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Prevalence of scoliosis and cost-effectiveness of screening in schools in Turkey

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Abstract. The study was intended determine the prevalence of scoliosis and to assess the cost-effectiveness of a school screening program for scoliosis in Turkey. A total of 4259 children (2057 females and 2022 males aged 10-14 years old) were screened. Thirty-nine children had a positive forward bending test. The prevalence of scoliosis was 25 per 1000 in the screened population. The ratio of girls to boys with scoliosis was 2.5:1. A minor curve was detected in 72.7% of children with scoliosis (Cobb angle of 10–20 degrees), and a major curve was found in 27.3% (Cobb angle >20 degrees). The cost of screening was found to be 47 cents per child, but the cost per case of scoliosis was determined to be $236.81. School screening for scoliosis seems to be cost-effective in Turkey.

Keywords: Scoliosis, screening, school, prevalence

1. Introduction

Although scoliosis is not an uncommon disease, there have been only two reports on its epidemiology in the Turkish population [14,17]. In other countries, prevalence rates of idiopathic scoliosis vary from 0.13% to 13.6%, depending on the definition of the Cobb angle, the screening age, and sex [2,12,21]. The female-to-male ratio for scoliosis varies from 1.2:1 to 3.7:1 in the literature [2,8,19,21].

Scoliosis detection via screening in schoolchildren has been popularized over the past two decades and is currently carried out in the USA, the Middle East, Sweden, South Africa and Japan [21]; however, no school screening programs have been performed in Turkey. We aimed to investigate scoliosis prevalence in a target area and to estimate the cost-effectiveness of a school screening program for scoliosis in Turkey.

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2. Materials and methods

The study began on January 26, 2008, with the approval of the Ethics Committee of Haseki Training and Research Hospital. An epidemiologic study was planned to determine the prevalence and distribution of various scoliotic parameters in schoolchildren in Fatih, Istanbul. During the 2008-2009 academic year, 4259 children aged 10–14 years were screened for idiopathic scoliosis. Our sample population comprised 13.9% of the total number of children registered in grades 4 through 8 of the public and private schools in Istanbul (total 30,699 children). Six schools were randomly selected out of 41 schools.

Both the schools and parents were informed about the objectives of this study and the details of the examination. Every child was examined by a team consisting of one orthopedic surgeon, one resident and one nurse. The actual examination was conducted with the students separated into groups by sex during their physical education classes. The physical examination included inspecting the back from behind with the patient bending forward (the forward bending test). Data including sex and age were collected. Parents of those patients with suspected scoliosis were notified of the positive test and were either advised to consult their pri-

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Table 1
Study sample (FBT: Forward bending test)

	Female			Male			Total		
	Number	Percent	Average age	Number	Percent	Average	Number age	Percent	Average
No. of children screened	2057	48.2	12.3	2202	51.7	12.3	4259	100	12.3
(+) FBT	29	0.68	12.5	10	0.23	12.4	39	0.91	12.4
Radiographic study	23	0.54	12.4	6	0.14	12.5	29	0.68	12.4
Minor curve	6	0.14	12.5	2	0.04	11.5	8	0.18	12.3
Major curve	2	0.04	13	1	0.02	13	3	0.07	13
Total scoliosis	8	0.18	12.6	3	0.07	12	11	0.25	12.4

vate physician or were referred to Haseki Training and Research Hospital for further evaluation and treatment recommendations.

Each child referred to Haseki underwent clinical examination by the senior author and spinal x-ray imaging. For each child, the author completed a form reporting the presence or absence of idiopathic scoliosis and described its type, location and severity. Diagnosis upon reassessment and treatment recommendations were also recorded.

3. Statistics

Statistical analyses were performed with the NCSS 2007 pocket program. Results were evaluated using descriptive statistics such as means and standard deviations. The significance level was set at $p < 0.05$.

4. Results

Thirty-nine children (0.91%) from our sample population displayed abnormalities on the bending test, and 29 children (0.68%) came to our hospital for further evaluation (Table 1). Eleven of these (0.25%) showed radiographic evidence of abnormal curvature. Thus, the prevalence of scoliosis among schoolchildren aged 10 to 14 years is 25 per 1000 and is higher among girls (18/1000) than among boys (7/1000). The ratio of girls to boys with scoliosis was 2.5:1. The average age of the whole group was 12.5 years (range 9–15 years). The average age for boys was greater than for girls (12.6 vs. 12.3).

