



THE IMPACT OF SMART HAND-HELD DEVICE FOR ONLINE LEARNING DURING COVID-19 ON CERVICAL POSTURE IN SCHOOL CHILDREN

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Abstract: Educational activities halted worldwide during Covid-19, challenging education system to shift to online mode of teaching overnight. Children were using smart hand-held device (SHHD) for minimum 4 to 5 hours per day for approximately five days a week and attending online classes. Prolonged sitting is known to result in poor posture which cause postural deviations in children. Through this study we investigated the impact of smart hand-held device for online learning during covid 19 on cervical posture in school children. **Method-** Forty-five school children aged 14-15 years fulfilling inclusion criteria were recruited. Subjects craniovertebral angle (CVA) and head tilt angle (HTA) was recorded in relaxed sitting posture and posture adapted during online learning on same day using On Protractor Application. **Result-** The data analysis reported significant change in craniovertebral angle and head tilt angle in relaxed sitting and posture adapted during online learning ($p < 0.05$). **Conclusion-** Use of smart hand-held device for online learning has an impact on cervical posture in school children.

Keywords – craniovertebral, posture, angle, online, cervical

I. INTRODUCTION

The sudden outbreak of a deadly disease called Covid-19 caused by a Corona Virus (SARS-CoV-2) shook the entire world. Around 32 crore learners stopped to move schools/colleges and all educational activities halted in India and abroad. This situation challenged the education system across the world and forced educators to shift to an online mode of teaching overnight. Many academic institutions that were earlier reluctant to change their traditional pedagogical approach had no option but to shift entirely to online teaching-learning. Posture is the alignment of body parts, whether standing, sitting, or lying down. It is described by the position of the joints and body segments, and the balance between the muscles crossing the joints. ^[3] Children of age group 14 to 15 years are at verge of skeletal growth development. Cervical development is completed approximately at 14-15 years of age.

Children are using smart handheld device (SHHD) for minimum 4 to 5 hours per day for approximately five days a week and attending online classes ^[4]. Prolonged sitting can lead to poor posture which cause postural deviations in children. Due to the small screen of the SHHD, children tend to use it from a close distance, sitting with their head bent forward without forearm and back support. ^[4]

Using SHHD for prolong period, is known to change cervical posture such as forward head posture (FHP), rounded shoulders, and increase in thoracic kyphosis. Sustained FHP can be a contributing factor for neck pain, injury to muscles and ligaments. ^[7] Forward head posture is a postural disorder in which the head is held forward toward the center of gravity of the body. ^[6] Craniovertebral angle (CVA) is the angle, in degrees, of the horizontal line intersecting a line drawn from the tragus of the ear to the spinous process of C7. A normal range of CVA angle is 50° and above. A smaller craniovertebral angle indicates a greater degree of forward head positioning with a craniovertebral angle less than 48°- 50° defined as forward head posture. Head tilt angle (HTA) is the angle formed at the intersection of a horizontal line through the tragus of the ear and a line joining the tragus of the ear and the lateral canthus of the eye. It represents the position in terms of flexion or extension of the cervical spine. The greater the angle is, more is the extension of the head. ^[4]

Forward head posture decreases cervical lordosis of the lower cervical vertebrae and creates a posterior curve in the upper thoracic vertebrae to maintain balance. ^[3,4,5] A previous study stated that FHP causes shortening of the muscular fibers around the articulation points of the atlanto occipitalis and overstretching of muscles around joints, possibly producing chronic neck pain. ^[8] FHP may affect not only the neck but also the thoracic spine and shoulder blades, potentially causing an overall imbalance in the musculoskeletal system. ^[4,8] Impairments of muscles can lead to poor coordination, activation, overload, and inadequate support of neck structure that can further lead to neck pain and changes in neck posture. ^[8,20,23] It is estimated that 75% of the world's population spends hours every day holding their mobile devices with their heads flexed forward. ^[6] Prolonged static sitting has been evaluated to adversely affect certain anatomical structures due to sustained loading. As a result, over time, these structures can cause musculoskeletal pain. ^[20,21]

