COBB ANGLE AS AN INDICATOR OF THE SEVERITY OF SCOLIOTIC DEFORMITY IN SCHOOL-AGED CHILDREN: AGE-RELATED CHARACTERISTICS

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Abstract: Background. Scoliotic spinal deformity is one of the clinically significant forms of musculoskeletal disorders in children and adolescents. Objective assessment of deformity severity is important for determining the follow-up strategy and timely identifying structural changes during growth. The Cobb angle is widely used to quantify spinal curvature; however, interpretation of its values requires consideration of clinical and age-related characteristics. **Objective.** To investigate age-related characteristics of Cobb angle values and the distribution of school-aged children according to the severity of spinal scoliotic deformity. **Materials and methods.** The study included 619 schoolchildren aged 6–18 years: 234 children in the main group and 385 children in the control group. Age-related characteristics were analysed in three subgroups: 6–10, 11–14, and 15–18 years. Deformity severity was assessed using the Cobb angle. Pearson's χ^2 test was used to analyse the distribution of children across categories. Differences were considered statistically significant at $p < 0.05$. **Results.** The mean Cobb angle in the main group was $8.22 \pm 0.64°$ in children aged 6–10 years, $11.35 \pm 0.94°$ at 11–14 years, and $13.79 \pm 1.27°$ in adolescents aged 15–18 years. Differences between the youngest and older age groups were statistically significant ($p < 0.05$). The distribution of children by deformity-severity category also differed by age ($\chi^2 = 34.869$; $p < 0.001$). A Cobb angle of 11° or greater was recorded in 66 of the 234 children in the main group (28.2%). **Conclusion.** Age-related differences in Cobb angle values and in the distribution of children by scoliotic-deformity severity were identified in the examined group. The findings highlight the importance of objective assessment of structural spinal changes. Further studies with repeated Cobb angle measurements are needed to determine the individual dynamics of deformity.

Keywords: school-aged children, scoliosis, Cobb angle, spinal deformity, age-related characteristics, orthopaedic pathology

I. Introduction

Musculoskeletal disorders in school-aged children represent a significant medical and social problem. Spinal deformities occupy a particular place among these disorders, and their severity may change as the child grows. Timely detection of structural changes is important for determining the need for further examination, dynamic follow-up, and selection of an individual management strategy [3, 4].

One of the main quantitative indicators used in the radiographic assessment of scoliotic deformity is the Cobb angle. It makes it possible to quantify the magnitude of spinal curvature and compare examination results. At the same time, measurement accuracy depends on the selection of end vertebrae, radiograph quality, and the method applied [1, 2, 5].

School age comprises several stages of physical development, including periods of rapid growth. During these periods, the severity of an existing spinal deformity may change. Therefore, investigating age-related differences in Cobb angle values is of interest for improving approaches to detecting scoliotic changes and organising follow-up of children with orthopaedic pathology [3, 4].

Analysis of the distribution of children by deformity severity across different age groups makes it possible to characterise the study sample and identify age-related differences in the severity of structural changes. However, differences between age groups in a cross-sectional study should not automatically be regarded as evidence that scoliosis progresses in every child. Repeated measurements during follow-up are required to assess individual changes.

The aim of the study was to investigate age-related characteristics of Cobb angle values and the distribution of school-aged children according to the severity of spinal scoliotic deformity.

II. Materials and Methods

The study included 619 school-aged children aged 6–18 years. The main group consisted of 234 children with musculoskeletal disorders, while the control group comprised 385 practically healthy schoolchildren.

To analyse age-related characteristics, the participants were divided into three groups: 6–10, 11–14, and 15–18 years.

A. Assessment of scoliotic deformity

The Cobb angle, a quantitative radiographic indicator used to determine the magnitude of spinal curvature in children and adolescents, was used to assess the severity of scoliotic spinal deformity [1, 3].

The Cobb angle is determined from an anteroposterior spinal radiograph. The most tilted vertebrae bounding the curve are selected, lines are drawn along the corresponding endplates, and the angle between these lines—or between perpendiculars to them—is then measured. The result may be affected by the choice of end vertebrae, image quality, and adherence to a consistent measurement method [1, 5, 7].

