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Comparison of cervico – vertibral angle (CVA) among final year physiotherapy students during activities in outpatient department standing and classroom sitting

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Abstract
Introduction: Musculoskeletal Disorders (MSDs) are a significant occupational health concern globally. Traffic Police Personnel (TPP) are a high-risk group due to prolonged static postures, continuous standing, and exposure to environmental stressors, predisposing them to Work-related Musculoskeletal Disorders (WRMSDs).
Aim: To determine the prevalence, distribution, and functional impact of WMSDs among traffic police personnel in Surat, Gujarat, India.
Materials and Methods: This cross-sectional study included 152 TPP aged 20–50 years. The Modified Nordic Musculoskeletal Questionnaire (NMQ), a validated and widely used tool for screening region-specific musculoskeletal symptoms was used to capture information on 12-month pain, 12-month activity limitation, and presence of pain in the past 7 days.
Results: The most commonly affected regions in the past 12 months were the lower back (25.0%), knees (21.1%), neck (13.8%), and foot/ankle (9.9%). Activity restriction in the last 12 months was highest for the knees (10.5%), followed by the lower back (4.6%). Age-wise analysis showed that lower-back pain predominated in the younger group (20–30 years), while knee pain sharply increased with age, peaking in the 41–50-year group (48.1%).
Background: Forward head posture (FHP) is a common postural deviation observed among students and healthcare professionals, especially those exposed to prolonged sitting and standing activities. The cervico-vertebral angle (CVA) is a reliable and widely accepted parameter for assessing FHP. Physiotherapy students are exposed to varying postural demands during classroom sessions and outpatient department clinical work, which may influence cervical posture.
Objectives: To measure and compare the cervico-vertebral angle (CVA) among final-year physiotherapy students during OPD standing activities and classroom sitting, and to determine the prevalence of forward head posture in both settings.
Methodology: A cross-sectional observational study was conducted on 100 final-year undergraduate physiotherapy students aged 20–25 years using convenient sampling. Lateral posture photographs were taken in classroom sitting and OPD standing positions using a digital camera mounted on a tripod. Anatomical landmarks (tragus of ear and C7 spinous process) were marked, and CVA was measured using Kinovea software. The average of two readings was considered for analysis. Data were analysed using paired and unpaired t-tests.
Results: The mean CVA was found to be significantly lower during classroom sitting compared to OPD standing, indicating increased forward head posture in the sitting position ($p < 0.05$). A high prevalence of forward head posture was observed among participants in both settings, with a greater prevalence during classroom sitting.
Conclusion: There is a significant difference in cervico-vertebral angle between OPD standing and classroom sitting among final-year physiotherapy students. Classroom sitting demonstrates a greater tendency toward forward head posture. Early ergonomic education and postural correction strategies are recommended to prevent long-term musculoskeletal complications.

Keywords: Cervico-vertebral angle, forward head posture, physiotherapy students, classroom sitting, OPD standing

Introduction

Posture plays an important role in maintaining proper musculoskeletal health, especially in students and healthcare professionals who spend long hours sitting or standing in fixed positions. One of the common postural problems seen in this group is Forward Head Posture (FHP). The Cervico-Vertebral Angle (CVA) is commonly used to measure FHP.

CVA is defined as the angle formed between a horizontal line passing through the spinous process of the seventh cervical vertebra (C7) and a line drawn from C7 to the tragus of the ear. When this angle becomes smaller, it indicates that the head is positioned more forward. A reduced CVA shows increased forward head posture, which can lead to extra strain on the neck muscles, ligaments, and cervical spine structures. This may result in neck pain and long-term musculoskeletal problems [1].

