Article

Screening of Forward Head Posture Through Measurement of Craniovertebral Angle in Medical Students

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ABSTRACT

Background: Forward head posture (FHP) is a prevalent musculoskeletal deviation among students, often linked to prolonged sedentary behavior and digital device use. Despite its growing incidence, limited research in Pakistan objectively evaluates FHP in medical students using validated clinical tools, creating a knowledge gap in early identification and intervention strategies. **Objective:** This study aimed to determine the prevalence and severity of forward head posture among medical students by measuring the craniovertebral angle (CVA) using a universal goniometer, and to examine its association with age and gender. **Methods:** A cross-sectional observational study was conducted at Akhtar Saeed Medical and Dental College, Lahore, involving 180 medical students aged 18–25 years. Participants with a history of spinal surgery, musculoskeletal disorders, or congenital deformities were excluded. CVA was measured using a universal goniometer in seated posture, with three readings averaged per participant. A CVA $< 50^\circ$ indicated FHP, classified into mild ($<49.9^\circ$), moderate ($<40^\circ$), and severe ($<30^\circ$). Ethical approval was obtained from the Institutional Review Board (IRB No. ASMC/2023/073), and informed consent was secured per the Helsinki Declaration. Data were analyzed using SPSS v27, with chi-square tests assessing associations between FHP severity and demographic variables. **Results:** Of 180 students, 87.8% exhibited FHP; 53.9% had mild, 32.2% moderate, and 1.7% severe FHP. No significant association was found between CVA and age ($p = 0.869$) or gender ($p = 0.407$), indicating a broad susceptibility across demographics. **Conclusion:** The high prevalence of FHP among medical students highlights the urgent need for early screening and posture correction strategies. Objective assessment using goniometry can guide clinical interventions to prevent long-term musculoskeletal complications.

Keywords: Forward Head Posture, Craniovertebral Angle, Medical Students, Posture Assessment, Musculoskeletal Disorders, Goniometry, Cross-Sectional Study

INTRODUCTION

Forward head posture (FHP) is increasingly recognized as a common postural deviation, especially among students and young adults engaged in prolonged sedentary tasks. The craniovertebral angle (CVA) serves as a reliable biomechanical indicator for evaluating FHP, offering an objective measure of head and neck alignment. It is defined as the angle formed between a line drawn from the C7 spinous process to the tragus of the ear and a horizontal line passing through the C7 vertebra. A CVA below 48–50 degrees is generally indicative of forward head posture, with lower angles representing more pronounced deviations from normal alignment (1). This posture, often

associated with modern lifestyle habits such as excessive screen time, smartphone use, and extended periods of study, can contribute to musculoskeletal discomfort, including neck and shoulder pain, cervical spine dysfunction, and reduced quality of life (2, 3).

Recent literature highlights a growing concern regarding the prevalence of FHP among students, especially those in healthcare-related fields. Studies have shown FHP rates ranging from 59% to over 70% in physiotherapy and medical student populations (2, 4). Contributing factors include poor ergonomics, heavy academic loads, and limited physical activity, all of which

are prominent in medical education settings (5). Additionally, upper crossed syndrome, a postural condition characterized by tightness in the upper trapezius, levator scapulae, and pectoral muscles alongside weakness in deep cervical flexors and scapular stabilizers, is commonly linked with FHP (11, 12). The resultant muscle imbalance further reinforces poor posture and increases strain on the cervical spine, exacerbating symptoms and predisposing individuals to chronic musculoskeletal disorders (13). Despite these known associations, most existing studies have used photogrammetric methods or self-assessment questionnaires, with limited research employing clinical tools such as the goniometer for CVA measurement in this population.