According to the classification used in this study, the following categories were distinguished: Cobb angle up to 10°,

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11–25° (mild), 26–50° (moderate), and greater than 50° (severe deformity). A Cobb angle of 11° or greater was considered the criterion for scoliotic deformity within the research classification adopted.

It should be noted that in clinical practice, scoliosis is generally defined radiographically by a Cobb angle of at least 10° in combination with corresponding clinical signs [3, 4]. Therefore, the categories used in this study should be interpreted in the context of the research protocol adopted.

B. Statistical analysis

Statistical analysis included assessment of mean Cobb angle values across age groups and analysis of the distribution of children by deformity-severity category. Pearson's χ^2 test was used to assess the association between age group and deformity category. Differences were considered statistically significant at $p < 0.05$.

III. Results

A. Age-related differences in Cobb angle values

In the main group, the mean Cobb angle increased across the older age categories. The value was 8.22 ± 0.64° in children aged 6–10 years, 11.35 ± 0.94° at 11–14 years, and 13.79 ± 1.27° in adolescents aged 15–18 years. The difference between the youngest and oldest age groups was 5.57°. Differences between the youngest group and each of the two older groups were statistically significant ($p < 0.05$).

Thus, age-related differences in the severity of structural spinal changes were identified in the examined sample. However, cross-sectional comparisons do not make it possible to determine the individual rate of change in the Cobb angle or to establish that deformity necessarily progresses in every child.

B. Distribution of children by severity of scoliotic deformity

When the distribution by Cobb angle was analysed, the largest category was that with an angle up to 10°, comprising 168 children. Mild deformity (11–25°) was recorded in 53 children, moderate deformity (26–50°) in 7, and severe deformity (greater than 50°) in 6 children.

According to the study data, a Cobb angle of 11° or greater was identified in 66 of the 234 children in the main group, accounting for 28.2%. The distribution of children across Cobb angle categories is presented in Figure 1.

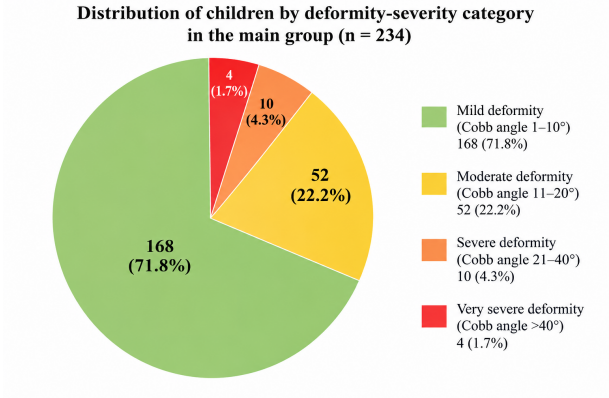


Figure 1. Distribution of children in the main group according to Cobb angle categories (n = 234).

The distribution of children by deformity-severity category differed significantly according to age ($\chi^2 = 34.869$; $p < 0.001$). Among children with a Cobb angle of 11–25°, adolescents aged 15–18 years accounted for the largest proportion—64.15% of all observations in this category. In the moderate-deformity group, the largest proportion of observations was in children aged 11–14 years. Of the six cases of severe deformity, one was recorded in the 11–14-year age group and five in the 15–18-year age group.

The results for moderate and severe deformity should be interpreted cautiously because the number of observations in these categories was small.

IV. Discussion

The results of this study demonstrate differences in Cobb angle values between the age groups of the schoolchildren examined. The highest mean value was recorded in adolescents aged 15–18 years, whereas the lowest was observed in children aged 6–10 years. In addition, a statistically significant association was found between age category and the distribution of children by deformity severity. Age and periods of rapid growth should be taken into account when assessing scoliotic changes in children and adolescents [3, 4].

The identified age-related differences are clinically relevant; however, they cannot be regarded as direct evidence of deformity progression. A cross-sectional study allows indicators in different age groups to be compared but does not reflect the individual dynamics of change in a particular child. Assessment of progression requires repeated Cobb angle measurements over a defined follow-up period [3, 4].

Of particular note is the proportion of children with a Cobb angle of 11° or greater, which was 28.2% in the main group. This figure characterises the examined sample and cannot be considered an estimate of scoliosis prevalence among all schoolchildren without additional data.

