ECRONICON OPEN ACCESS

EC ORTHOPAEDICS
Research Article

Trunk Rotation in Adolescence: Screening in a School in Southern Portugal

Beatriz Minghelli[1,2]*, João Guerreiro[1], Joana Matos[1], Ana Carolina Coelho[1], André Pinto[1], Andrea Marreiros[1], Bruno Marques[1], Carina Pacheco[1] and Pedro Silva[1]

[1]*Instituto Piaget, Escola Superior de Saúde Jean Piaget/Algarve, Portugal*

[2]*Research in Education and Community Intervention (RECI), Portugal*

***Corresponding Author:** Beatriz Minghelli, Instituto Piaget, Escola Superior de Saúde Jean Piaget/Algarve, Enxerim, Silves, Portugal.

Received: January 21, 2019; **Published:** April 30, 2019

Abstract

Introduction: Scoliosis is a lateral deviation in the spine in the frontal plane that includes a vertebral body rotation. This study aimed to verify the prevalence of trunk rotation in Portuguese adolescents.

Methods: Sample was constituted by 176 adolescents, 71 (40.3%) boys and 105 (59.7%) girls, aged between 10 and 16 years old. Scoliometer was used to evaluate trunk rotation; adolescents were classified as intermediate or severe asymmetric, according to the values obtained with scoliometer evaluation.

Results: Twelve (6.8%) adolescents were classified as intermediate asymmetric and only 1 (0.6%) as severe asymmetric. Girls showed more prevalence of trunk rotation than boys (58.3% versus 41.7%), as well as older adolescents compared to younger ones (58.3% versus 41.7%), but these associations did not reach statistical significance.

Conclusions: Data showed a low prevalence of trunk rotation in this analyzed adolescent sample. Despite the low prevalence detected in this study, it is believed that it is necessary to continue screening for the early detection of this disease.

Keywords: *Scoliosis; Adolescents; Epidemiology; Prevalence; Trunk Rotation*

Introduction

Scoliosis is a lateral deviation in the body frontal plane that includes a vertebral body rotation and ribs alterations; the diagnosis is made by x-ray, when an angle greater than 10° by Cobb method is observed [1,2].

Regarding the etiology, there is still no scientific consensus theory for the cause of adolescent idiopathic scoliosis. The possible theories include genetic factors, asymmetries of bone growth, bone mass, abnormalities of the neuromuscular system and mechanical factors, but the theories of the environment and weakness of the abdominal muscles are not totally excluded [1-5]. One asymmetric load applied to the vertebral axis can be the main force for the development and progression of a spinal deformity [5].

The Scoliosis Research Society [6] reported that scoliosis cannot occur by carrying excessive weights in school backpacks, by assuming wrong postures, or by spending many hours watching television, however, there are some studies that do not confirm this theory [4,7]. Zheng., *et al.* [8] identified that carrying the backpack on one shoulder and using computers for many hours are associated to scoliosis.

As behavioral changes in young people are observed, such as increasing of sedentary activity, adoption of inadequate postures when using computers and mobile phones, it is necessary to evaluate the presence of possible postural changes. Since bone growth is still occur-

ring at this stage, this follow-up becomes important. Thus, this study aimed to determine the prevalence of trunk rotation in adolescents and to identify risk factors.

Methods

An epidemiological and cross-sectional study was developed at E.B.2,3 Dr. Garcia Domingues school, in Silves, south of Portugal.

The study was approved by the Piaget Institute's Research Unit RECI - Research in Education and Community Intervention, and by the director of the school. Written informed consent was obtained from all parents or guardians of the students.

Population

Population involved students enrolled in E.B.2,3 Dr. Garcia Domingues school, in grades 5 and 7, in the 2017 - 2018 school year. There were 5 classes in grade 5 (97 students) and another 5 in grade 7 (101 students), making a total of 198 students.

Inclusion criteria were students present on data collection days, who had provided parental or guardian consent, and who agreed to participate.

Measures

A scoliometer (Pedihealth Oy, Finland) was used to measure the angle of trunk rotation.

For evaluation, adolescents were asked to perform an anterior trunk flexion keeping the feet at a distance of 15 cm, knees in extension position, and upper limbs relaxed. In this position, the evaluator positioned the scoliometer perpendicular to the evaluated vertebral zone [10] which were the mid-thoracic (between T4 and T8 vertebrae), thoracolumbar (between T12 and L1 vertebrae) and lumbar (between L2 and L5 vertebrae) zones.

