

CROSS-SECTIONAL ANALYSIS OF POSTURAL ABNORMALITIES IN SCHOOL-AGED CHILDREN

Original Article

Mamoona Tasleem Afzal¹, Muhammad Aamir Zaman², Muhammad Anwar³, Hamza Siddique⁴, Hafiza Nimra Ijaz⁵, Israr Ahmad^{6*}

¹Lecturer Institute of Rehabilitation Science, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, Pakistan.

²Doctor of Physical Therapy (Bacha Khan University). Fida Medical & Peshawar General Hospital, Peshawar, Pakistan.

³Principal, Medtec College of Nursing and Allied Health Science, Dir Upper Wari, Pakistan.

⁴MS Rehabilitation Scholar, Superior University Lahore, Pakistan.

⁵Lecturer at College of Home Economics, University of Peshawar, Peshawar, Pakistan.

⁶Department of Basic Veterinary Sciences, Faculty of Veterinary and Animal Sciences, Gomal University, Dera Ismail Khan, Pakistan.

Corresponding Author: Israr Ahmad, Department of Basic Veterinary Sciences, Faculty of Veterinary and Animal Sciences, Gomal University, Dera Ismail Khan, Pakistan, Israhmad@GU.edu.pk

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ABSTRACT

Background: Postural abnormalities, including Forward Head Posture (FHP), lumbar lordosis, and kyphosis, are increasingly prevalent among young adults, particularly those in academic settings. Contributing factors such as sedentary lifestyles, suboptimal ergonomics, and reduced physical activity have exacerbated these issues globally. Despite growing awareness, limited regional research exists on postural abnormalities and their associated factors, especially in South Asia. This study focuses on young male students in Punjab, Pakistan, to address this critical public health concern.

Objective: To determine the prevalence of postural abnormalities and their associations with age, body mass index (BMI), and physical activity among young male students in Punjab, Pakistan.

Methods: A cross-sectional study was conducted from January to May 2024 across multiple academic institutions in Punjab. A total of 500 male students aged 18–25 years were selected using stratified random sampling. Data collection included demographic surveys, BMI measurements, and physical activity assessments using the International Physical Activity Questionnaire (IPAQ). Postural abnormalities, including FHP, lumbar lordosis, and kyphosis, were evaluated using photogrammetry and a spinal mouse device. Statistical analyses were conducted using SPSS version 28, with Pearson's correlation and logistic regression models applied to explore associations.

Results: The prevalence of FHP was 86.4%, making it the most common abnormality, followed by lumbar lordosis (72.8%) and kyphosis (40.6%). Participants with FHP had an average BMI of 24.5 kg/m² and a mean age of 20.8 years. Higher BMI correlated with lumbar lordosis (mean BMI = 23.7 kg/m², $p < 0.01$), while physical inactivity was significantly associated with kyphosis ($p < 0.05$). Participants aged 20–23 years exhibited the highest rates of abnormalities, with 82% falling into this age group.

Conclusion: Postural abnormalities are highly prevalent among young male students in Punjab, with FHP as the leading issue. Significant associations with BMI and physical activity levels suggest the need for targeted preventive measures and lifestyle interventions. Public health strategies must prioritize awareness and correctional programs for this vulnerable population.

Keywords: Age Factors, Body Mass Index, Kyphosis, Lumbar Lordosis, Physical Activity, Posture, Students.

INTRODUCTION

Postural health plays a critical role in maintaining musculoskeletal balance and overall well-being, especially during the formative years of life. The adoption of poor posture has been linked to a variety of physical ailments, including musculoskeletal pain, reduced functional capabilities, and chronic health conditions that may persist into adulthood (1, 2). The prevalence of postural abnormalities has risen significantly in recent decades, largely due to the growing reliance on technology, sedentary lifestyles, and suboptimal ergonomic environments in educational settings. These factors, combined with limited physical activity and improper load distribution, such as carrying heavy backpacks, have been shown to exacerbate postural issues, particularly among school-aged and young adults (3).

