anatomy
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An International Journal of Experimental and Clinical Anatomy

Original Article

http://dergipark.org.tr/en/pub/anatomy
Received: September 13, 2025; Accepted: December 26, 2025
doi:10.2399/ana.25.1809260

Prevalence and clinical characteristics of idiopathic scoliosis among adolescents presenting to a tertiary care hospital outpatient department in Karachi

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Abstract

Objectives: To investigate the prevalence of idiopathic scoliosis among adolescent population and their magnitude of ailment on Walter Reed Visual Assessment Scale (WRVAS).

Methods: This cross-sectional study included 119 adolescent individuals of both genders from 10–19 years of age. The prevalence, degree of back pain and disease severity were assessed by using self-structured questionnaire, Visual Analogue Scale and WRVAS. Data were analyzed using SPSS 23 and Pearson Chi-square test.

Results: A total of 190 participants were enrolled, with a female predominance (61.6%). The mean age was 14.55±2.38 years, height 1.59±0.19 m, and weight 50.62±10.19 kg. The highest mean clinical parameter was lateral flexion (30.98°). Among 190, 50% reported spinal abnormality. A significant association (p=0.003) was found between scoliosis severity and awareness of spinal deformity.

Conclusion: This study identifies a considerable prevalence of scoliosis among adolescent population. The study highlights that early detection and combining clinical data with patient-reported outcomes can improve scoliosis diagnosis and treatment in resource-limited adolescent populations.

Keywords: back pain; Cobb angle; posture; spinal curvature; Walter Reed Visual Assessment Score (WRVAS)

Anatomy 2025;19(3):86–92

Introduction

The posture is one particular element that affects the contour of the body. People are quite particular about the appropriateness of their body's structure and shape.[1] The posture can be defined as "the orientation and configuration of body segments with respect to gravity at any given time." The normal spine appears as an "S-shaped" structure when viewed laterally, having natural curvatures in anteroposterior directions.[2] They are thoracic and sacral kyphosis along with cervical and lumbar lordosis. Scoliosis is the medical term for any lateral curvature of the spine. It causes the body to lose both shape and form and it also negatively impacts the internal organization of the human body.[3] Scoliosis is divided into three distinct categories depending on the age at which the affected person's spine deformity has been diagnosed: infantile - develops between the ages of 0 to 3 years, juvenile - develops between the ages of 4 to 10 years, and adolescent - develops between the ages of 11 to 18 years. By far, adolescents are the age group most commonly affected by scoliosis with a global prevalence of about 3.1% and a female predominance. It seems to occur more often during the adolescent growth spurt.[4] In addition to this, poor static posture caused by factors like the prolonged use of computer, watching television and hanging heavy backpacks can lead to postural abnormalities. Many studies have proposed that carrying heavy backpacks contributes significantly to

back pain, muscular strain, and may lead to irreversible spinal abnormalities.[5]

Adolescent idiopathic scoliosis is the most common variant of scoliosis, defined by the "Scoliosis research society" as a three-dimensional deviation of the curvature of the spine of unknown origin associated with a Cobb angle of >10°.[6,7] Studies have reported that the lumbar segment of the spine is most significantly affected by scoliosis followed by the thoracic segments. Back pain is a common finding associated with scoliosis of either segments of the vertebral column however, the severity often depends on other conditions like disc degeneration and/or nerve compression which are more common in aging spine.[8] As scoliosis is a three-dimensional cosmetic deformity, it is hence a matter of concern for both physicians and patients. In order to manage this clinical condition in a proper manner, it is important to know the prevalence and magnitude of the spinal disease. Literature has revealed that there is a higher incidence of spine deformities in girls as compared to boys with an overall ratio of 2:1 in adolescent population.[9] Many diagnostic techniques has been used to know extent of disease like Moiré topography - an observation based on shadows of back, using an automated photogrammetric technique or the Quantec imaging system, but all these methods are resource intensive requiring a lot expertise and expensive machines for their functionality.[10] Walter Reed Visual Assessment Score (WRVAS) is a newer technique among these efforts. It comprises of seven sets of questions, each having a set of five figures representing the degree of deformity. Studies have shown that this assessment provides a good correlation between the scores of an individual and the magnitude of the disease.[11]

Knowing the precise epidemiology and severity based on the clinical characteristics of the disease is therefore essential for developing an effective management strategy to deal with such kind of spinal deformities. Hence, the current study is aimed at investigating the prevalence of idiopathic scoliosis among adolescent population and the magnitude of this condition using the WRVAS. The present investigation has provided insights into early diagnosis and management options by determining the burden of the disease.

