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Original Research Article

Effect of screentime in college students during the COVID-19 online classes on their neck posture and postural control: an observational study

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ABSTRACT

Background: Corona virus which is the source of severe acute pulmonary syndrome causes an airway tract contamination (COVID 19). Prolonged sitting for online classes in the college students leads to the enlarged postural deviation, increased low back pain. Prolonged static contraction of skeletal muscles of the cervical region, lower back leads to impaired flow of blood to the muscle groups together with edema and accumulation of waste metabolites will trigger the muscle spasm.
Methods: Total 30 college students aged between 18-25 years who attended the online classes during COVID-19 were included in this study by using a questionnaire. The outcome measures used were the measurement of CV angle, SEBT and BBS. The postural control was estimated by using star excursion balance test and Berg balance scale.
Results: Using Karl Pearson's correlation coefficient, a positive correlation was observed between CV angle and BBS (r = 0.82). Between BMI and CV angle there exists a statistically significant negative correlation (r = -0.564).
Conclusions: This study proved that there exists a forward neck posture in the students who attended the online classes during the COVID-19 pandemic and that also affected their postural control.

Keywords: BBS, BMI, Body posture, Covid-19, CV angle, Forward neck, Postural control, SEBT

INTRODUCTION

Coronavirus disease 2019 (COVID-19) causes respiratory illness in humans and the source is severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). The World Health Organization proclaimed the virus, a pandemic since March, 2020 in the view of the fact that it has high level of contagious nature.[1] This virus altered our everyday routines, including how we worked and how we attended lectures. The pandemic forced the great majority of the 19.7 million college students to switch from traditional classes to online classes.[2]

The impact of this COVID-19 pandemic has been hit the education system worldwide, prior to the pandemic outbreak, most of the teaching methods for students in schools and universities were lecture-based approach via face-face mode in the physical classroom, but for all educational institutions COVID-19 pandemic turned to be a catalyst and had to explore the alternate innovative solution of teaching through online by which students could not slow down their classes during this time.[3]

Among the most important factors affecting an individual's physical and psychological level throughout their existence is posture. Different elements such as family factors, anatomical, musculoskeletal defects postural patterns and occupational considerations all have an impact on posture. Numerous other factors including congenital conditions, age, gender, environmental factors,

emotional factors, physical activity, ergonomics, and others may also have an impact on posture.[4]

Good posture is one that achieves the objective with the least amount of effort and the greatest degree of efficiency. Any change in the muscle distribution, an imbalance in how the body is aligned and the development of bad postural habits are all possible effects of poor posture. It causes discomfort of muscle tension equilibrium known as muscle imbalance when static or dynamic overload predominates in these constant repetitive patterns of body alignment. When there is a muscular imbalance the stabilizing effects of the stabilizing muscles which work in accordance with recurrent patterns create certain postural patterns.[5]

Almost 80% of people reported flexing their head and neck when looking at the monitor.[6] While 14% reported having a stretched head/neck posture. When the head is in the forward head posture (FHP), it projects forward from the sagittal plane and seems to be in front of the body. The joint will extend more under these conditions which are thought to be the most common postural deformity. The sub-occipital, neck and shoulder muscles' power and sustained atlanto-occipital contraction are also decreased in this posture. The musculoskeletal, neurological, and vascular components become dysfunctional in FHP because the head's center of gravity (COG) changes in antero-superior direction elevating the stress on the neck.[7]

Musculoskeletal problems: Prolonged smartphone use causes the upper cervical region to be mostly flexed, placing strain on the neck. Serious long-lasting harm including spine misalignment, arthritis, spinal degeneration, disc herniation, disc compression, and nerve injury will result from excessive sitting. These will make neck disabilities worse.[8]

The musculoskeletal complaints are connected to both modifiable and immutable risk factors. Genetic propensity, structural spinal abnormalities and gender are non-modifiable factors. Body alignment (posture), task type, and task length are the controllable factors.[9] Student's common screen-time usage has elevated from average three hours before lockdown to five hours throughout lockdown. In pre-lockdown period, 70% college students had been doing exercise whereas throughout lockdown around 70% students had been doing bodily exercise occasionally or no longer at all. 71.2% population of students has no longer used any particular ergonomically designed vicinity to attend online classes which adversely have an effect on the student's posture. Seated posture for very long may be a factor for cause of lower back pain. Prolonged static contraction of the skeletal muscles of the cervical region and lower back lead to impaired flow of blood to the muscle groups (ischemia) together with oedema and accumulation of the waste metabolites which will trigger the pain spasm.[10] Traditional description of upright bipedal stance that provide postural equilibrium and alignment of body segment with regard to gravity are depending on sensory information from vestibular, somatosensory and visual systems.[11] Thus human has supervision over balance. Whereas an inanimate object does not.[12]

