THE EARLY DETECTION OF SCOLIOSIS IN SCHOOL CHILDREN: GENDER AND AGE DIFFERENCES AT CROSS-SECTIONAL SCREENING

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RANA DETEKCIJA SKOLIOZE U ŠKOLSKOE DECE: RAZLIKE U POLU I UZRASTU KOD SISTEMATSKOG PREGLEDA

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SAŽETAK
Programi sistematskog otkrivanja skolioze se danas susreću sa mnogo izazovima pa je cilj ovog rada da utvrdi ukupnu prevalencu i obras- zac raspodele skolioze u različitim klasterima školske dece koji su bazirani na polu i uzrastu. Studija je observaciona, retrospektivna bez kontrole grupe. Podaci su prikupljeni iz medicinske dokumentacije sistematskih i specijalističkih pregleda zdravih učenika uzrastao od 7 do 14 godina. Diagnosu skolioze je ustanovljena korišćenjem astro- pometrijskih, topografskih i, u suspetskim slučajevima, radioloških kriterijuma. Od 14,634 dece 1,324 njih (9.04%) je imalo loše držanje a 357 (2.3%) skoliozu. Osim kod najmlađih devojčica (7-8 godina) koje su sklonije skoliozi nego dečaci (χ²=13.93, p=0.05), u druga dva jednogodišnja uzrasta intervala (9-10 godina, χ²=8.65, p<0.05, 13-14 godina, χ²=8.4, p<0.01) skolioza je učestalija kod dečaka nego kod devojčica. Najveće slučajeve je otkriveno u uzrastu od 14 godina, za ukupnom prosječnom starošću od 12.7 godina (+/- 2.3). Naša studija je pokazala da postoje značajne razlike u ukupnoj prevalencu i obrascu distribucije skolioze kod različitih polnih i uzrastnih grupa u velikom uzorku školске dece.

Ključne reči: skolioza, sistematski pregled, školska deca, pol, uzраст, klasteri

INTRODUCTION
Scoliosis is characterized by the permanent lateral cur- vature of the spinal cord, the rotation of the vertebrae towards the convex side of the spinal cord and the gib- bsite. Beside aesthetic and functional problem related to the skeleton, the changes on the visceral organs, particularly in the thorax, are also very important with the biggest problems being disturbance of the cardiovascular system.

The diagnostic work up of scoliosis mainly constitu­ tes of looking for the typical clinical (anthropometric, topographic) signs. The most important are: level of shoulders (definition), position of scapula (asymmetry and destination from the middle line), asymmetry of the triangle of built (Laurence’s triangle), vertical line of spine, asymmetry of the thorax, presence of the rib hump, position of the pelvis, increased tone of the pel­ vic and femoral muscles (Thomas’ test) and translation of the spine (1).

Several treatment methods are available for scoliosis that can be divided into three groups: kinesitherapy with observations, orthotic treatment and surgery (2). The treatment options primarily depend on the grade of scolo­ siosis severity and the presence of unfavorable prognostic factors. The signs of poor outcome includes: infantile progressive scoliosis, the curvature > 50°, rotation of the third degree, a prominent nail like asymmetry, and decrease or loss of the starting correction during the conservative therapy. In these cases, the surgical treatment is usually required but this is associated with significant distress and much more medical hazard then conserva­ tive modalities. Only at small children, the conservative treatment can temporarily be determined.

The various screening programs for scoliosis detection were introduced long time ago which has provided valuable knowledge about the prevalence and natural history of the disorder. However, these programs are facing today many challenges like the low prevalence rate of clinically significant scoliosis, the problems with specificity and sensitivity of used methods and the inflated costs because of over-referral (3). In addition, it has been reported that natural history of scoliosis was independent of its early detection (4) or even a conservative treatment (5) which questioned wide-spread use of some diagnostic techniques.

It seems that improvements in the field are needed and one of them could be the more detailed analysis of different strata of the patients. This subgroup could be based not only on anthropometric but also on other variables which might influence the musculoskeletal development like sex or growth hormones. Therefore, the goal of this work was to establish overall prevalence and distribution pattern of the scoliosis across different gender and age groups in a large sample of school children.
PATIENTS AND METHODS
The study was observational and retrospective, without control groups. The data are extracted from available medical documentation based on the systematic check-ups of healthy pupils of the age of 7 to 14 years from the Children's Health Center in the area of the municipality of Kragujevac in the period from 1995 to 1996. The examination of the children was performed by both pediatrician and investigators. During exams, the following clinical signs of scoliosis were searched for: level of shoulders, the position of scapula, the asymmetry of body (Laurence's triangle), vertical line of spine and the asymmetry of thorax (1, 6). In cases suspected for clinical significant scoliosis, radiographic examinations were done at the Department of Radiography, Clinical Centre, in Kragujevac. The plain films were of the size 30x 40 cm, in a standard way, in a standing position and AP-position and rotation of vertebrae and the angle of the curvature of scoliosis were identified as radiographic signs of scoliosis.

Additional sample consisted of 56 children who were, in the same period, suspected to have scoliosis and were referred to and evaluated by the specialist. In the specialist office the vertebral radiography was done and the size of the curvature of scoliosis was determined by the measuring Cobb angle (7).

The statistical analysis of the collected data included the descriptive statistics and hypothesis testing: chi-square test and Fisher’s test (8).