Frequent use of smartphones can negatively affect cervical posture, as well as respiratory biomechanics among boys and girls. Pulmonary dysfunction has found to be associated with FHP as a result of constant neck flexion while viewing the phone. Therefore, education on proper posture while using the smartphone and education on the effects of prolonged usage of smartphones are necessary to preserve craniocervical function.^[7] Continuous maintenance of typical posture requires low level of sustained isometric work of Longus capitis, Longus Colli, Semispinalis Cervicis and Capitis, Rectus Capitis muscles. These muscles get fatigue and need frequent rest intervals. To overcome this fatigue an individual adopts atypical posture which might cause stress and strain to surrounding ligaments, joints, and muscles.^[8,10,16]

Incorrect posture while sitting in front of SHHD can strain the extraocular muscles, neck, and the back it's not just adult who are affected but even younger children who are attending online classes during COVID-19 situation are now complaining of back and neck pain. Longer screen time can impair the child's spine and lead to back stiffness, physical fatigue, and other postural problems. Neck pain is positively correlated with holding the neck in a flexed posture for a prolonged period which can cause static loading of the musculoskeletal structures.^[5,9,11,13]

Cervical spine angle abnormalities occurred in people who consistently flexed their neck forward. The load on the cervical spine increases dramatically as the neck flexion increases.^[11] Forward neck flexion at different degrees increases the stress on the cervical spine, which changes the natural curve and surrounding structure of the cervical angle. Therefore, a reduction in the cervical angle may cause cervical dysfunction.^[10,11]

With more months extended into online learning, it will become more imperative that good posture and suitable learning environment must be crafted even at home. The adopted incorrect posture may develop into permanent habits leading to significant problems and increase the risk of many painful syndromes in future.

Because of this helpless situation, students compulsorily had to sit for prolonged period in front of SHHD which led to postural change, as this age group are at the verge of skeletal growth cessation so postural changes can lead to serious complications. Therefore, it is important to find out postural anomalies to prevent further musculoskeletal problems and to improve functioning and quality of life.

Hence this study is done to see whether there are any changes happening at cervical spine secondary to the posture adapted during increased screen time. To check if there are any deviation in craniovertebral angle (CVA) and head tilt angle (HTA) while attending online classes as compared to routine sitting posture. This study will help children to develop good postural habits leading to a fit and healthier life in future.

Children and their parents need to be educated on the effects of prolonged smartphone usage and on the need for balance between the time spent using smartphones and doing other physical activities. Maintaining proper posture while using smartphones is highly important as well because this could lead to improved cervical spine posture and help prevent future impairment or pain.^[5]

II. METHODOLOGY

In this observational study, 45 school children between age group 14-15 years using SHHD at least 1 year for minimum 4 to 5 hours per day for approximately 5 days a week were recruited. Children with any previous complains of Neck and/or Shoulder pain and those using laptops were excluded from the study. Ethical committee clearance was taken. Consent was taken from the participants. To measure the craniovertebral angle and head tilt angle, participants were asked to sit at usual place in which he/she attends online learning classes and maintain relax sitting posture then a photograph during 1st session was clicked from lateral aspect using android mobile camera. Second photograph was clicked while attending the 4th session on same day, from lateral aspect, without him/her noticing, so that he/she will not be alerted and assumed posture will not change. The data was collected and entered in excel sheet and analyzed using paired T test subjected to normality of the data.

III. PROCEDURE

On protractor application was used for which radium sticker markers were placed on C7 vertebra, tragus of ear, and canthus of eye. Craniovertebral angle is described as the acute angle formed between a horizontal line passing through the spinous process of C7. The head tilt angle is the angle formed between line passing the tragus and the line passing through the lateral canthus of eye

Head tilt angle

Craniovertebral angle



Fig 1a-1st session

Fig 1b-4th session

Fig 2a-1st session

Fig 2b-4th session

IV. OUTCOME MEASURES

ON PROTRACTOR APPLICATION

On Protractor smartphone application. (Reliability = 0.879). [28]

Craniovertebral angle (CVA) and Head Tilt angle (HTA) was measured using ON Protractor mobile application using android phone. The application is freely available in Google app store. This application allows to take a picture and draw an angle by touching the screen at the reference points on the markers.