Neck injury or vestibular damages might change torque required to maintain posture, which is associated with reduced balance controlling ability. Decreased sensation in joints thereby abnormal proprioception leads to postural imbalance. Neck pain and muscle pain after smartphone use ought to alter the sensitivity of neck proprioception as a result of muscle fatigue and increased loading of the neck and shoulder muscle mass. This is due to the repeated motions of hands, wrists, and arms all these are the factors affecting dynamic balance capacity.[13] The problem of postural control is frequently supplied by way of the use of muscular activation. Coordinated activation of the trunk muscle groups has been delivered as being indispensable for maintenance of the upright erect standing posture with minimal postural sway. Alterations of the recruitment sample of the trunk muscle mass has additionally been recommended to impose postural penalties challenging the balance of the backbone.[14]

Proprioceptive training: (ProT) targets the enhancement of common proprioceptive function by means of the usage of somatosensory indicators from the suboccipital muscle tissues to improve perceptual and unconscious proprioception. ProT will improve static balance, cranio-cervical flexor function and cervical proprioception and to minimize neck soreness in people with neck discomfort and static balance impairment.

Cranio-cervical flexor training improves tonic postural characteristic of the deep cervical flexors and minimizes activation of the superficial cervical flexors. It focuses on motor manipulation of the deep cranio-cervical flexors, decreases neck pain, and improves cervical proprioception after 6 weeks of training.[15]

Working posture using a laptop with a table while sitting

This posture is assumed to be bent at an angle of 20–60° which forces students and staff to leantheir heads forward for a long time exposing them to an increased risk of musculoskeletal disorders. Static postures are also likely to occur in the neck and shoulder regions which leads to increased flexion of the forward neck posture and static tension.

Working posture using a laptop without a table while sitting on a chair

This posture is assumed to be in a position where laptop is placed above the thigh. Additionally, the knees are bent to form an angle of 90 degree with the thighs and torso where the weight is supported by the ischial tuberosities. Students who practice this position need to maintain a

good posture with their head, hands, and palms kept in a static position to prevent their necks from tilting forward leading to an increased angle between the eyes and neck. The use of this position for more than 3 hours can cause MSDs such as neck pain due to a shortage of the trapezius and levator scapulae muscles.

Working posture using a laptop while lying

The lying position which requires students to lean on the neck and body weight on the elbowscauses an increase in musculoskeletal complaints in the neck and back. The wrong neck position can also lead to muscle tension which is caused by frequent, deep and continuous viewing of the screen.

Working posture using a laptop without a table while sitting on the floor

This is assumed to be in the position where laptop is placed on the thigh with legs crossed. Furthermore, this position can cause MSDs and varicose veins due to blocked veins if maintained for 1-3 hours. The recommended duration is 10-20 minutes to avoid symptoms of pain in the muscles of the waist, thighs, and knees but may cause mild symptoms if the individual doesn't exercise before assuming that position.[9]

Star excursion balance test

The SEBT is a valid and reliable realistic tool to consider dynamic postural control of the lower limb. Several intrinsic elements can influence SEBT performances between participants such as sex, age, stage of play, and injury history. Moreover, grasp the specific adaptations to imposed demands principle, type of sport additionally influences SEBT values.

The excursion attain of SEBT in accordance with gender shows that male individuals have greater normalized excursion attain ratings in all 8 instructions of the SEBT in contrast with females, because height and leg length of male subjects were comparatively higher than females. Males possess higher balance overall performance than females due to the fact that in females postural sway increase due to the increase in body weight. When body weight is greater in comparison to muscle mass then it will fail to keep stability resulting in less attaining of the distance.[16]

Craniovertebral angle

Members who had been immense smartphone users had low (abnormal) craniovertebral perspective and those who were non-excessive smartphone customers had a high (normal) craniovertebral angle. This condition may additionally be attributed to the reality that many human beings use smartphones with the head shifted forward and the smartphone positioned close to the waist or lap while in a sitting position. Most smartphone tasks require users to stare sharply downward or to hold their hands out in front to the screen which makes the head pass forward.