Physiotherapy students are more prone to developing forward head posture because they spend many hours attending lectures and performing clinical duties in the outpatient department (OPD). During these activities, students may maintain incorrect sitting or standing posture for prolonged periods. Continuous exposure to such postural stress can increase the risk of cervical discomfort and dysfunction. Studies have reported a high prevalence of FHP among healthcare students, mainly due to poor ergonomics and unhealthy postural habits [2]. Comparing the cervico-vertebral angle of physiotherapy students in classroom settings and during OPD work can help understand how different environments affect posture. This

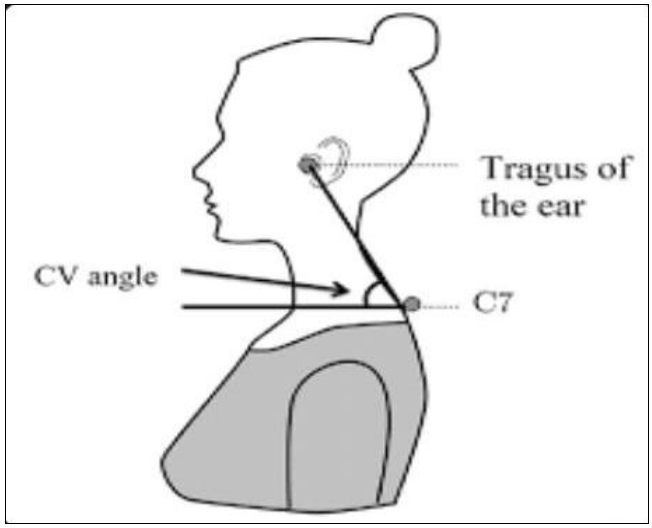
information can help in designing ergonomic awareness programs and postural correction strategies. Therefore, this study aims to measure and compare the CVA among final-year physiotherapy students during classroom sessions and OPD duties.

The study findings show that approximately 70% of physiotherapy students demonstrate forward head posture. This high percentage suggests that students are at significant risk of developing postural abnormalities. Hence, educating physiotherapy students about proper ergonomics and posture correction is essential to prevent musculoskeletal disorders in the future. Forward head posture can be assessed using various methods such as visual observation, posture measuring devices, electronic head posture systems, and cervical range of motion tools. Imaging methods like radiographs and photographic analysis are also commonly used. Among these methods, photogrammetry
(photographic analysis) is considered reliable and valid for measuring forward head posture. It has shown good correlation with radiographic findings and is simple, practical, and cost-effective for clinical use [4].

In photogrammetry, standardized lateral-view photographs are taken and analyzed using computer software. The photographs can be taken in sitting or standing positions. However, since the spine is a three-dimensional structure, assessing posture from only one side may sometimes result in minor measurement variations if there is cervical rotation or side bending. Kinovea is a free, open-source 2D motion analysis software developed in 2009. It is widely used in sports and clinical settings for measuring joint angles using digital images or videos. The software is portable, easy to use, and costeffective. It has been tested for reliability and validity in measuring joint range of motion, including the cervical spine [5]. Some important advantages of Kinovea include:

1. Free availability
2. No need for physical sensors
3. Ability to zoom images for accurate angle measurement
4. Easy comparison of pre- and post-intervention measurements

Due to these benefits and its proven accuracy, Kinovea is increasingly used as a clinical tool for measuring body angles and posture assessment [6].



Need of Study

Forward head posture (FHP) is increasingly recognized as a common postural deviation among students and healthcare professionals, especially those engaged in activities that require prolonged sitting, such as attending lectures or performing clinical tasks in outpatient departments (OPDs). Physiotherapy students are particularly.

susceptible due to the dual demands of academic study and hands-on clinical training. Despite being educated in ergonomics and posture, these students may unknowingly adopt faulty postures that could predispose them to musculoskeletal issues, particularly in the cervical spine.

The cervico-vertebral angle (CVA) is a reliable and non-invasive measure used to assess the degree of FHP. A reduced CVA indicates a forward positioning of the head, which has been linked to neck pain, reduced proprioception, and functional limitations. While numerous studies have examined FHP in office workers and general student populations, there is limited literature specifically focusing on physiotherapy students and how their posture may vary between academic Classroom and Clinical settings.

Given the importance of posture in the prevention of musculoskeletal disorders and the professional role physiotherapists play in modeling and teaching proper body mechanics, it is essential to understand their own postural tendencies. This study will help identify whether a significant difference exists in the CVA of physiotherapy students in different working environments. The findings can contribute to early intervention strategies, curriculum adjustments, and ergonomic training programs aimed at promoting better postural awareness and spinal health in future healthcare providers.