Scientific literature highlights that postural abnormalities such as Forward Head Posture (FHP), lumbar lordosis, and kyphosis are among the most common postural defects, often occurring in clusters (4). These conditions are not merely cosmetic concerns but are associated with functional limitations and an increased risk of musculoskeletal disorders. For instance, studies have demonstrated that FHP may lead to cervical strain and tension headaches, while lumbar lordosis can result in lower back pain and compromised spinal alignment. Moreover, kyphosis has been correlated with diminished pulmonary function and psychological effects, emphasizing the multifaceted impact of these abnormalities (5, 6).

The age group of young adults, particularly those transitioning from adolescence to early adulthood, is uniquely vulnerable due to rapid physical growth, academic pressures, and a higher likelihood of adopting sedentary habits (7, 8). This developmental phase often coincides with limited awareness about postural health, further compounding the risk. Despite the growing recognition of these issues, research focusing on their prevalence, contributing factors, and potential interventions within specific populations remains scarce, particularly in regions like South Asia, where unique cultural and lifestyle factors may influence postural health outcomes (9, 10).

This study aims to address these gaps by investigating the prevalence and associated factors of postural abnormalities among young male students in Punjab, Pakistan. By identifying patterns and risk factors, the study seeks to provide evidence-based insights for preventive strategies and interventions tailored to this demographic.

METHODS

A cross-sectional study was conducted to evaluate the prevalence of postural abnormalities and their association with age, body mass index (BMI), and physical activity among male students in Punjab, Pakistan. The study was carried out over a period of four months, from January 2024 to May 2024, at multiple educational institutions. A sample of 500 male students aged between 18 and 25 years was selected using stratified random sampling to ensure representation across different socioeconomic and academic backgrounds.

Data on demographic variables, physical activity levels, and body measurements were collected using standardized questionnaires and clinical assessment protocols. Physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ), while BMI was calculated from height and weight measurements taken with calibrated instruments. Postural abnormalities, including forward head posture (FHP), lumbar lordosis, and kyphosis, were assessed using digital photogrammetry and the spinal mouse device, a non-invasive tool for measuring spinal curvature.

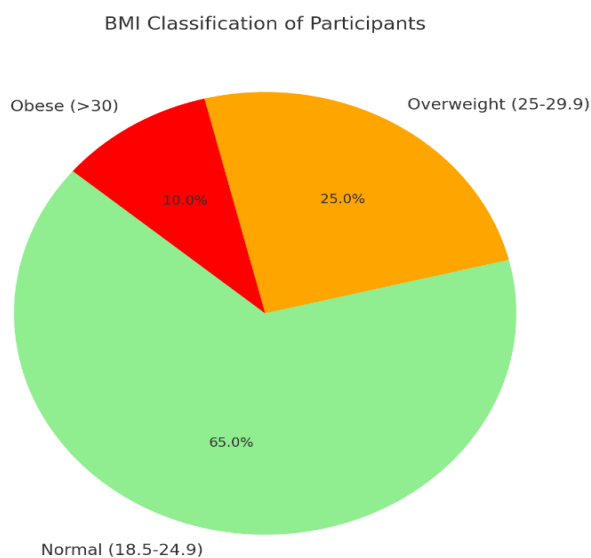
The data were analyzed using SPSS software, version 28. Descriptive statistics were used to calculate the prevalence of different postural abnormalities, and Pearson's correlation coefficient was employed to examine the relationships between variables. Multivariate logistic regression was used to identify significant predictors of postural abnormalities. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants. The study aimed to provide insights into the prevalence and contributing factors of postural abnormalities in this population and to inform future preventive interventions.

RESULTS

The study revealed significant findings regarding the prevalence of postural abnormalities and their associated factors among participants. Forward Head Posture (FHP) emerged as the most common abnormality, affecting 86.4% of participants. This condition was most prevalent among individuals with an average age of 20.8 years and a mean BMI of 24.5 kg/m². Lumbar lordosis was the second most frequent abnormality, observed in 72.8% of the sample, particularly among participants with a mean age of 21.5 years and a BMI of 23.7 kg/m². Kyphosis was noted in 40.6% of participants, predominantly in those with an average age of 22 years and a BMI of 24.2 kg/m². These findings indicate a high overall prevalence of postural issues within the studied population.