The practical value of the Cobb angle lies in its ability to quantify deformity severity and enable comparison of examination results. Nevertheless, interpretation should take into account the clinical presentation, the child's age, and the results of dynamic follow-up. When comparing repeated measurements, possible variability associated with the selection of end vertebrae and the measurement method should be considered [1, 2, 5, 7].

One limitation of this study is the absence of presented data on changes in the Cobb angle for each child over time. In addition, the number of observations in the moderate- and severe-deformity categories was small, limiting the possibility of more detailed comparisons of these subgroups.

Thus, the findings should be regarded as a description of age-related differences in the examined sample. Prospective studies with repeated Cobb angle measurements and consideration of children's physical-development characteristics are needed to confirm the identified patterns.

V. Conclusion

In the examined group of school-aged children, the mean Cobb angle increased from the youngest to the oldest age group. The value was 8.22 ± 0.64° in children aged 6–10 years, 11.35 ± 0.94° at 11–14 years, and 13.79 ± 1.27° in adolescents aged 15–18 years.

The distribution of children by severity of scoliotic deformity differed significantly according to age ($\chi^2 = 34.869$; $p < 0.001$). A Cobb angle of 11° or greater was recorded in 28.2% of the children in the main group.

The findings highlight the importance of objective assessment of the Cobb angle when examining children with musculoskeletal disorders. However, the age-related differences identified do not, by themselves, allow conclusions to be drawn about individual deformity progression. Further prospective studies with repeated radiographic measurements and consideration of the child's growth rate are required to determine the dynamics of change.

REFERENCES

[1] d'Astorg H., Bourret S., Ramos-Pascual S., Szadkowski M., Le Huec J.-C. Comparison of Cobb angle measurements for scoliosis assessment using different imaging modalities: a systematic review. EFORT Open Reviews. 2023;8(6):489–498. DOI: 10.1530/EOR-23-0032.

[2] Huang X., Luo M., Liu L., et al. The Comparison of Convolutional Neural Networks and the Manual Measurement of Cobb Angle in Adolescent Idiopathic Scoliosis. Global Spine Journal. 2024;14(1):159–168. DOI: 10.1177/21925682221098672.

[3] Jinnah A.H., Lynch K.A., Wood T.R., Hughes M.S. Adolescent Idiopathic Scoliosis: Advances in Diagnosis and Management. Current Reviews in Musculoskeletal Medicine. 2025;18(2):54–60. DOI: 10.1007/s12178-024-09939-2.

[4] Kim H., Chang B.-S., Chang S.Y. Current issues in the treatment of adolescent idiopathic scoliosis: a comprehensive narrative review. Asian Spine Journal. 2024;18(5):731–742. DOI: 10.31616/asj.2024.0367.

[5] d'Astorg H., Bourret S., Ramos-Pascual S., Szadkowski M., Le Huec J.-C. Comparison of Cobb angle measurements for scoliosis assessment using different imaging modalities: a systematic review. EFORT Open Reviews. 2023;8(6):489–498. DOI: 10.1530/EOR-23-0032.

[6] Wiliński P., Piekutin A., Dmowska K., Zawieja W., Janusz P. Which Method of the Radiologic Measurements of the Angle of Curvature in Idiopathic Scoliosis is the Most Reliable for an Inexperienced Researcher? Indian Journal of Orthopaedics. 2025;59(2):140–147. DOI: 10.1007/s43465-024-01307-z.

[7] Prestigiacomo F.G., Hulsbosch M.H.H.M., Bruls V.E.J., Nieuwenhuis J.J. Intra- and inter-observer reliability of Cobb angle measurements in patients with adolescent idiopathic scoliosis. Spine Deformity. 2022;10(1):79–86. DOI: 10.1007/s43390-021-00398-0.

[8] Stott S.M., Wu Y., Hosseinpour S., et al. Correlative Assessment of Machine Learning-Based Cobb Angle Measurements and Human-Based Measurements in Adolescent Idiopathic and Congenital Scoliosis. Canadian Association of Radiologists Journal. 2024;75(4):751–760. DOI: 10.1177/08465371241231577.

[9] Wong J.C., Reformat M.Z., Parent E.C., et al. Validation of an artificial intelligence-based method to automate Cobb angle measurement on spinal radiographs of children with adolescent idiopathic scoliosis. European Journal of Physical and Rehabilitation Medicine. 2023;59(4):535–542. DOI: 10.23736/S1973-9087.23.08091-7.