Of those students with confirmed scoliosis, eight had curves between 10 and 20 degrees, while three students had curves greater than 20 degrees. Six cases (54.5%) had a double curve, and five cases (45.5%) had a thoracic curve (Table 2).

Immature patients with minor curves had follow-up appointments scheduled for observation. One patient with thoracolumbar scoliosis had previously undergone operative repair, while the remaining two patients with major curves were placed in braces.

Table 2
Detailed characteristics of scoliosis patients

	Sex	Age	Thoracic Cobb angle	Lumbar Cobb angle
NGH(**)	F	13	12	25
EO(**)	F	13	25	17
SG	F	11	9	20
IDO	F	14	14	20
MP	F	12	15	14
MS	F	14	10	18
ECA	F	12	18	
YT	F	12	20	
RB(*)	M	13	34	
BE	M	11	16	
FT	M	12	14	

(*) Previously operated on. (**) Both were started on brace therapy.

Screening costs included diagnostic costs, salaries, transportation, communications and filing costs, but they excluded research costs. The costs of clinical confirmation of the diagnosis consisted of professional fees and radiological services. Screening 4259 children cost $2,025, an average of $0.47 per child. Clinical evaluation of the 29 scoliosis-positive children identified by screening cost $580, or $20 per child, including the cost of x-rays. Out of the total cost of $2,605, the cost per case of confirmed scoliosis was estimated at $236.81, and the cost per case of scoliosis brought to immediate treatment was $1302.5 (excluding RB, who had already been operated on for scoliosis).

5. Discussion

The overall prevalence of scoliosis in various parts of the world may differ due to regional and ethnic differences [21]. Moreover, results from different studies may not be comparable because methods and diagnostic criteria are not standardized [15]. In other reports, the prevalence of scoliosis varies from 0.5–3%, for de-

formities ≥10 degrees [2,8,9,18]. The prevalence found in the current study was 0.25%. Similarly, in other Turkish populations, Serin and Ozerdemoglu independently reported the prevalence of scoliosis as 0.59% and 0.33%, respectively [14,17]. In addition, the female-to-male ratio in our population (2.5:1) is comparable to that of other study populations [2,8,19,21].

The proportion of children (0.91%) in this study who were referred for further evaluation after school screening differs from other studies, which have reported ranges of 3–18% in foreign countries [10,15]. It is possible that the referral rate was low because children were examined by orthopedic surgeons.

Orthopedic surgeons view scoliosis screening as beneficial and cite the effectiveness of nonoperative treatment, meaning high-standard conservative treatment, including physical therapy (side-shift and hitch exercises), intensive inpatient exercise programs and bracing [11,20]. It is also generally accepted that bracing can alter the natural history of idiopathic scoliosis [1, 4–6], while high-standard conservative treatment can reduce the need for (and thus the incidence of) surgical treatment [11,16,20]. Grivas et al. stated that school screening is justified, as it enables detection of mild and reversible spinal curvatures [5], so that they can be treated conservatively before they develop into spinal deformities with potential to cause life-long symptoms [7].

Although epidemiologists and public policy makers argue that the total health care burden of scoliosis is low and the cost of screening excessive [3], Lonstein et al. estimated the cost of screening at an average of 35 cents per pupil in Minnesota, although this figure varied from 24 cents to $1.75 [10]. Morais et al. reported that the cost of screening was $2.31 per child [13]. In this study, the cost of screening for scoliosis was low, at 47 cents per child screened, but the cost per child with scoliosis who began brace therapy was $1302.50. Today, the total cost of a scoliosis operation in Turkey is approximately 9,000 USD. Thus if only one child is successfully braced and does not require surgical treatment, the savings in treatment costs will have paid for the entire screening program.

However, we did not include costs for surgical treatment for children who failed brace treatment; in addition, the study sample was relatively small. Therefore a more extensive study is warranted to determine whether a screening program for scoliosis is justified.

In conclusion, the prevalence rate of idiopathic scoliosis in our school-age population was comparable to rates in other school-screening studies. The prevalence rate was 18 per 1000 for girls and 7 per 1000 for boys. The scoliosis screening program appears to have been cost-effective in Turkey. The average cost of finding one child with a scoliotic curve of 10 degrees or greater was $236.81.

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