Materials and Methods

This cross-sectional study was conducted at the Outpatient Department of Physical Therapy, Liaquat National School of physical therapy (LNSOP) in collaboration with the Department of Anatomy, Liaquat National Hospital and Medical College, Karachi (LNH&MC), among adolescents presenting with back pain. The duration of this study was one year and the data was collected after getting the approval from Ethical Review Board of the Institute (Ref. No: 0921-2023-LNH-ERC Dated: September 6, 2023). The sample size was calculated by using open EPI (version 3.01). The calculation was based on an expected prevalence of 21.16%,[12] with a 95% confidence interval and a margin of error of 5%. This yielded a minimum required sample size of 190 participants. The samples were collected by using non-probability convenience sampling in a clinical out-patient setting. Adolescents of both genders between 10 and 19 years of age with complaints of back pain, who presented to the OPD of physical therapy either directly or referred from some other clinical specialty, having no prior diagnosis or treatment for scoliosis were included in the study. Patients with any previous spinal surgery, congenital or acquired anomaly of the spine or who refused to participate were excluded from the study. A self-structured assessment form was filled by the researcher for all the patients fulfilling the inclusion criteria. The content validity was ensured through expert by faculty members from the departments of Physical Therapy and Anatomy. This questionnaire comprised up of four sections having closed-ended items covering the demographic characteristics, daily life activities, and assessment on the basis of WRVAS and measurements including leg length discrepancy, Cobb angle, and goniometric dimensions. Assessment of clinical parameters was done by utilizing standardized measurement techniques. The intensity of pain was recorded by using Visual Analog Scale (VAS; 0–10), where higher scores indicated greater pain severity. The perception of spinal deformity was assessed by WRVAS, consisting of a set of seven items along with five graded figures representing increased severity in deformity. Leg length discrepancy was measured in centimeters using a tape measure from the anterior superior iliac spine to the medial malleolus in the supine position. The Cobb angle measurements were obtained through an anteroposterior spinal radiograph in the standing position. All measurements were recorded by a trained physiotherapist having expertise in musculoskeletal assessment. The same measurement protocol was adopted for all study participants to ensure consistency and uniformity in the results.

The data were kept completely confidential and were only accessible to the researchers. It was compiled and analyzed using SPSS version 23 (Chicago, IL, USA). The descriptive statistics such as age, weight, height, age

Table 1
Prevalence of idiopathic scoliosis among adolescents by gender and age group.

Category		Total (n=190)	Prevalence (%)
Gender	Male	73	38.4
	Female	117	61.6
Age group (years)	10–13	58	30.5
	14–16	92	48.4
	17–19	40	21.1

of puberty, waist and hip circumference, and clinical parameters in scoliotic patients were presented as mean±SD. Gender was presented as a percentage. The association between the categorical variables of spinal deformity with severity of idiopathic scoliosis was analyzed by using the Pearson chi-square test. A p value of <0.05 was considered statistically significant. Normality of continuous variables was assessed using the Shapiro–Wilk test and visual inspection of histograms. As Cobb angle and WRVAS scores did not follow a normal distribution and the WRVAS represents an ordinal scale, Spearman's rank correlation coefficient was used to assess the association between radiographic severity (Cobb's angle) and perceived spinal deformity (WRVAS score). All tests were two-tailed, and a p value <0.05 was considered statistically significant.

Results

The distribution of cases of idiopathic scoliosis among the participants by gender and age group is shown in **Table 1**. A total of 190 study participants were recruited for the study, among them 73 (38.4%) were found to be males while 117 (61.6%) were females, indicating a clear female predominance in the study. The age group ranging from 14–16 years presented with the highest prevalence (48.4%), followed by 10–13 years (30.5%) while the age group 17–19 years was noted to have the lowest prevalence (21.1%). The mean age (years) of study participants was 14.55±2.38. The average height (m) and weight (kg) were found to be 1.59±0.19 and 50.62±10.19 respectively (**Table 2**).

Table 2
Demographic and anthropometric characteristics of the study population.