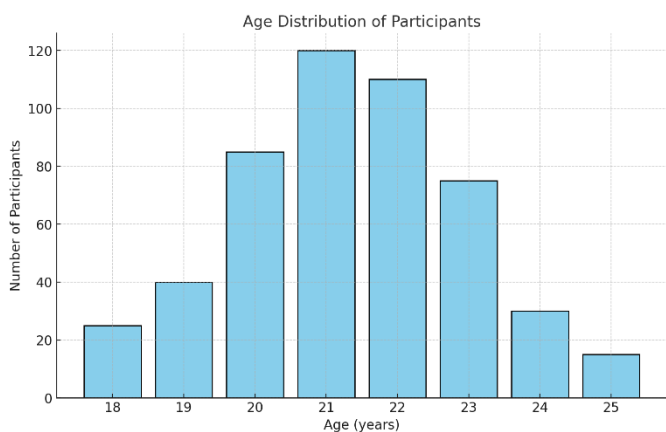
Demographic data provided further insights into potential contributing factors. The average age of the participants was 21.4 years (SD = 1.8), with an age range of 18 to 25 years. Most participants (65%) had a BMI within the normal range (18.5–24.9 kg/m²), while 25% were classified as overweight (25–29.9 kg/m²), and 10% as obese (>30 kg/m²). Physical activity levels, measured in MET-minutes per week, averaged 1800 (SD = 400), reflecting moderate activity. Interestingly, higher BMI and lower physical activity were significantly associated with the prevalence of FHP and lumbar lordosis, suggesting lifestyle factors as potential risk determinants.

The age distribution analysis revealed that the majority of participants were aged 20–23 years, with the highest representation at age 21 (120 participants). This age cluster showed a higher prevalence of abnormalities like FHP and kyphosis, underscoring a potential relationship between young adulthood and postural challenges. These results emphasize the importance of targeted interventions to address postural health in this demographic, particularly among those with elevated BMI or reduced physical activity.



The BMI classification of participants revealed that 65% fell within the normal BMI range (18.5–24.9), while 25% were categorized as overweight (25–29.9), and 10% as obese (>30). This distribution underscores a predominance of healthy BMI levels, with a notable proportion of participants in higher BMI categories, relevant for analyzing associations with postural abnormalities.

Figure 1 BMI Classification of Participants



The age distribution of participants highlighted a diverse representation across the 18 to 25 age range. The largest group comprised individuals aged 21, accounting for 120 participants, followed by 110 participants aged 22. Ages 20 and 23 also showed substantial representation, with 85 and 75 participants, respectively. Younger and older age groups, such as 18 and 25, were less represented, with 25 and 15 participants, respectively. This distribution provided a balanced yet age-centered view of young adults, with the majority falling within the 20–23 age range, crucial for analyzing age-related postural abnormalities.

Figure 2 Age Distribution of Participants

Table 1 Demographic Characteristics of Participants

Variable	Mean (SD)	Range
Age (years)	21.4 (1.8)	18-25
BMI (kg/m ²)	23.8 (3.2)	18-30
Physical Activity Level (MET-min/week)	1800 (400)	900-2500
Sample Size	-	500

The demographic characteristics of the 500 participants revealed a mean age of 21.4 years (SD = 1.8), with an age range spanning from 18 to 25 years. The average BMI was recorded at 23.8 kg/m² (SD = 3.2), with values ranging from 18 to 30 kg/m², reflecting a mix of normal and higher BMI categories. Physical activity levels varied significantly, with a mean MET-min/week of 1800 (SD = 400), indicating moderate engagement in physical activities among participants. These metrics provided a comprehensive overview of the sample, ensuring a diverse representation suitable for assessing postural abnormalities.