Aims and Objective

Aim 1: To measure and compare the cervico – vertebral angle (CVA) among final year physiotherapy students during activities in outpatient department (OPD) setting and classroom sitting.

Objectives

1. To measure the cervico- vertebral angle (CVA) of final-year physiotherapy students while they are working in the OPD setting.
2. To measure the cervico-vertebral angle (CVA) of the same students while they are seated in a classroom environment.
3. To compare the cervico-vertebral angles between the two settings to determine any significant difference in posture.
4. To identify the prevalence of forward head posture (FHP) among the participants in both settings.

Materials & Methodology

- Source of data – Rashtrasant Janardhan swami college of Physiotherapy
- Study design – A cross-sectional observational study.
- Sample population – Final year undergraduate physiotherapy students involved in both classroom sessions and OPD clinical duties.
- Sampling method – Convenient sampling
- Sample size – 100 Participants

- Participants – Final year undergraduate physiotherapy students
- Study duration – 6 months

Materials

1. Digital Camera or Smartphone with HighResolution Camera To capture lateral posture images of participants in both OPD and classroom settings.
2. Tripod Stand
3. To ensure consistent height and angle while taking posture photographs.
4. Plumb Line or Wall Grid (Optional)
5. To assist in aligning the participant and maintaining consistency in posture assessment.
6. Reflective Markers or Skin-safe Adhesive Dots
7. To mark anatomical landmarks such as the tragus of the ear and spinous process of C7 vertebra.
8. Computer with Image Analysis Software (e.g., Kinovea or AutoCAD)
9. To measure the cervico-vertebral angle accurately from captured images.
10. Informed Consent Form
11. To obtain voluntary participation and agreement from the students.
12. Data Recording Sheet or Spreadsheet Software (e.g., Microsoft Excel)
13. For documenting CVA measurements and other relevant participant data.
14. Stationery
15. Pens, markers, notepads, and other general supplies for recording and organizing data.

Selection Criteria

Inclusion criteria

1. Final-year undergraduate physiotherapy students.
2. Students actively participating in both outpatient department (OPD) clinical duties and classroom academic sessions.
3. Age between 20 to 25 years.
4. Willingness to participate and provide informed consent.

Exclusion criteria

1. Students with a history of cervical spine injury, surgery, or congenital spinal deformities.
2. Students currently undergoing treatment for neck pain, musculoskeletal disorders, or postural correction.
3. Presence of neurological conditions affecting posture or balance.
4. Use of assistive devices or braces that may influence head or neck posture.

Outcome Measures

1. **Cervico-Vertebral Angle (CVA) Description:** CVA is the angle formed between a horizontal line through the spinous process of C7 and a line drawn from C7 to the tragus of the ear. It is a widely used measure to assess forward head posture. Tool: Digital photography and image analysis software (e.g., Kinovea or AutoCAD). Scoring: A smaller CVA (<50°) typically indicates forward head posture; higher angles suggest more neutral head posture. Reliability: Intraclass Correlation Coefficient (ICC): 0.83 to 0.89 [7, 8]
2. **Photographic Postural Assessment Description:** Standardized digital photographs are used to assess postural alignment in the sagittal plane.

Tool: Digital camera, tripod, reflective markers, and analysis software.
Scoring: Measurement of angles like CVA; data recorded in degrees.
Reliability: ICC: 0.96 for sagittal plane postural angles using digital images [9].

Procedure

Ethical Considerations:
Data Collection:

1. Sitting
2. Standing

Prior to data collection, ethical approval was obtained from the Institutional

Ethics Committee. Informed written consent was taken from all participants.

1. Participants was briefed about the purpose and procedure of the study.
2. Reflective markers were placed on two anatomical landmarks: The tragus of the ear. The spinous process of the 7th cervical vertebra (C7)
3. Each participant was photographed from the right lateral view: Once while seated in the classroom (during a regular lecture session) Once while working in the OPD (in a natural clinical posture)
4. A digital camera mounted on a tripod was used to maintain a consistent distance and height (approximately shoulder level and 1.5 meters away from the subject).
5. The images were transferred to a computer and analyzed using Kinovea (or equivalent image analysis software) to measure the cervicovertebral angle (CVA).
6. The angle formed between a horizontal line through C7 and the line joining C7 to the tragus was measured. A smaller angle indicates a more forward head posture.
7. Each measurement was repeated twice, and the average of the two readings was taken for analysis [10].