Variable	Mean±SD / Frequency (%)
Age (years)	14.55±2.38
Height (m)	1.59±0.19
Weight (kg)	50.62±10.19
Puberty age (years)	12.18±1.37
Waist circumference (cm)	66.70 13.84
Hip circumference (cm)	75.43±14.28

The mean values of key clinical parameters observed in adolescents with idiopathic scoliosis, with error bars representing standard deviation is shown in **Figure 1**.

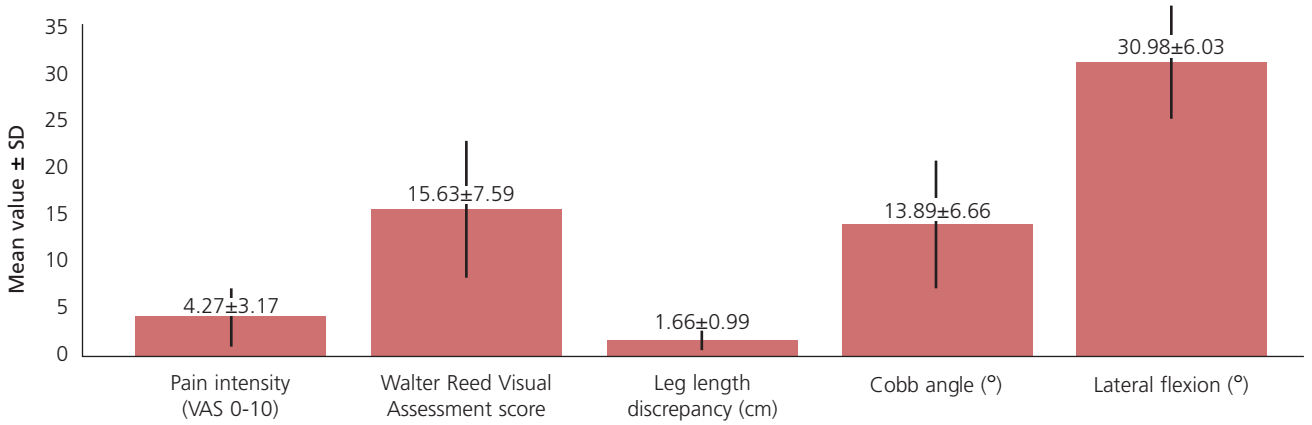

Figure 1. Clinical parameters in patients with scoliosis.

Table 3
Association between self-reported spinal deformity and severity of idiopathic scoliosis.

Spinal deformity response	>10° scoliosis (n=142)	<10° scoliosis (n=48)	Total (n=190)	% within idiopathic scoliosis	p-value
Don't know	8	21	29	15.3%	0.003*
No	18	48	66	34.7%	
Yes	22	73	95	50.0%	

*Statistically significant.

The highest mean value (30.98±6.03) was observed in lateral flexion, followed by the WRVAS and Cobb's angle. The lowest mean was seen in leg length discrepancy (1.63±0.99).

The self-reported spinal deformity and its association with the severity of scoliosis within the total idiopathic scoliosis sample is demonstrated in **Table 3**. Out of 190 participants, 95 (50.0%) reported having a spinal abnormality, while 66 (34.7%) stated having no deformity, and 29 (15.3%) were unclear. Participants with Cobb's angle <10° were included when associated with significant WRVAS scores and/or leg length discrepancy to account for clinically meaningful early deformities. Awareness of spinal deformity was higher in individuals with Cobb's angle ≥10° (73/142) than in those with <10° (22/48), indicating an increasing clinical and perceptual impact with greater curvature (**Table 3**). A statistically significant p-value (0.003) demonstrated the association between scoliosis severity and the conscious perception of spinal deformity among the affected individuals. Visual inspection of the scatter plot (**Figure 2**) demonstrated a wide dispersion of WRVAS scores across varying Cobb angles, with no strong linear relationship observed. The low R^2 value indicated that Cobb angle alone explained minimal variability in perceived spinal deformity.

Discussion

The present study investigated the demographic, anthropometric, clinical, and perceptual characteristics of adolescents diagnosed with idiopathic scoliosis in a tertiary care hospital in Karachi. The results of this study provide context-specific insights that enhance understanding of idiopathic scoliosis in the local community while also aligning the previous conducted in a variety of different settings.