Scoliometer angle values between 5 and 6 degrees corresponded to an intermediate asymmetric trunk rotation (corresponding to an angle of 10º in Cobb´s method), and values equal or higher than 7 degrees corresponded to severe asymmetric trunk rotation (corresponding to an angle equal or above 30º in Cobb´s method) [11-13].

The trunk rotation (hump) on the right side corresponded to a right asymmetry, and the left side was defined as left asymmetry.

Scoliometer use has a good inter and intra-rater reliability, reporting a sensitivity of 90.6% and a specificity of 79.8% [10,14,15].

The students also answered a short questionnaire by interview that include questions about age, gender, physical activities outside the school (with a weekly frequency of at least 2 times), time spent per week watching television, playing video games and using the computer or mobile phone.

Data analysis

Data was analyzed using descriptive statistics for all variables in the study. Chi-square test was used to evaluate associations between some variables and the presence of trunk rotation. The influence of the variable "sports practice" on the presence of trunk rotation was assessed using binary logistic regression.

Statistical significance was set at 0.05.

Statistical analysis was performed using IBM Statistical Package for Social Sciences, version 24.0.

Results

Sample was constituted by 176 adolescents, 71 (40.3%) boys and 105 (59.7%) girls, aged between 10 and 16 years old (11.65 ± 1.34).

Most of the adolescents (81; 46%) reported to spend until 5 hours per week watching television, 51 (29%) from 6 to 10 hours, 27 (15.3%) between 11 and 15 hours, and 17 (9.7%) reported 16 or more hours.

Regarding the time per week spent playing video games and using the computer or mobile phone, 52 (29.5%) adolescents referred to use these electronic devices until 5 hours, 73 (41.5%) between 6 to 10 hours, 29 (16.5%) between 11 and 15 hours, and 22 (12.5%) equal to or more than 16 hours.

One hundred and fourteen (64.8%) students reported the practice of sports outside the school, with a frequency of at least 2 times a week.

Regarding scoliometer measurements, trunk rotation angles with values between 5 and 6 degrees were observed in 12 (6.8%) adolescents; values equal or higher than 7 degrees were detected in only 1 (0.6%) adolescent; 163 (92.6%) adolescents showed values below 4 degrees.

Table 1 shows the frequency and percentage of intermediate and severe asymmetric trunk rotation regarding each variable analyzed in this study.

Variables		Intermediate asymmetric (5º to 6º)	Severe asymmetric (≥ 7º)	p-value	Total
Gender	Boys	5 (41.7%)	0	0.411	5 (38.5%)
	Girls	7 (58.3%)	1 (100%)		8 (61.5%)
Age group	10 - 12 years old	5 (41.7%)	0	0.411	5 (38.5%)
	13 - 16 years old	7 (58.3%)	1 (100%)		8 (61.5%)
Hours TV	Until 10 hours	10 (83.3%)	1 (100%)	0.657	11 (84.6%)
	More than 10 hours	2 (16.7%)	0		2 (15.4%)
Electronic devices	Until 10 hours	10 (83.3%)	0	0.488	10 (76.9%)
	More than 10 hours	2 (16.7%)	1 (100%)		3 (23.1%)
Sport practice	Yes	8 (66.7%)	1 (100%)	0.057*	9 (69.2%)
	No	4 (33.3%)	0		4 (30.8%)
Total		12 (92.3%)	1 (7.7%)	-	13 (100%)

Table 1: *Trunk asymmetry by gender and age group.*

Once the relationship between "sports practice" and "trunk rotation" variables was statistically significant, binary logistic regression was performed; the obtained results showed that students who practice some sport outside the school have 1.39 more probabilities of developing trunk rotation than those that only practice sport at school (Confidence interval: 0.367 - 5.279; p = 0.627).

Table 2 shows the distribution of trunk rotation angles by spine zone and by side of asymmetry, as well as minimum and maximum values, mean and standard deviation obtained with the scoliometer in each spine region.

Spine region	Right	Left	Total	Minimum and maximum	Mean ± standard deviation
Mid-thoracic (T4-T8)	6 (60%)	4 (40%)	10 (28.6%)	0 - 5	2.77 ± 2.01
Thoracolumbar (T12-L1)	9 (69%)	4 (31%)	13 (37.1%)	1 - 8	4.69 ± 1.75
Lumbar (L2-L5)	8 (67%)	4 (33%)	12 (34.3%)	0 - 6	2.92 ± 2.10
Total	23 (65.7%)	12 (34.3%)	35 (100%)	---	

Table 2: *Trunk asymmetry by spine region.*

Discussion

Data obtained in this study indicated a low prevalence of trunk rotation, indicating the possible presence of scoliosis (7.4%). Some studies indicated a prevalence of scoliosis with values ranging from 1% to 4% in adolescents aged between 10 to 16 years old [1,2,16].