Data Analysis

Table 1: Descriptive statistics

Variable	Mean	Std Dev	Std Err	Wer 95%	Per 95% C	N
Sitting	44.1	1.5	0.	43.78	44.385	10
deg)			2	9		0
Standing (deg)	47.0	1.5	0.2	46.708	47.314	100

Table 2: tailed t-Test

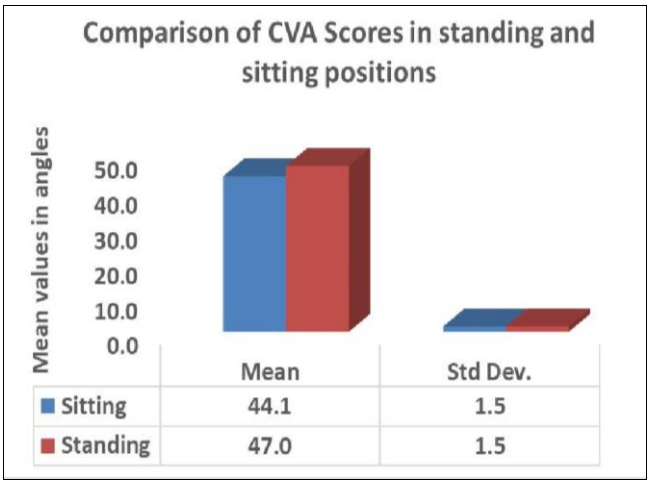
Ho. Diff	Mean.Diff	SE Diff	T	DF	P
0.000	-2.924	0.214	13.65 0	198	0.000

Inference 't' value 13.65 is significant ['p' 0.000; 'p' < 0.01]

Variable	Mean	Std Dev	Std Err
Sitting (deg)	44.1	1.5	0.2
Standing (deg)	47.0	1.5	0.2

Table 3: CVA angle comparison

Variable	Mean	Std Dev
Sitting	44.1	1.5
Standing	47.0	1.5



Result

A total of 100 final-year undergraduate physiotherapy students were included in this study. The cervico-vertebral angle (CVA) was measured for each participant in two different positions: classroom sitting and OPD standing. Photogrammetric analysis was performed using Kinovea software to obtain accurate measurements.

On comparison, the mean CVA recorded during OPD standing was higher than the mean CVA observed during classroom sitting. Since a higher CVA indicates a more neutral head posture, this finding suggests that students maintained a better head alignment while standing in the OPD. In contrast, the lower CVA values during classroom sitting indicate the presence of increased forward head posture (FHP) in that position. A paired t-test was applied to determine the statistical significance of the difference between the two positions. The analysis revealed a statistically significant difference ($p < 0.05$). Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted, confirming that head posture significantly differs between classroom sitting and OPD standing. For the assessment of prevalence, CVA values less than 50° were considered indicative of forward head posture. The results showed that approximately 70% of the students demonstrated FHP. The prevalence was notably higher during classroom sitting compared to OPD standing.

Discussion

In contrast, OPD standing typically involves dynamic postural adjustments, frequent movement, patient interaction, and greater postural awareness. These factors may facilitate improved activation of postural stabilizing muscles and reduce prolonged flexion stress on the cervical spine, contributing to a more neutral cervical alignment.

In this study, CVA values were higher during OPD standing than during classroom sitting. Since a higher CVA represents a more neutral alignment of the head and neck, this finding suggests that students maintained better cervical posture while standing in the OPD. Conversely, the reduced CVA during classroom sitting reflects increased forward head displacement in this position.

The decreased CVA observed during classroom sitting may be attributed to prolonged static posture, sustained cervical flexion, forward bending while viewing lecture materials, laptops, or mobile phones, and inadequate ergonomic support. Extended sitting often promotes a slouched posture characterized by posterior pelvic tilt, increased thoracic kyphosis, and compensatory forward head posture, thereby reducing the CVA.

