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Research Article

Evaluation of Craniovertebral Angle in Bike Riders Using Global Postural System

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Abstract

Background:

Craniovertebral angle (CVA) which is also known as forward head angle or cervical angle is used for the assessment of posture. Mainly forward head posture (FHP) or cervical abnormality is seen if this angle is short. head posture.

Objective: The objective of this study is to evaluate the craniovertebral angle in bike riders using a global postural system tool.

Methodology: This cross-sectional study aims to evaluate the craniovertebral angle (CVA) in bike riders using the Global Postural System (GPS). The craniovertebral angle was drawn in GPS as the angle between a line connecting the tragus of the ear to the seventh cervical vertebra (C7). Measurements were taken in a supervised environment. The GPS will capture real-time data on the head and neck posture of bike riders.

Results: Out of 98 participants 58.16% had lower than 50 degrees of craniovertebral angle which indicated forward head posture, while 41.84% had higher than 50 degrees of craniovertebral angle. Out of the 98 participants, there were 67.3% of individuals with the frequency of 66 whose helmets weighed 1-2 kg and 32.7% individuals with the frequency of 32 whose helmets weighed over 2kg.

Conclusion: This study concluded the differences in CVA caused by the use of two different types of helmets and to determine how the usage of helmets affected riders' CVA using GPS. We got to know that there is a significant change in CV angle with participants using helmets with different weights

Keywords: craniovertebral angle; forward head posture; global postural system; bike riders

Introduction

Craniovertebral angle (CVA) which is also known as forward head angle or cervical angle is used for the assessment of posture. Mainly forward head posture (FHP) or cervical abnormality is seen if this angle is short. This angle is between two lines, one coming from the tragus of the ear to the outer skin of the C7 spinous process and the second line which is horizontal and is cutting the midline of the body till C7]. Craniovertebral angle (CVA) measurement is very important for the measurement of any abnormality of the cervical spine, especially, FHP. A study suggested that the prevalence of FHP is 85.5% and there is a correlation between FHP and gender [2] Prevalence of FHP in school-going children and teenagers is 53.5 % [3]. Nowadays there are various reasons for the shortening of CVA which include excessive usage of smartphones and bike riding. A short craniovertebral angle indicates forward head posture [4].

This angle was previously measured by goniometer which is an instrument for measurement of different angles and range of motions. But now it can be measured by a tool named as Global postural system (GPS). The global postural system is a computerized tool that is used for photographic postural assessment. It consists of a ruler, a fixed floor, and a digital camera for photographic assessment [5]. There are many studies that inform us about the reliability of the global postural system, not just in terms of cervical assessment for FHP but also for chronic neck pain and also for thoracic and lumbar assessment of posture [6].

Occupational and non-occupational bikers' craniovertebral angle is affected as the head is in a forward position while driving. Prolonged flexion of the neck makes our extensor muscles weak which are very important for upright posture and normal posture of the cervical spine. It is also seen that there is a muscular imbalance between neck muscles and fatigue which is caused by prolonged bike riding with or without a helmet [7].

Motorcyclists, and cyclists using helmets are more prone to muscular imbalance and fatigue mainly in the cervical area and hence forward head posture.CV angle is much shorter in bikers using heavy helmets than the bikers using light helmets [8].

Decreased cranio-vertebral angle is strongly related to forward head posture. This can also lead to other postural deformities and gait disturbances. Static and dynamic balance along with cervical proprioception can also be affected. Decreased plantar flexion in the ankle and restricted mobility in knee and hip joints are also seen in patients with chronic forward head posture [9].

In 2023, Aafreen et al. studied bike riders who had and did not have neck pain. Two groups of one hundred bike riders, ages twenty to fifty, were formed: fifty of them (n = fifty) had neck pain and fifty of them did not. A head repositioning test was used to measure cervical ROM, a plumb line was used to compute CVA from lateral-view photos, and neck proprioception was evaluated. When compared to their counterparts without neck discomfort, bike drivers experiencing neck pain showed significantly reduced cervical ROM (p-value=<0.001), poorer neck proprioception (p-value=<0.001), and decreased CVA (p-value=<0.001). Neck discomfort was found to have a substantial negative connection with QOL, with worse scores in each of the eight SF-36 categories [10].