In Pakistan, there is a lack of published data evaluating FHP among medical students using objective tools like the universal goniometer, which is a practical and validated method for assessing CVA in clinical settings (14). Moreover, previous studies have often overlooked the early identification of postural abnormalities in medical students—a group at high risk due to their intensive academic demands and sustained static postures. Early detection is essential, as timely postural interventions can prevent the onset of chronic musculoskeletal issues and promote long-term occupational health and well-being (9). This study aims to address these gaps by screening for forward head posture in medical students through direct measurement of the craniovertebral angle using a goniometer, thus offering a more accurate and clinically relevant assessment method.

Therefore, the objective of this study is to determine the prevalence and severity of forward head posture in medical students by measuring the craniovertebral angle and to investigate any association between FHP and demographic factors such as age and gender. The study hypothesizes that a high prevalence of FHP will be observed in this population and that no significant association will exist between FHP severity and age or gender.

MATERIAL AND METHODS
This observational cross-sectional study was conducted over a period of six months at Akhtar Saeed Medical and Dental College, Lahore, with the objective of screening forward head posture (FHP) among undergraduate medical students. Participants were recruited using non-probability convenience sampling from the student body aged between 18 to 25 years, a demographic considered to be at elevated risk of postural deviations due to prolonged sedentary behavior and academic workload. The inclusion criteria consisted of currently enrolled medical students within the specified age range, with no prior history of spinal or cervical surgeries, known musculoskeletal disorders, or congenital deformities affecting the spine or posture. Participants presenting with scoliosis, cervical spine trauma, or diagnosed neurological or orthopedic conditions affecting neck posture were excluded to eliminate confounding influences. Recruitment was conducted in collaboration with academic departments, and each participant provided written informed consent after being briefed on the study's purpose, procedures, and voluntary nature. Ethical approval for the study was obtained from the Institutional Review Board of Akhtar Saeed Medical and Dental College (IRB approval number: ASMC/2023/073), and all procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki.

Data collection involved a single-session assessment of the craniovertebral angle (CVA) using a universal goniometer, which served as the primary outcome measure to determine the severity of FHP. CVA was measured with the participant seated in a neutral upright posture. The C7 spinous process was first identified through palpation during neck flexion and extension. The goniometer's axis was then positioned over the C7 vertebra, with the stationary arm aligned horizontally through the same level and the movable arm directed toward the tragus of the ear. This technique has been previously validated and shown to provide reliable estimates of head and neck posture in both clinical and research settings (14). To ensure measurement accuracy, three consecutive CVA readings were taken for each participant, and the average value was used for analysis. A CVA of approximately $49.9°$ was considered normal, whereas angles below 48–$50°$ indicated the presence of FHP, with specific thresholds used to classify mild ($<49.9°$), moderate ($<40°$), and severe ($<30°$) postural deviations. The secondary outcomes included age and gender-based stratification of FHP severity to assess potential demographic associations.

Data were entered and analyzed using IBM SPSS Statistics for Windows, Version 27.0. Descriptive statistics were used to report demographic variables such as age and gender, presented as frequencies, percentages, means, and standard deviations. The severity of FHP was similarly categorized and expressed in percentage distribution across predefined CVA ranges. Inferential analysis was performed using the chi-square test to examine associations between craniovertebral angle and demographic variables, including age and gender. A p-value of <0.05 was considered statistically significant. Missing data were minimized through real-time cross-verification during data entry, and no imputation methods were required. The study did not involve longitudinal follow-up, and no adjustments were necessary for confounding variables or sensitivity analysis due to the descriptive and exploratory nature of the study. All participant data were kept confidential and anonymized, with identification codes assigned to ensure data protection throughout the research process.

RESULTS
A total of 180 medical students participated in the study, with a mean age of 21.6 ± 1.7 years. The gender distribution included 93 males (51.7%) and 87 females (48.3%). The overall prevalence of forward head posture (FHP), defined as a craniovertebral angle (CVA) less than $50°$, was 87.8% (n = 158), indicating a high rate of postural deviation among the medical student population. Among these, 53.9% (n = 97) had mild FHP, 32.2% (n = 58) had moderate FHP, and 1.7% (n = 3) had severe FHP, while only 12.2% (n = 22) had a normal CVA. Table 1 summarizes the demographic data and severity classification of FHP. Notably, the 22–23 age group represented the largest segment (50%), suggesting peak academic load could contribute to postural issues.