V. Data analysis

Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p < 0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Francia test ($W^* = 0.0023$). Inferential statistics to find out the difference between the groups was done using Mann Whitney U Test and Wilcoxon Sign Rank Rest was used to find out the difference between and within two groups.

Table 1- descriptive data

	Height (m)	Weight(kg)	BMI	CVA		HTA	
				1st session	4 th session	1 st session	4 th session
MEAN (SD)	1.618	49.68	18.47	51.788±5.6	41.72±6.8	37.21±6.5	27.63±7.8
MEDIAN(IQR)	1.61	49	18.47	52.41(47.9-54.9)	42.71(39.4-46.5)	37.93(35.0-41.6)	30.42(21.6-34.4)
MODE	1.68	50	19.53	52.41	39.21	36.48	36.29
P VALUE (NORMALITY)	>0.05	<0.05	>0.05	<0.05		<0.05	

Table 2- comparison of craniovertebral angle & head tilt angle between 1st and 4th session

		CVA	HTA
ANGLE	1st session	51.78±5.55	37.21±6.57
	4th session	41.72±6.79	27.63±7.73
P VALUE (WILCOXON SIGN RANK TEST TEST)		0.0001*	0.0002*
DIFFERENCE		10.06±6.27	9.58±6.53

Within group -Wilcoxon sign rank test analysis reported significant change in CV angle & HT angle between normal posture altered posture. (p<0.05)

Table 3- comparison of CV angle between gender

		MALE	FEMALE	P VALUE (MANN WHITNEY U TEST)
CVA ANGLE	1st session	52.88±4.81	49.98±6.33	0.01*
	4th session	42.84±5.53	38.89±8.34	0.008*
P VALUE (WILCOXON SIGN RANK TEST TEST)		0.0001*	0.0001*	
DIFFERENCE		10.04±6.31	10.09±6.38	

within group - Wilcoxon sign rank test analysis reported significant change in CV angle & HT angle between normal posture & altered posture within males & females. (p<0.05) between groups- Mann Whitney u test reported significant difference both at normal posture & altered posture (p<0.05) regarding CV angle between males & females

Table 4- comparison of HT angle between gender

		MALE	FEMALE	P VALUE (MANN WHITNEY U TEST)
HTA ANGLE	1st session	39.24±4.73	33.86±7.87	0.0002*
	4th session	29.25±7.11	24.96±8.17	0.009*
P VALUE (WILCOXON SIGN RANK TEST TEST)		0.0001*	0.0001*	
DIFFERENCE		9.99±6.56	8.90±6.68	

VI. Discussion

This study was done to observe the impact of Smart Hand-Held Device for online learning during COVID-19 pandemic on cervical posture in school children. Due to Covid 19 Pandemic crisis there was increase amount of screen viewing time. SHHD such as tablets and mobile phones are widely used for online education. Viewing a smartphone, which is located below an inappropriate height for eyesight, for extended periods of time makes the head tilt forward. Extended smartphone use can cause FHP^[3,5,8], myofascial syndrome of the hand, forearm, shoulder, and neck muscles, and depression.^[8] In addition, the weight supported by the spine dramatically changes when the head is flexed forward at varying degrees. So heavy smartphone users lose the natural curve of the cervical spine and instead place increased amounts of stress on the cervical spine.^[7,8] These stresses may lead to changes in the cervical angle and the pain threshold of the neck and shoulder muscles. In addition, a high frequency of smartphone use could be a risk factor for symptoms of depression.^[8,20]