Aoun Hassan et al. carried out a cross-sectional study in 2023 in twin cities. Once the inclusion and exclusion criteria were adopted, 227 individuals were chosen. Numerous venues in Rawalpindi and Islamabad provided information on cyclists. This study found a connection between neck pain, weight, and helmet wear. The Neck Pain and Disability Scale was used to gauge the degree of pain. During data processing, 227 out of the 370 individuals (SPSS 26.149, or 65.6%) reported experiencing neck pain. 87 volunteers reported that they experienced no neck pain while wearing helmets. According to the survey, 65.6% of bike riders in the Twin Cities who wore helmets reported having neck pain [11].

Understanding the frequency of deviations in the craniovertebral angle among bike riders is essential for several reasons including Long-term neck and head alignment problems when riding can cause postural tension and pain. The research gains a technical advantage which includes the use of the Global Postural System, which enables accurate and quantitative measurement of the craniovertebral angle. Current research focuses mostly on general posture, lower back discomfort, and musculoskeletal diseases connected with cycling. However, the cranio-vertebral angle, a vital predictor of head and neck posture, has not been well studied in the context of bike riding. This angle is critical for understanding the pressure on the cervical spine and its possible long-term health consequences for cyclists. Furthermore, the use of GPS, a sophisticated and comprehensive technology for postural evaluation, is underutilized in cycling studies. Existing research often uses less precise methodologies, which might result in mistakes in postural assessment.

Materials And Methods

This study employed a cross-sectional design to evaluate the craniovertebral angle (CVA) in bike riders using the Global Postural System (GPS). Data was collected from the neurological department of ULTH. The sample size comprised 98 participants, selected through non-probability convenient sampling. To provide a representative and homogeneous sample, we set certain inclusion and exclusion criteria. The inclusion criteria for this study are as follows: participants must be male, aged between 20 and 40 years, and must ride a motorbike while wearing a helmet. The exclusion criteria are extensive to ensure the validity and safety of the study. Participants will be excluded if they have a cervical rib fracture, a history of cervical surgery, or facial trauma. Additionally, those with cervical congenital anomalies, repeated middle ear infections, or any neurogenic conditions such as cervical radiculopathy, impingement, or cervical spondylosis will also be excluded from the study. This careful selection process aims to create a homogeneous study population and minimize confounding variables. The Validity and reliability of the GPS was assured. After Ethical approval, the data was obtained from males, and assessment was done using GPS. Then the data was evaluated. This research poses no risk to participants and is unlikely to have any negative consequences. The information was kept secret and not utilized for any other research. First Data was verified and then entered in SPSS through MS Excel. SPSS 26 was employed to generate results. Mean and standard deviation were calculated for continuous or quantitative variables with graphical representation through a histogram. The qualitative or categorical variables were calculated in terms of frequency percentages with bar charts. The association was assessed through inferential statistics using the chi-square Test.

Results & Discussion

The study included a total of 98 male bike riders. Out of the 98 participants there were highest was 11.2% individuals with a frequency of 11 of age 25 and the lowest being 1.0% of age 33, 36, 29. there were 67.3% individuals with frequency of 66 whose helmet weights 1-2 kg and 32.7% individual with frequency of 32 whose helmet weights over 2 kg (Table 1).

	Frequency	Percentage
1-2 kg	66	67.3%
Over 2 kg	32	32.7%
Total	**98**	**100%**

Table 1: Descriptive statistics of Gender

The sample size of 98 male bike riders with distinctions based on helmet weight was divided into 2 categories one with 1-2 kg and the other with more than 2 kg. Out of the 98 participants are maximum of 11.2% were individuals of age 25 and a minimum being 1.0% of age 33, 36, 29. 67.3% of individuals with the frequency of 66 whose helmets weights 1-2 kg and 32.7% of individuals with the frequency of 32 whose helmets weights over 2 kg.

The primary aim of this observational cross-sectional study was to assess the cranio-vertebral angle (CVA) in bike riders with helmets during dynamic cycling activities using helmets of different weights, employing the GPS for accurate and real-time measurements. The observed variations in the CVA among participants indicate the dynamic nature of head and neck posture while riding a bike using helmets. This suggests that factors such as individual age, helmet geometry, and weight, along with personal preferences contribute to the increased cranio-vertebral angle causing forward head posture (8, 12).

This study included participants with an age range between 20-40 years and all men (Table 2), meanwhile, a study in 2023 by Baruah Pallabi was done to evaluate the posture of the cervical spine in which 300 participants were included and most of them were male and aged 20-30 years and concluded that there was a strong relationship between the weight of the helmet and FHP (7).