Table 1 Demographic Characteristics and FHP Severity Distribution (n = 180)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18–19 years	15	8.3%
	20–21 years	52	28.9%
	22–23 years	90	50.0%
	24–25 years	23	12.8%
Gender	Male	93	51.7%
	Female	87	48.3%
FHP Severity	Normal (≥50°)	22	12.2%
	Mild (<49.9°)	97	53.9%
	Moderate (<40°)	58	32.2%
	Severe (<30°)	3	1.7%

To determine the relationship between FHP severity and demographic variables (age and gender), chi-square tests of independence were performed. The test for association between FHP severity and age revealed no statistically significant difference (χ^2 = 4.578, p = 0.869), indicating a uniform distribution of FHP across all age groups.

Similarly, no significant association was observed between gender and FHP severity (χ^2 = 2.899, p = 0.407). In terms of clinical interpretation, the overwhelmingly high prevalence of FHP (87.8%) highlights a significant ergonomic and musculoskeletal concern within this academic cohort.

Table 2 Cross-tabulation of FHP Severity by Age and Gender with Chi-square Analysis

Variable	Normal (n)	Mild (n)	Moderate (n)	Severe (n)	Total (n)	χ^2 Value	p-value
Age Group						4.578	0.869
18–19 yrs	1	7	6	1	15		
20–21 yrs	7	29	15	1	52		
22–23 yrs	10	49	30	1	90		
24–25 yrs	4	12	7	0	23		
Gender						2.899	0.407
Male	14	45	32	2	93		
Female	8	52	26	1	87		

The predominance of mild to moderate FHP cases suggests that postural deviations are likely in the early or developing stages, offering an optimal window for early intervention. The lack of significant association with age or gender indicates that FHP is a widespread issue, likely linked to behavioral and environmental factors common to all students regardless of demographic differences.

stage to avoid progression to more severe dysfunction. The study demonstrates that objective measurement of CVA via goniometry is both clinically feasible and diagnostically informative in identifying postural deviations, providing a valuable foundation for future screening and intervention programs targeting at-risk populations in academic institutions.

DISCUSSION

The present study investigated the prevalence and severity of forward head posture (FHP) among medical students using direct measurement of the craniovertebral angle (CVA), revealing a high prevalence rate of 87.8%. This finding underscores a critical postural concern among young adults engaged in prolonged academic activities and screen time. The majority of participants presented with mild FHP (53.9%), followed by moderate (32.2%), while only a small fraction exhibited severe FHP (1.7%) or maintained normal posture (12.2%). These results align with the growing body of literature emphasizing the impact of sedentary behavior, digital device usage, and academic stress on musculoskeletal health in student populations (2, 4, 5). The elevated prevalence in this study exceeds the rates reported in similar investigations, such as 70% among physiotherapy students (2), 63.96% in general university students (4), and 63% in adolescents aged 12–16 years (15), highlighting a potentially worsening trend influenced by evolving digital habits and academic demands. The lack of a statistically significant association between FHP severity and demographic variables such as age and gender is consistent with several previous studies that reported similar non-associations (3, 16). Although
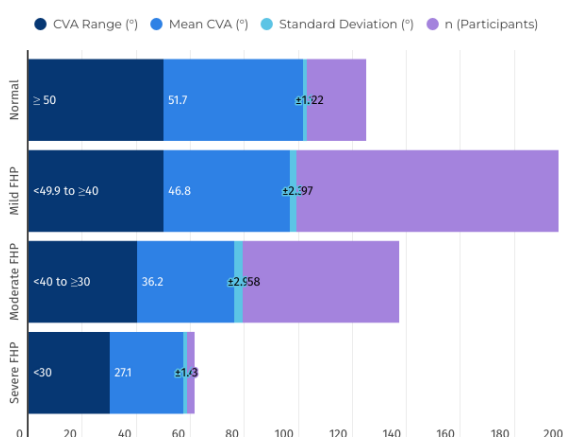
Figure 1 Mean Craniovertebral Angle (CVA) by FHP Severity Group