Moreover, the upkeep of this head shifted ahead function decreases the lordosis of thelower cervical vertebrae and creates a posterior curve in the upper thoracic vertebrae to maintain balance which decreases the craniovertebral attitude. The male individuals are usually taller than the female individuals which may be a contributing element to the low craniovertebral attitude among the male participants.[17]

The need of this study was to determine whether there was any neck postural deformity emanated in the college students due to the increased screentime during their online classes in COVID outbreak. To find any abnormality in the postural control of college students due to prolonged use of smartphones and laptops in pandemic conditions. The study objective was to analyse the effect of screentime in college students duringCOVID-19 online classes on their neck posture and postural control.

METHODS

Study design and methods

An Observational Study was conducted at Tejasvini Hospital Group of Institutions, Mangalore. Total of 33 participants meeting eligibility criteria were included in the study by using a questionnaire in which 3 were excluded as per the exclusion criteria with the help of the questionnaire. The study included both male and female students who were aged between 18-25 years and students who attended the online classes more than 04-05 hrs per day during COVID-19 pandemic (Jun 2021 - Dec 2021). The students who were not willing to give a consent, students with spinal deformities at the level of thoracic or lumbar spine, recent surgical history of the spine, severe neck pain with VAS greater than 08, & the students with any vestibular problems were excluded from the study. The study was conducted after obtaining the institutional review committee approval of Tejasvini Physiotherapy College, Mangalore.

Procedure

The informed consent was obtained from the subjects prior to the data collection. The subjects were selected for the study by using a questionnaire regarding body posture and ergonomics, duration of laptop or smartphone, headset use and body ailments. The height of the subjects were measured by making them stand in an anatomical position in front of the wall, by keeping a ruler of 15 cm horizontally towards the wall and the point is marked on the wall. The total length from floor to the point was measured by using an inch tape. The weight was measured by using a weighing machine and the BMI of the subjects were calculated.

Outcome measures

A) Craniovertebral angle**:** It was measured for assessing neck deformity. Prior to the measurement, procedure was demonstrated to the subjects. The subjects were standing in a sagittal plane and a plumb line was hanging from a support from 1 metre distance away from the subject. The plumbline was passing anterior to the acromion process and through the tragus of the ear. The spinous process of C7 and the tragus of ear were marked with an adhesive tape. A smartphone was kept in a tripod stand posterior to the plumbline and a photograph of the subjects were taken. In the photograph, craniovertebral angle was measured by a protractor, marking the angle between the line connecting C7 spinous process with the tragus of the ear and the horizontal line through the C7 spinous process. The line passing through the C7 spinous process was drawn by using a level scale. Average range of the angle was 46 to 50°. Smaller the craniovertebral angle more severe the forward neck posture. B) Visual Analogue Scale: Using a ruler, the score was determined by measuring the distance (mm) on the 10-cm line between the "no pain" anchor and the subjects' mark, providing a range of scores from 0-100. A higher score indicates greater pain intensity. No pain (0-4 mm), mild pain (5-44 mm), moderate pain (45-74 mm), and severe pain (75-100 mm). C) Berg balance scale: To evaluate the postural control Berg balance scale was used. This was to objectively determine the subjects' ability (or inability) to safely balance during a series of predetermined tasks. It was a 14-item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete. The total score of the subjects were found and interpreted. D) Star excursion balance test**:** To find dynamic balance Star Excursion Balance Test was used. Four strips of athletic tape were taken in which two pieces were used to form a '+', with the other two which was placed over top to form an 'x' so that the shape of a star could be formed, all lines were separated from each other by a 45° angle.

The goal of the Star excursion balance test was to maintain single leg stance on one leg while reaching as far as possible with the contralateral leg. The subject performing the test must maintain their balance on one leg, while using the other leg to reach as far as possible in 8 different directions: anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral. When the subject demonstrates a significantly decreased reach while standing one leg the Star excursion balance test has highlighted his/her loss of dynamic postural control.

Statistical analysis

As the data follows normal distribution (Shapiro-Wilk test) demographic data were summarized by using mean, standard deviation (SD), frequency and percentage. Comparison of study variable based on height were analysed by using one-way Anova. Correlation between CV angles with BMI & BBS were established by using Pearson correlation coefficient. The significant level of the study were 95% CI ($p<0.05$).

RESULTS

Majority of study participants were females (56.70%) than males (43.30%) and majority of the participants BMI were belongs to normal category (n=15). Participants with height ranging from 141-150 cm was 3.30%, 151-160 cm, 171-190 cm was 33.30%, 161-170 cm was 30%. Among 30 individuals considered for the study, it was observed that the 33.30% of the population had forward neck posture (<46 degree) and participants with cervical hyperlordosis (>50 degree) were 46.70%. A negative correlation between CV angle and BMI and a positive correlation between CV angle and BBS were established in this study.

Table 1: Demographic data of the study subjects.