We chose to call scoliosis the trunk rotation since the diagnosis of scoliosis must be made by radiography; despite the high sensitivity and specificity of scoliometer for scoliosis detection reported in several studies [17,18], it is not comparable to an imaging examination.

Our results are different from those observed in Minghelli., *et al*. [19], that evaluated a similar sample. In Minghelli*., et al.* [19] study, 966 students from the south of Portugal, aged between 10 and 16 years, were evaluated using a scoliometer, and data revealed the presence of scoliosis (with angles equal or more than 5º) in 15.2% of students.

Recently Zheng., *et al.* [20] study evaluated 79,122 adolescents, aged between 10 to 16 years old, using a scoliometer, in eastern China. Individuals who presented angle values equal or more than 5° were submitted to x-ray evaluation; a prevalence of 2.4% for scoliosis was observed.

Suh., *et al*. [21] evaluated 1,134,890 schoolchildren in Korea, aged between 10 to 14 years old; 77,910 (6.2%) students presented scoliometer values above 5º and 37,339 of them had positive results with Cobb angles ≥ 10° by radiography (46.4%); the prevalence of scoliosis diagnosed by x-ray was 3.26%.

Despite the differences in scoliosis´s prevalence presented in these different studies, most indicated a low prevalence of this disorder in adolescent population; however, scoliosis is still present, and it is important to continue screening for its early detection by monitoring the evolution of the curve.

In our study, no significant difference in number of curves was found between the regions of the spine (13 in thoracolumbar, 12 in lumbar and 10 in mid-thoracic). Several studies verified that most of the curves were located in the thoracolumbar region [19, 22,23]. However, in relation to the side of the curve, the right side showed 11 more curves in our study, results that are in agreement with literature which reveals that most common standards of simple curvature are located in the right side in the thoracic and thoracolumbar region and in the left side in the lumbar zone [24,25]. In our study, most of curves in lumbar spine was located on the right side, but the literature also reveals that the curves may be located on either side of the body.

Although no significant differences were observed, trunk rotation was more present in girls than in boys. The same was observed in several studies [18,19,22]. These differences between gender can be explained by age of menarche that can be considered a factor for the development of idiopathic scoliosis, if it appears late.

Regarding age group, our study showed that the older group presented more prevalence of trunk rotation, but data did not reveal statistical significance between age groups and prevalence of trunk rotation, which is in accordance to the study of Minghelli., *et al* [19]. There are still no guidelines that indicate the age of greatest risk for the development of scoliosis and the ideal age for a screening of scoliosis is still under debate [19].

The association between the presence of trunk rotation and sedentary habits (watching television, playing video games, using computers and mobile phones) showed that the students who spend less time in these activities were the ones that had the most presence of trunk rotation. However, no significant differences were observed.

The information about the hours spent in sedentary activities obtained through self-report may not be accurate and may be overestimated or underestimated. This is a limitation of these type of studies that use subjective data. It would be interesting to conduct future studies where these hours could be measurable, for example with the installation of applications that count the hours of use of these devices.

The results obtained in the binary logistic regression analysis revealed an increased risk of developing trunk rotation in adolescents practicing sports. However, no information was collected on the type of sport practiced, the intensity, frequency and duration of the sport, and years of practice and may have been these factors that could lead to changes in the trunk.

Further studies involving larger samples from different age groups are required, as well as an imaging examination to confirm the presence of scoliosis. All adolescents who were detected with trunk rotation were informed of this possible change, as well as their respective parents, suggesting a more thorough evaluation with a health professional.

Conclusions

This study revealed a low prevalence of trunk rotation in adolescents, being more common in girls and in older students.

Although this disorder presents low prevalence, it is important to perform screenings so that these curvature alterations of the spine can be detected early in this population that has not yet finalized the process of bone growth.

Funding Sources

This study is financed by national funds through FCT - Foundation for Science and Technology, I.P., in the scope of the project UID/Multi/04587/2019; Research in Education and Community Intervention (RECI)

Acknowledgment

PhD Sílvia Fernandes by the language proofreading.