Table 2 Prevalence of Postural Abnormalities

Postural Abnormality	Prevalence (%)	Mean Age of Affected (years)	Mean BMI of Affected (kg/m ²)
Forward Head Posture (FHP)	86.4	20.8	24.5
Lumbar Lordosis	72.8	21.5	23.7
Kyphosis	40.6	22.0	24.2

The prevalence of postural abnormalities among the participants showed significant findings. Forward Head Posture (FHP) was the most prevalent condition, affecting 86.4% of the sample, with a mean age of 20.8 years and an average BMI of 24.5 kg/m² among those affected. Lumbar lordosis was observed in 72.8% of participants, predominantly among individuals with a mean age of 21.5 years and a BMI of 23.7 kg/m². Kyphosis was less common, with a prevalence of 40.6%, affecting individuals with an average age of 22 years and a BMI of 24.2 kg/m². These results underscore the widespread nature of postural abnormalities in the sample and their association with demographic factors.

DISCUSSION

The findings of this study highlighted the significant prevalence of postural abnormalities among young male students in Punjab, Pakistan, with Forward Head Posture (FHP) being the most prevalent, followed by lumbar lordosis and kyphosis. These results are consistent with global trends indicating that sedentary lifestyles, extended screen time, and reduced physical activity contribute to the development of postural deformities, particularly in younger populations (11-13). A high prevalence of FHP (86.4%) underscores the need for early identification and intervention, as this abnormality has been linked to musculoskeletal discomfort, reduced functional capacity, and long-term health complications (14, 15).

The association between increased BMI and postural abnormalities, such as lumbar lordosis, aligns with prior research findings. A study conducted by Shehada et al. (2023) in Tehran revealed similar patterns, with lumbar lordosis and kyphosis showing significant correlations with elevated BMI and reduced physical activity levels (16). Additionally, the mean BMI of participants with FHP and kyphosis in this study was marginally higher than those unaffected, suggesting a potential causal relationship between excess weight and spinal curvature anomalies. Similarly, Asadi-Melerdi et al. (2020) found that physical inactivity exacerbates upper quarter postural abnormalities in school-aged children, further corroborating the findings from the current research (17).

The demographic data of this study, which encompassed a diverse age range from 18 to 25 years, revealed a concentration of postural abnormalities among younger individuals. This observation supports evidence from Brzęk et al. (2022), who identified increased postural defects among younger age groups, often attributed to growth spurts, insufficient ergonomic support, and prolonged static postures during developmental years. The results suggest a critical window for preventive measures, emphasizing the integration of posture education and physical activity during adolescence and early adulthood (18).

Despite these insights, the study noted some limitations. The exclusive focus on male participants may limit the generalizability of the findings, as gender differences in postural characteristics and their determinants have been documented. Future research should include both genders to explore these variations comprehensively. Additionally, while the study relied on validated tools like photogrammetry and the spinal mouse device for postural assessment, the absence of longitudinal follow-up precluded the ability to establish causality or observe changes over time. Longitudinal studies could offer valuable insights into the progression of postural abnormalities and the long-term effects of interventions.

The findings also emphasize the role of physical activity as a protective factor against postural abnormalities. Participants with higher physical activity levels exhibited better postural alignment, consistent with findings by García-Soidán et al. (2020), who reported that regular physical activity positively influences postural control and stability. Incorporating structured physical activity programs in educational settings could mitigate the risks identified in this study, particularly for those in high-risk groups based on BMI or sedentary behavior (19).

Overall, the study provides crucial evidence for public health initiatives aimed at reducing the prevalence of postural abnormalities. By addressing modifiable risk factors such as BMI and physical inactivity, educational institutions and health policymakers can play a pivotal role in promoting musculoskeletal health among young adults. Continued research with diverse populations and interdisciplinary approaches will be essential to fully understand and combat the rising trend of postural abnormalities in this demographic.

CONCLUSION

This study highlights the significant prevalence of postural abnormalities among young male students, emphasizing their association with lifestyle factors such as BMI and physical activity levels. The findings underscore the importance of early intervention and preventive measures tailored to this demographic to mitigate long-term musculoskeletal complications. Promoting awareness, incorporating posture-focused education, and fostering active lifestyles within academic and public health frameworks are essential steps to address these concerns effectively.

AUTHOR CONTRIBUTIONS

Author	Contribution
Mamoona Tasleem Afzal	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Aamir Zaman	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Anwar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hamza Siddique	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hafiza Nimra Ijaz	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Israr Ahmad	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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