Statistics		
age of bike riders (20-40)		
N	Valid	98
	Missing	0
Mean		27.5204
Std. Deviation		5.29974

Minimum	20.00
Maximum	40.00

Table 2: Descriptive statistics of age of riders

There were 27 individuals whose craniovertebral angle was higher than 50 degrees and 39 individuals with less than 50-degree angles with 1-2 kg helmets. While 14 have a higher than 50-degree angle with a helmet weight of more than 2 kg and 18 individuals with less than 50-degree angle with more than 2 kg helmet weight (Table 3). Out of 98 participants 58.16% have higher than 50 degrees of craniovertebral angle while 41.84% have less than 50 degrees of craniovertebral angle.

CVA	**Frequency**	**Percentage**
Higher than 50 degree	41	41.8%
Less than 50 degree	57	58.2%
Total	**98**	**100%**

Table 1: Descriptive statistics of CVA

This study shows a significant association between helmet weight and CV angle. A previous study by Fouzia Khan in 2015 also displayed similar results when she compared three different types of helmets and found that there is a significant difference in CV angle with different helmet weights.

This study shows that there is a greater prevalence of participants with FHP and helmet weight of more than 2kg. In another previous study, bike riders were assessed, changes in cervical, thoracic, and lumber areas were related to prolonged bike riding and it was discovered that the majority of participants have an increased cervical lordotic curve; these alterations are all caused by prolonged bike riding and poor sitting position. So in this study, we purely focused on the cervical region and evaluated the CV angle which is related to FHP. Moreover, helmet weight is also related to neck pain and FHP (Table 4). Participants who used helmets weighing more than 2kg had a greater incidence rate of having neck pain (7). The significance value ($p = < 0.01$) shows that there is a significant relationship between helmet weight and forward head posture. The cross-tabulation table shows that subjects using helmets of over 2kg were more prone to develop forward head posture as compared to those who use 1-2 kg helmets.

CVA * Helmet Crosstabulation				
Count				
		Helmet		Total
		1-2kg	over 2	
CVA	higher than 50 degree	40	12	57
	less than 50 degree	26	20	41
Total		66	32	98

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.496[a]	1	.001		
Continuity Correction[b]	.236	1	.001		
Likelihood Ratio	.493	1	.001		
Fisher's Exact Test				.001	.003
Linear-by-Linear Association	.491	1	.001		
N of Valid Cases	98				

Table 2: cross-tabulation of CVA with different weight

However, the specific assessment of CVA using advanced technology such as GPS is relatively novel. The study's outcomes provide valuable information on the evolving understanding of how a rider's helmet weight provides unnecessary forces to the cervical spine causing deviation of craniovertebral angle during bike riding, complementing existing knowledge on the broader topic of bike-related musculoskeletal issues.

The observed variations in the CVA have practical implications for helmet ergonomics and musculoskeletal health (13). The identification of ideal helmet weight with their association during bike riding parameters, suggests the potential tailored interventions and ergonomic recommendations for patients with forward head posture. Bike riders, especially those experiencing discomfort or strain in their shoulder and neck region, could benefit from awareness of their head and neck posture and make adjustments for helmet weight accordingly.

Conclusion

This study concluded the differences in CVA caused by the use of two different types of helmets and determined how the usage of helmets affected riders' CVA using GPS. We got to know that there is a significant change in CV angle with participants using helmets with different weights. Evaluating the cranio-vertebral angle in bike riders using the Global Postural System (GPS) has numerous constraints that must be recognized. First, extrinsic variables such as lighting conditions may impair GPS accuracy, influencing picture quality and, as a result, angle measurement precision. Furthermore, the GPS is dependent on the proper positioning of markers and the rider's ability to keep a constant posture during the evaluation, which may create unpredictability and possible mistakes in the data. Another disadvantage is the GPS assessment's static nature; it only records a single point in time and may not fully depict dynamic postural changes that occur during real riding circumstances.

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Disclaimer

The opinions stated in this research are exclusively those of the authors and do not necessarily represent those of any connected institutions or funding sources. The results and conclusions offered are based on the data obtained and the authors' interpretations and should be viewed in light of the study's limitations.

Conflict of interest

The authors indicate that there are no conflicts of interest with the publication of this work. We have no financial, personal, or professional links that may be interpreted as biasing the research, data interpretation, or findings made in this study.

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