Variables	Mean±SD
Age (years)	21.13±1.38
Height (cm)	164.15±9.56
Weight (Kg)	55.66±14.46
BMI (Kg/M^2)	20.47±4.29
CV angle (degree)	50.36±6.18
BBS	51.06±2.08

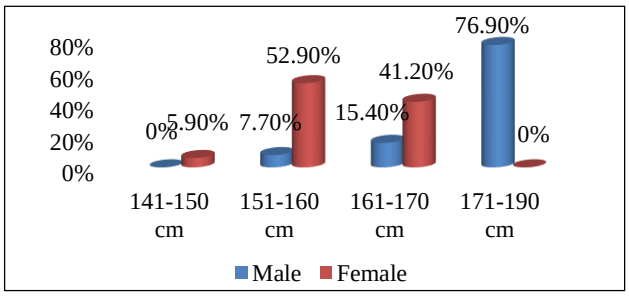

Figure 1: Height distribution based on the gender.

Table 2: SEBT values based on the directions.

SEBT directions	Right	Left
	Mean±SD	
Anterior	74.95±8.83	76.67±8.36
Anteromedial	78.52±11.44	77.30±9.57
Medial	76.15±10.09	77.03±12.75
Posteromedial	74.39±11.13	75.87±10.33
Posterior	68.92±14.19	69.94±10.92
Posterolateral	66.47±11.73	65.30±12.49
Lateral	63.22±10.12	62.61±8.18
Anterolateral	70.76±8.80	72.91±9.57

Table 2: Berg balance score based on the category of height.

Variables	Height category	Mean±SD	F value
BBS	141-150 cm	53.00±0	0.289*
	151-160 cm	51.10±1.66	
	161-170 cm	51.00±2.73	
	171-190 cm	50.90±2.02	
*Test performed was One-way Anova and shows between the groups there is no statistical difference			

Table 3: SEBT direction values based on the category of height.

SEBT direct-ions	141-150 cm (n=1)		151-160 cm (n=10)		161-170 cm (n=9)		171-190 cm (n=10)		F value	
	Mean ± SD									
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Ante-rior	82.38 ±0	86.87 ±0	76.02±6.45	75.74±6.47	71.97±10.78	76.53±12.02	75.83± 9.44	76.71± 6.49	0.633 *	0.511 *
Antero - medial	77.14 ±0	94.71 ±0	78.57±8.69	76.91±7.68	76.90±13.82	77.05±12.81	80.07±13.06	76.19±7.42	0.115 *	1.174 *
Medial	77.14 ±0	91.15 ±0	76.98±8.31	74.30±5.89	74.96±13.63	77.09±17.72	76.28±9.56	78.29±13.34	0.061 *	0.567 *
Postero - medial	70.06 ±0	84.48 ±0	71.11±8.98	74.91±11.43	76.81±11.66	74.00±8.42	75.93±13.26	77.65±11.59	0.518 *	0.430 *
Posteri or	63.14 ±0	73.37 ±0	63.44±11.69	64.66±9.02	70.82±17.89	69.67±14.53	73.27±12.89	75.10± 7.32	0.909 *	1.663 *
Postero -lateral	66.07 ±0	78.78 ±0	64.22±11.27	61.44±12.66	63.70±14.75	61.13±13.56	71.25±9.18	71.56± 9.03	0.828 *	2.086 *
Lateral	77.19 ±0	73.29 ±0	60.66±6.61	60.99±9.82	61.00±9.11	60.94±8.55	66.38±12.96	64.68± 5.60	1.363 *	1.041 *
Antero -lateral	88.46 ±0	89.97 ±0	69.14±7.23	69.74±9.21	67.29±8.49	72.19± 8.91	73.74± 8.58	75.02± 9.54	2.716 *	1.721 *
*Test performed was one way ANOVA and shows between the groups there is no statistical difference										

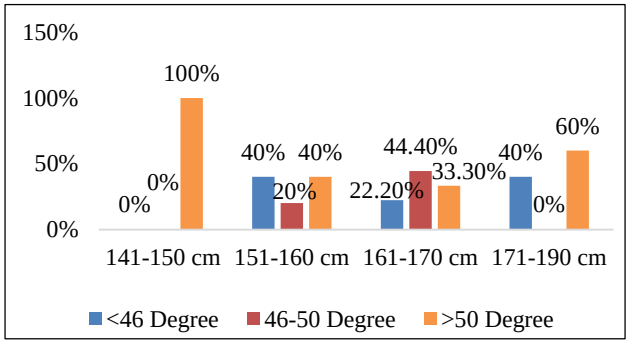

Figure 2: Craniovertebral angles based on the category of height.

