are spending more time on their phones instead of human interaction, which has adverse effect on their mental and physical health.

This study shows that healthy adults are susceptible to smartphone addiction. This can result in a decrease in craniovertebral angle, which, in turn, leads to a forward head posture that invariably causes an increase in scapular dyskinesia. Therefore, smartphone addiction has an impact on the neck and shoulder posture of male and female, which, in the long run, may result in musculoskeletal disorders.

Smartphone addiction level should be assessed on all patients with neck and shoulder pain. Emphasis should also be placed on mitigating smartphone addiction and its musculoskeletal effects on healthy adults.

The results of this study could be applied to educational programs about the correct posture while using smartphone for extended periods. It can also help in differential diagnosis of the cause of neck pain and inform physiotherapists to include proper neck postural information in neck care education.

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