The findings of the present study are consistent with previous research that reported significantly lower CVA values in sitting compared to standing among young adults. These studies concluded that sitting posture tends to exaggerate forward head posture, particularly in individuals with underlying postural deviations. Similarly, the present study demonstrates that classroom sitting results in a greater reduction in CVA than OPD standing.

The present study was undertaken to compare the cervico-vertebral angle (CVA) among final-year physiotherapy students during outpatient department (OPD) standing activities and classroom sitting, and to determine the prevalence of forward head posture (FHP) in these two environments. The results demonstrated a statistically significant difference in CVA between the two positions. A lower CVA was observed during classroom sitting, indicating a greater degree of forward head posture compared to OPD standing.

The prevalence of forward head posture in the present study was approximately 70%, indicating a high occurrence among physiotherapy students. This aligns with earlier studies reporting similar prevalence rates in this population. Despite having academic knowledge regarding posture and ergonomics, physiotherapy students appear equally susceptible to developing faulty postural habits.

Prolonged static postures involving sustained visual focus, such as desk-based academic activities, are known to contribute to forward head posture and altered cervical biomechanics. Classroom settings often demand prolonged attention with limited movement, which may explain the increased FHP observed during sitting.

Forward head posture significantly alters cervical spine biomechanics by increasing the load on posterior cervical structures. As the head translates forward, the effective load on cervical extensor muscles, facet joints, and intervertebral discs increases substantially. Over time, this may result in neck pain, muscle imbalance, reduced cervical mobility, and functional impairment.

The clinical implications of these findings are noteworthy. Physiotherapy students, as future healthcare professionals, are expected to model and teach optimal posture. Persistent faulty posture during their training may predispose them to early musculoskeletal disorders and potentially affect professional performance.

The high prevalence of FHP suggests a gap between theoretical knowledge and practical implementation of ergonomic principles. Factors such as inappropriate desk and chair height, prolonged lecture sessions without adequate breaks, lack of ergonomic awareness, and excessive screen exposure may contribute to poor classroom posture.

These results emphasize the need for ergonomic modifications in academic settings, incorporation of corrective exercise programs, scheduled microbreaks during lectures, and reinforcement of selfmonitoring strategies. Early identification of postural deviations using objective measures such as CVA assessment may aid in preventing longterm musculoskeletal complications.

The use of photogrammetry and Kinovea software in this study provided a reliable and non-invasive method for CVA measurement. The standardized procedures, use of

anatomical landmarks, and repeated measurements enhanced the accuracy and credibility of the findings.

In conclusion, the present study demonstrates that postural demands differ significantly between academic and clinical environments, with classroom sitting associated with greater forward head posture compared to OPD standing. These findings highlight the importance of promoting ergonomic awareness and preventive strategies among physiotherapy students to minimize the risk of future musculoskeletal disorders.

List ofAbbreviation

Sr. No	Abbreviation	Full Form
1	CVA	Cervicovertebrel angle
2	FHP	Forward head posture
3	OPD	Out patient department

Conclusion

The present study concludes that there is a significant difference in the cervico-vertebral angle (CVA) of final-year undergraduate physiotherapy students between outpatient department (OPD) standing and classroom sitting postures. The CVA was found to be reduced during classroom sitting, indicating a greater degree of forward head posture when compared to OPD standing.

The findings also reveal a high prevalence of forward head posture among physiotherapy students, with approximately 70% of participants exhibiting reduced CVA values. This suggests that prolonged classroom sitting and academic activities contribute more significantly to faulty cervical posture than clinical standing activities.

Despite possessing knowledge of ergonomics and posture, physiotherapy students demonstrate poor postural habits during academic sessions, highlighting a gap between theoretical understanding and practical application. The results emphasize the need for early identification, ergonomic modifications, and postural correction strategies within academic environments.

In conclusion, classroom sitting poses a greater risk for the development of forward head posture compared to OPD standing. Incorporating postural education, ergonomic interventions, and regular posture monitoring during physiotherapy training may help prevent long-term cervical musculoskeletal disorders and promote better spinal health in future healthcare professionals.

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