Table 4: Correlation between CV angles with BMI & BBS.

Variable (s)		r value	Sig. (2-tailed)
CV angle	BMI	- 0.564	.001*
	BBS	0.823	.000*

DISCUSSION

The study purpose was to determine the effect of Covid-19 online classes on the neck posture and postural control in the college students. The result of the present study proved that there is a direct relationship between craniovertebral angle and balance and inversely proportional to BMI.

This study has undertaken due to scenario of covid 19 online classes that leads to prolonged use of smartphones and other online platforms for their educational purposes. This leads to various postural abnormalities in their body. According to Gir et al (2002), prolonged sitting increases a number of risk factors that result in a variety of postural alterations. These risks result from increased computer use, which has been linked to an increased risk of MSD, particularly in the upper limb and cervical spine.[18] Kotowski et al (2021), in their study demonstrated that static postures in students are likely to occur in the neck and shoulder areas, increasing forward neck flexion and static muscular tension.[2]

In our study we spotted that there is a negative correlation between BMI and CV angle i.e.; as BMI increases, CV angle decreases and vice versa. Dezousa et al (2005), in their studyproved that anterior head posture is caused by spinal malalignment, greater thoracic kyphosis, and lumbar lordosis in patients with higher body mass indexes. As CV angle decreases the balance will also decrease in our study.[19] Ando et al (2020), in their study found that it might be challenging to maintain good balance when a person has a protruding abdomen, which encourages the anterior relocation of COG anteversion of the pelvis and accompanying rise inlumbar.[20]

Hang et al (2016), in their study established that in order to maintain balance, pupils who are seated more in front of laptops have protruded heads and anteriorly altered COGs.[14] These people have postural instability and a decline in motor control capacity, which can be measured in terms of their balancing abilities. Due to prolonged sitting in online classes can lead to weakness and atrophy of neck muscles that affects the joint proprioception. Lee et al (2012), in their study proved that Online classes that require a lot of sitting cause forward head posture and decreased joint proprioception.[7] Dariuz et al (2018), in their study proved that during prolonged sitting, the function of stabilizing muscles is disturbed by hypoactivity reaction resulting in muscular weakness and hyperactivity of mobilizing muscles and decrease in flexibility which finally led to the pathological chain of reaction within musculoskeletal system.[21]

The deficit in the postural control of the students can be due to improper proprioception of neck muscles because of the prolonged sitting in the online classes lead to the cervical muscle weakness. Hamberto et al, in their study found that certain neuromuscular systems that control posture enable the head to retain this position. The vestibular system, which is a component of the hearing organ that is internal, is a balancing organ that uses sensory receptors in semi-circular channels to determine where the head is in space and how it is moving. The second control mechanism is the ocular system, which in addition to positioning the visual field to provide spatial perception also has a joint position sense ocular function that causes eye and neck muscles to contract together in unison. Both systems are crucial for keeping the head in place and for synchronizing movements of the head, neck, and eyes through the labyrinthine and ocular straightening reflexes, both of which can affect the neck muscles' activity.

The tonic neck reflex is created by the neck's proprioceptors and is brought on when the cervical spine's ligaments are stretched. This reflex is activated by stimulating the tendinous Golgi organs. Thus, one can maintain a lifted head at all times thanks to a reflex contraction of the neck muscles caused by this. According to this latter process, the cranio-cervical position is fundamentally under control. The same core neuromuscular systems that regulate body posture also regulate cranio-cervical posture. The brain control system and the peripheral system (tonicneck reflex) may combine to produce the head orientation. The tonic neck reflex appears to be a mechanism by which the latter system's effects on head posture are conveyed. The cranio-cervical posture that patients most frequently adopt when both neuromuscular systems (peripheral and central) have failed to acquire and maintain the individual's upright postural position is the forward head position.[22]

CONCLUSION

Students spent profuse period of time in front of laptops and other web-space due to the implementation of e-learning policy during the COVID-19 pandemics. In particular, the neck region developed aberrant posture as a result. Students who attended the online classes had a lower craniovertebral angle, which also had an impact on their ability to maintain the normal posture. According to these findings, it is imperative to teach the students about the excellency of the ergonomics in order to minimize or to prevent the postural alterations caused due to the improper postural acquisition. The necessity of the micro-breaks after every hour, proper ergonomical workspaces and changing the postures will lessen the postural deviations originated by the extended use of the technology.

Recommendations

We recommend future studies with larger samples and imaging/ electro-diagnostic tools can be used to improve the precision of the measurement of CV angles.

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