This study included 190 adolescent participants, with a mean age of 14.55±2.38 years, which is consistent with most common age bracket where idiopathic scoliosis is prevalent among the general population. A considerable female dominance was found (61.6% females vs. 38.4% males), aligning with global literature that specifies higher prevalence and increased severity of scoliosis in adolescent females that may be an attribute to estrogen influence impacting the growth of spine in pubertal age group.[13] Konieczny et al.,[14] reported a similar trend with a female-to-male ratio of approximately 3:1 and an increased Cobb angle of up to 30° or more. This gender distribution highlights the importance of targeted screening programs, especially for school-aged girls to potentially prevent or reduce the progression of spinal curvature. The average age at the onset of puberty was documented as 12.18±1.37 years, coinciding with the period when scoliosis typically manifests or advances due to growth spurts with rapid curve progression.[15]

Previous studies have shown that a substantial number of adolescent population with idiopathic scoliosis experiences back pain, rib prominence, cardiopulmonary issues leading to a decreased quality of life and discomfort in daily activities.[16] However, these clinical features are not always correlated with the degree of curvature. Our study also found that a significant number of participants reported physical discomfort and concerns about body image, even in cases of mild to moderate curvature. A systematic review conducted by An et al.,[17] revealed that the individuals having adolescent idiopathic scoliosis and mild curvature abnormalities reported moderate intensity of pain with prolonged duration, highlighting that pain perception is influenced by more than spinal curvature alone. This emphasizes how crucial it is for clinicians to manage pain in scoliosis patients, regardless of radiological severity.