No unexpected trends were observed in the data, though the low proportion of students with severe FHP (1.7%) could suggest that while FHP is widespread, extreme forms are still uncommon in this age group—possibly due to the shorter duration of cumulative postural stress. Nonetheless, this emphasizes the importance of awareness and preventive strategies at an early

some studies have suggested that males, individuals with higher BMI, or taller stature may be more prone to FHP(16), the present findings suggest that FHP may be uniformly distributed across these subgroups within the medical student population. The possible explanation may lie in the homogeneous exposure of all students to similar academic routines and ergonomic challenges, irrespective of sex or age differences.

Clinically, forward head posture is associated with increased stress on cervical vertebrae and surrounding musculature, often leading to chronic neck pain, muscular fatigue, cervicogenic headaches, and compromised functional mobility (6, 9). Prolonged anterior head translation alters the biomechanics of the cervical spine, often accompanied by muscle imbalances as seen in upper crossed syndrome—a pattern characterized by tight upper trapezius, levator scapulae, and pectorals, alongside weakened deep cervical flexors and scapular stabilizers (11, 12). This muscular imbalance perpetuates the dysfunctional posture and can, over time, contribute to structural adaptations and long-term disability if unaddressed (13). The clinical relevance of early detection using objective tools such as goniometry becomes increasingly important, not only to identify at-risk individuals but also to initiate timely corrective strategies such as posture training, ergonomic education, and physiotherapeutic interventions.

An important advancement of this study lies in its methodological approach. Unlike many previous studies that relied on photogrammetry or subjective assessment tools, this study utilized a universal goniometer for direct CVA measurement, offering a reliable, cost-effective, and accessible alternative in clinical and academic settings (14). This enhances the reproducibility of the findings and supports the broader applicability of goniometric assessment in routine posture screening. Moreover, the study contributes valuable local data to a growing but still limited body of literature on FHP in Pakistani populations, thus helping to bridge a regional research gap.

However, certain limitations must be acknowledged. The cross-sectional design restricts the ability to draw causal inferences, and the convenience sampling approach may introduce selection bias, limiting the generalizability of the results beyond the single-institution setting. The sample size, although statistically adequate, may not fully capture the diversity of posture-related behaviors across different academic years, socioeconomic backgrounds, or physical activity levels. Furthermore, while the use of goniometry improves measurement accuracy, inter-rater reliability was not assessed, which may affect the consistency of measurements across different evaluators.

Future research should consider multi-center studies with larger, more diverse samples and incorporate longitudinal follow-up to examine the progression of FHP over time and its potential musculoskeletal consequences. Incorporating additional variables such as BMI, screen time, physical activity levels, and ergonomic habits could provide a more comprehensive understanding of the contributing factors. Studies exploring the effectiveness of targeted posture-correction programs and ergonomic interventions in medical students would also be of significant clinical value. Ultimately, early identification and management of FHP in student populations can contribute not only to improved musculoskeletal health but also to better academic performance and long-term occupational well-being.

CONCLUSION

This study screened forward head posture (FHP) among medical students through craniovertebral angle (CVA) measurement and found a high prevalence rate of 87.8%, with most participants exhibiting mild to moderate postural deviations. These findings underscore the growing musculoskeletal risks associated with prolonged sedentary behaviors and digital device use in academic environments. The absence of significant associations between FHP severity and age or gender suggests a widespread vulnerability across student demographics. Clinically, early identification of FHP using objective tools such as goniometry can inform timely interventions to prevent long-term cervical spine dysfunction, postural syndromes, and related healthcare burdens. From a research perspective, the study highlights the need for longitudinal, multi-institutional studies to explore contributing risk factors and evaluate the effectiveness of targeted preventive strategies in student populations.

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