The result of this study showed, there is a significant change in CVA angle between normal (mean 51.78 ± 5.55) & altered (mean 41.72 ± 6.79) posture due to increase screen time. This indicates that the postural change due to increase screen time are representative of cervical spine changes. Constant neck flexion over time results in FHP, which may have resulted in shortening of the posterior cervical muscles and weakening and lengthening of the anterior cervical muscles.^[26] FHP not only weakens the middle and lower trapezius, semispinalis capitis, and levator scapulae but also mid-thoracic rhomboid muscle. On the other hand, upper trapezius, sternocleidomastoid (SCM), splenius, and pectoralis major can be shortened.^[10,26] Furthermore, an increase in lower cervical spine lordosis, rounded shoulder, and thoracic spine kyphosis may occur as a result of FHP.^[7]

Park and colleagues (2015) have found that excessive use of smartphones increases the pressure on the cervical spine, which eventually changes the cervical angle and results in increased levels of pain in the sternocleidomastoid and upper trapezius muscles.^[10] This change in the cervical angle can lead to an increase in the posterior curve of the upper cervical vertebrae and a decrease in the lordosis of the lower cervical vertebrae, which is forward head posture (FHP).^[12, 14, 15]

A CVA angle less than 50° was defined as FHP it was established in a study.^[4] Another study found smaller CVA values ranged from 39° - 46° were considered the cause of FHP and upper quadrant pain.^[15] Continuous smartphone possesses greater risk to develop neck pain due to combine factors of poor posture, long duration, and frequency of usage.

De-la-Llave-Rincon et al found that a reduced craniovertebral angle (CVA), which indicates larger FHP, might cause a reduction in the cervical range of motion (ROM). Larger FHP was also related to a decrease in cervical flexion and right and left cervical rotation.^[27] As a result of the increased usage of smartphones among children, there were significant decreases in cervical ROM mobility because of muscular abnormalities of the cervical spine. Also, cervical ROM may be reduced due to the habitual FHP of those who frequently maintain neck flexion.^[4,27]

This study showed there is significant change in HTA angle between Normal (mean 37.21 ± 6.57) and Altered (mean 27.63 ± 7.73) posture due to increase screen time. This indicates there is flexion at cervical spine. This flexion is caused due to FHP i.e., change in CVA angle, in which there is flexion at lower cervical spine and extension at upper cervical spine. These results come in agreement with the conclusion that the neck flexion angle was greater and CVA was smaller, during smartphone use.^[23,24]

In this study there was unequal gender distribution, there was (62.2%) males and (37.7%) females. This study shows significant difference both in CVA and HTA angles in males compared to females. This study result is similar with the previous study as Gold et al. (2011) reported that boys showed greater FHP while typing on smartphones than girls did^[27], while there are even contradictory reports to this study as Ruivo et al. (2014) and Hakala et al. (2006) found that girls had more FHP than boys when the postural alignment of the heads and shoulders were examined in a natural standing position.^[15] Chiu et al. (2002) reported similar findings in adults, where females had more FHP than males during computer use.^[27] But, McEvoy et al. (2005) and Van Niekerk et al. (2008) did not find gender differences in children and pre-school children for habitual cervical posture.^[27]

This study result shows there is a significant change in the cervical posture while attending online classes. In order to avoid and prevent any further change in the cervical posture the correct ergonomics need to be explained to the students as a precautionary measure. It would be more appropriate if a proper study environment can be crafted at the place of study while handling the smartphone devices. This study is important to educate the students and implement the ergonomics, as this is the age group where the cervical spine gets developed and if no precautionary measures are taken it would lead to several complications to the spine in future.

VII. Conclusion

This study concluded that there is significant change in craniovertebral angle and head tilt angle between first session and fourth session of online learning recorded on same day. As there is change in cervical posture while attending online classes, correct ergonomics can be explained to students while attending online classes or while using smartphone. Proper study environment can be crafted in home while using smartphone devices. The information collected can be utilized to educate students by enlightening ergonomics necessity and the need of adapting ergonomics in their life.

VIII. References

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