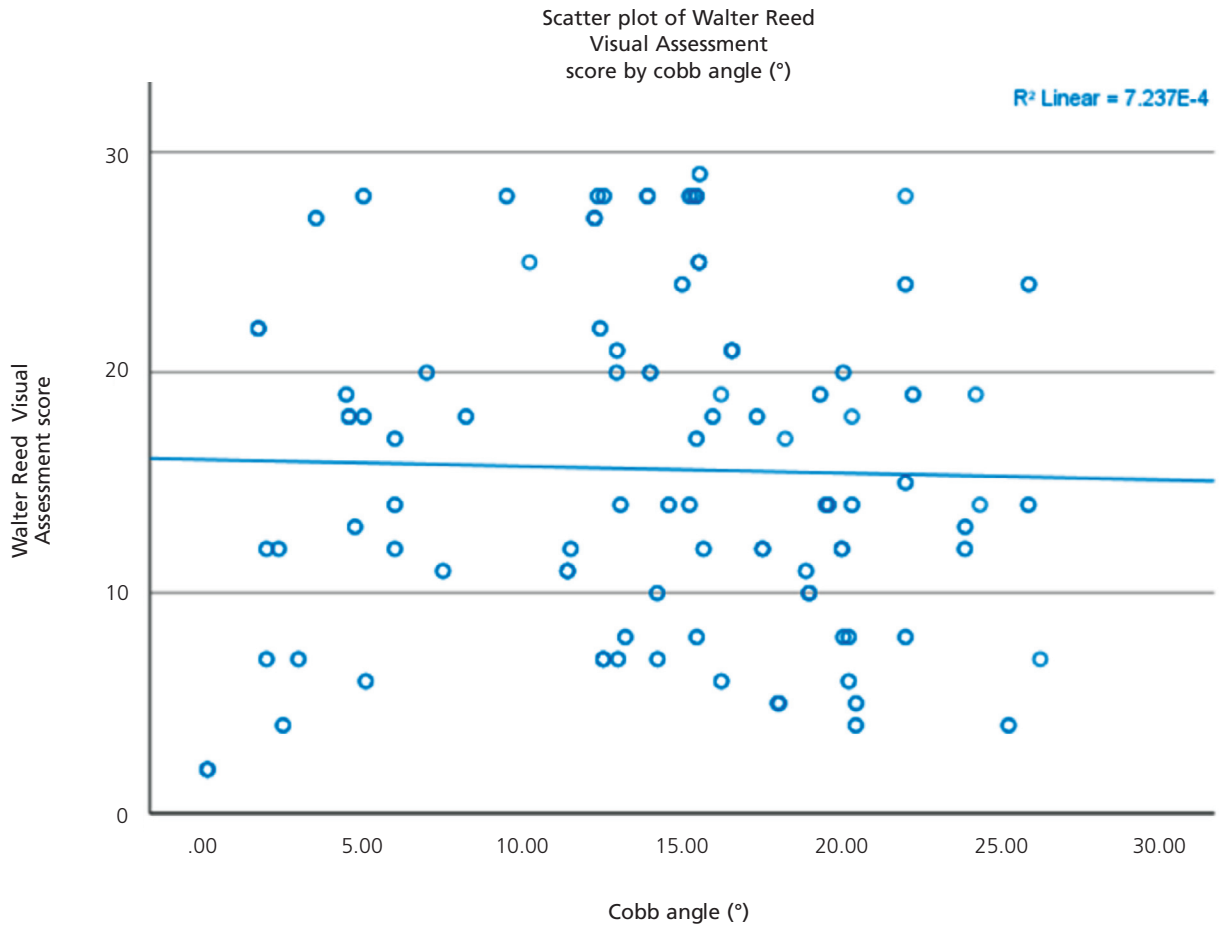

Figure 2. Scatter plot illustrating the relationship between Cobb's angle and Walter Reed Visual Assessment Scale (WRVAS) score.

Scoliosis deformity profoundly impacts the lower-limb gait kinetics. The alterations may manifest as altered Cobb angle, pelvic tilt, trunk flexion and obliquity of pelvis which can lead to reduced speed of walking and increased stress on joints.[18] These findings are consistent with current study where an average Cobb angle was found to be 13.89±6.66°, indicating mild to moderate scoliosis in the study participants. With lateral flexion averaging 30.98±6.03°, spinal limitations in mobility were apparent despite the relatively small curve size, suggesting reduced flexibility could negatively impact the daily life of an individual.

The WRVAS is a validated tool for assessing the subjective awareness of spinal deformity. This scale is valuable in capturing individual differences in how patients perceive their condition, effectively distinguishing between those who "notice" their spinal deformity and those who do not.[19] In the present study, deformity perception was assessed using the WRVAS, with an average score of 15.63±7.59. This implies that even adolescents with relatively mild curves may recognize notable spinal asymmetry. Adolescents with a Cobb angle exceeding 10° were significantly more likely to report deformity. These findings are in accordance with prior literature that showed a positive correlation between Cobb angle and WRVAS scores.[20]

Our study's findings about female dominance, onset of puberty, moderate intensity of pain, and the correlation between perceived deformity and curve severity are consistent with data from other countries. However, certain distinctions were observed: although our population's curvatures were milder than those reported in other cohorts, where Cobb angles frequently approached 30°, the degree of perceived deformity was still substantial. This underscores the importance of incorporating perceptual instruments like WRVAS in regular evalua-

tions by demonstrating that even mild spinal deformities can have a significant psychological or aesthetic impact on teenagers.

There are several limitations of this study. The present study was a single-center investigation that may limit the generalizability of the results and provides a snapshot of prevalence among the adolescent population. In addition, there were self-reported measures were used to assess the severity of pain and extent of deformity which may be influenced by various psychosocial factors. In future, multicenter, longitudinal studies should be conducted to increase the generalizability and assess the progression of disease.

Conclusion

In conclusion, scoliosis was identified in 74.7% (142/190) of the adolescents screened, predominantly presenting as mild to moderate curvature (mean Cobb angle: 13.89±6.66°). Despite lower radiological severity, affected adolescents reported moderate pain, functional limitations, and a notable degree of self-perceived deformity (mean WRVAS score: 15.63±7.59). The observed association between Cobb angle and deformity perception highlights that even mild scoliosis can have significant clinical and psychosocial implications. These findings emphasize the need for early detection and the integration of objective clinical measures with patient-reported outcomes, particularly in resource-limited settings.

Acknowledgments

The authors express their gratitude to the patients who generously taken their time out and participated in the study.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

FR: project development, data analysis, manuscript writing; NR: project development, data collection, manuscript writing; SA: project development, data collection; ZUI: data analysis, manuscript editing; SHAR: data collection, manuscript editing.

Ethics Approval

Ethical approval was received from the Ethical Review Board of LNH&MC (Ref. No: 0921-2023-LNH-ERC Dated: September 6, 2023),

Funding

This research has not received any specific grant from any funding agency in the public, commercial, or not-for-profit sector.

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Conflict of interest statement: No conflicts declared.

 How to cite this article: Rehman F, Rizvi N, Arshad S, Ul Islam Z, Abbas Rizvi SH. Prevalence and clinical characteristic s of idiopathic scoliosis among adolescents presenting to a tertiary care hospital outpatient department in Karachi. Anatomy 2025;19(3):86–92.