RESULTS
In the area of Kragujevac, in 11 primary schools, there were 15,592 school children: 7,986 boys (51.21%) and 7,606 girls (48.79%). The study sample consisted of 14,634 children which were examined (93.85%), 7,316 were boys and 7,318 girls. All the cases with one positive sign of scoliosis were taken into account. From 14,634 students, there were 1,324 (9.04%) with bad posture and 357 (2.3%) with the positive signs of scoliosis.

The systematic check-ups

a. The frequency of bad posture at age groups
The bad posture was present in 556 (42%) of girls and 768 (58%) of boys. Since the age of seven, the frequency of bad posture increases both in boys and in girls. At the age of 13 to 14 it falls down to the approximate value of the age group of 7 to 8 years (Figure 1).

b. The frequency of scoliosis at age groups
The mean age when scoliosis appeared was 12.4 years (SD, 2.3). The most cases of the scoliosis were detected during the „adolescent swing” of the growth that lasts from 1.5 to 2 years and appears at girls between 10 and 13 years, and at boys two years later. When the growth stops, the progression of scoliosis is stabilized. The parallelism of the flow of scoliosis with the growth is a characteristic of all the types of scoliosis.

c. The gender differences
In the children aged from 7 to 8 years, the bad posture appeared equally in both genders ($\chi^2=0.13$, $p>0.05$). However the scoliosis were more prevalent in girls than boys ($\chi^2=13.93$, $p<0.05$). In the children aged from 9 to 10 years, the bad posture appeared equally in both genders ($\chi^2=5.63$, $p>0.05$). However the scoliosis were more prevalent in boys than in girls ($\chi^2=4.52$, $p<0.05$) and 3.96, $p>0.05$). Finally, in the children aged from 13 to 14 years, both the bad posture ($\chi^2=59.13$, $p<0.01$) and the scoliosis ($\chi^2=8.4$, $p<0.01$) were more prevalent in boys than in girls.

d. Degree of scoliosis
The degree of the scoliosis did not depend on the gender. According to the results of Fisher’s test, different grades of the scoliosis were equally distributed in girls and boys including the following intervals: $6°-10°$ ($p=0.3$), $11°-15°$ ($p=0.28$), $16°-20°$ ($p=0.66$), $21°-40°$ ($p=0.52$), and $>40°$ ($p=0.31$).

The scoliosis in the specialist’s office
During the study period 56 children were evaluated by the orthopedics which was certified for evaluation and management of scoliosis. There was a statistically significant difference between boys and girls related to the degree of scoliosis. In general, scoliosis was more frequent at girls (Table 1).

Table 1. Degree of scoliosis regarding the respondent’s sex.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Degree of scoliosis</th>
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<tbody>
<tr>
<td></td>
<td>0 - 5</td>
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<tr>
<td>Male (n)</td>
<td>0</td>
</tr>
<tr>
<td>Female (n)</td>
<td>0</td>
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<td>Total (n)</td>
<td>0</td>
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DISCUSSION
In our study the bad posture was found in near every 10th child and it was the most prevalent at the age of 10–11 years. The overall frequency and the distribution pattern across the age intervals are in agreement with the previous studies in which the bad posture was found in 8.6% of children at the age of 7 years and increased to 28.3% at 11 years (1) and fell down to 13.8% at 16 years (9). Although the bad posture in its beginnings represents a functional difficulty it can cause significant discomfort (e.g. back pain) and even structural changes at advanced age. For example, among 5353 of children with bad posture at San Francisco Bay, USA, in about a third of them lumbar pain was detected after one year of the follow-up (10).
In our children the scoliosis was detected in about 2% which was in the middle of the reported range of scoliosis prevalence in the similar age. For example, a screening program in 2700 pupils in Greece, aged 8 to 16 years, was performed for detection of spinal deformities and Adams forward bending test, Moiré topography, the scoliometer and the hump-meter were used. About 6% of subjects had some spinal deformity and scoliosis was present in about 1% (4). On the other hand, in Netherlands out of the 10000 children of 10 to 14 years, the scoliosis was confirmed in 423 of them (4.23%), using a spinal radiograph and measuring of the Cobb angle (11). Initial screening was performed using bending test and surface topography and suspected cases were reexamined before a specialist referral with measurement of rib hump weight, angle trunk rotation and Moiré topography. In this study the radiography confirmed scoliosis in 53% of suspected cases which is close to our findings (39%, 22 out of 56) obtained in specialist’s office.
The studies reporting gender differences of the vertebral deformity within age intervals in school children are not frequent. We found that, except the youngest pupils, the boys are more prone to scoliosis than girls. Contrary, Brooks and co-workers found that in younger adolescents the prevalence of the scoliosis was about 2%, with the ratio of 3:2 in favor of the girls (9). The methodological issues and the characteristics of the study sample could explain these differences. The current methods for detection of the scoliosis are far from optimal because many of them suffer from the lack of sufficient sensitivity and specificity. Therefore, novel approaches as the noninvasive anthropometric techniques (12) and functional tests (13) are intensively developing. In addition, it has been recently reported that a 10-fold higher incidence of scoliosis was found in the girls who regularly trained the rhythmic gymnastics (12%) than in their non-trainees counterparts (1.1%) (14). Therefore, the differences of the lifestyle and, in general, the attributes of the screened children could influence not only overall prevalence of scoliosis but also its distribution pattern across gender and age groups among different studies.
In conclusions, our study revealed significant differences in overall prevalence and distribution pattern of the scoliosis across different gender and age groups in a large sample of school children. These findings could be of interest for designing further studies which will follow up the natural scoliosis course and treatment outcomes in the children clusters, similar to ours.

REFERENCES