Bibliography

1. Asher M and Burton D. "Adolescent idiopathic scoliosis: natural history and long term treatment effects". *Scoliosis* 1 (2006): 2.
2. Reamy B and Slakey J. "Adolescent idiopathic scoliosis: review and currents concepts". *American Family Physician* 64.1 (2001): 111-116.
3. Lowe T., *et al*. "Etiology of Idiopathic Scoliosis: Current Trends in Research". *Journal of Bone and Joint Surgery-American Volume* 82A.8 (2000): 1157-1168.
4. Burwell R. "Aetiology of idiopathic scoliosis: current concepts". *Pediatric Rehabilitation* 6.3-4 (2003): 137-170.
5. Hawes M and O'Brien J. "The transformation of spinal curvature into spinal deformity: pathological processes and implications for treatment". *Scoliosis* 1.1 (2006): 3.
6. Scoliosis Research Society.
7. Burwell R., *et al*. "Etiologic Theories of Idiopathic Scoliosis: Enantiomorph Disorder Concept of Bilateral Symmetry, Physeally-created Growth Conflicts and Possible Prevention". *Studies in Health Technology and Informatics* 123 (2006): 391-397.
8. Zheng Y., *et al*. "Prevalence and determinants of idiopathic scoliosis in primary school children in Beitang district, Wuxi, China". *Journal of Rehabilitation Medicine* 48.6 (2016): 547-553.
9. Burwell R., *et al*. "Concepts on the pathogenesis of adolescent idiopathic scoliosis. Bone growth and mass, vertebral column, spinal cord, brain, skull, extra-spinal left-right skeletal length asymmetries, disproportions and molecular pathogenesis". *Studies in Health Technology and Informatics* 135 (2008): 3-52.
10. Amendt LE., *et al*. "Validity and reliability testing of the Scoliometer". *Physical Therapy* 70.2 (1990): 108-117.
11. Bunnell WP. "An objective criterion for scoliosis screening". *Journal of Bone and Joint Surgery-American Volume* 66.9 (1984): 1381-1387.
12. Grivas TB., *et al*. "Trunk asymmetry in juveniles". *Scoliosis* 3 (2008): 13.
13. Bunnell WP. "Selective screening for scoliosis". *Clinical Orthopaedics and Related Research* 434 (2005): 40-45.
14. Karachalios T., *et al*. "Ten-year follow-up evaluation of a school screening program for scoliosis. Is the forward-bending test an accurate diagnostic criterion for the screening of scoliosis?" *Spine (Phila Pa 1976)* 24.22 (1999): 2318-2324.
15. Murrell GA., *et al*. "An assessment of the reliability of the Scoliometer". *Spine (Phila Pa 1976)* 18.6 (1993): 709-712.
16. Weinstein SL., *et al*. "Adolescent idiopathic scoliosis". *Lancet* 371.9623 (2008): 1527-1537.

17. Viviani GR., *et al*. "Assessment of accuracy of the scoliosis school screening examination". *American Journal of Public Health* 74.5 (1984): 497-498.

18. Adobor RD., *et al*. "School screening and point prevalence of adolescent idiopathic scoliosis in 4000 Norwegian children aged 12 years". *Scoliosis* 6 (2011): 23.

19. Minghelli B., *et al*. "Prevalence of Scoliosis in Southern Portugal Adolescents". *Pediatric Endocrinology Reviews* 11.4 (2014): 374-382.

20. Zheng Y., *et al*. "Epidemiological study of adolescent idiopathic scoliosis in Eastern China". *Journal of Rehabilitation Medicine* 49.6 (2017): 512-519.

21. Suh S., *et al*. "Idiopathic scoliosis in Korean schoolchildren: a prospective screening study of over 1 million children". *European Spine Journal* 20.7 (2011): 1087-1094.

22. Grivas TB., *et al*. "Study of trunk asymmetry in normal children and adolescents". *Scoliosis* 1 (2006): 19.

23. Wong HK., *et al*. "Idiopathic scoliosis in Singapore schoolchildren: a prevalence study 15 years into the screening program". *Spine (Phila Pa 1976)* 30.10 (2005): 1188-1196.

24. Scoliosis Australia. About scoliosis: symptoms, causes, treatment.

25. Rinsky L and Gamble J. "Adolescent idiopathic scoliosis". *Western Journal of Medicine* 148.2 (1988): 182-191.

Volume 10 Issue 5 May 2019