

# Prevalence of Scoliosis in School-Children from Mostar, Bosnia and Herzegovina

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## ABSTRACT

*In the school-year 2002/2003 a prospective epidemiological study was performed with the aim of evaluating the prevalence and distribution of scoliosis in the population of schoolchildren from Mostar, Bosnia and Herzegovina. The general check-up of primary-school children covered a total of 2,517 children aged 7–14. The children in which at least one positive symptom of scoliosis was found were directed to undergo orthopedic examination and – if indicated – radiography. Incorrect posture was noted in 33.4% of children, and 11.8% of children were sent to orthopedic specialist examination. The prevalence of structural scoliosis amounted to 3.1%, with the spine curvature threshold being 10 degrees. In eight children (0.32%; 1 boy and 7 girls) a curvature of 20 degrees or more was diagnosed. The most common type of curvature was the thoracal (39%) and the thoraco-lumbar (39%) while 14 children had a double curvature (17.8%). A scoliosis was detected due to here performed check-up in 83.5% of children with scoliosis. No case of serious spine deformity (45 degree or more) was recorded, due to regular general check-ups taking place biannually in this population.*

**Key words:** scoliosis, prevalence, epidemiology, primary-school children

## Introduction

Spine deformities are the most common disorders in the spine pathology<sup>1</sup>. Spine disorders during childhood are peculiar in terms of specificities of spine pathology as well in terms of treatment possibilities, particularly surgical, which are limited in the period of growth and development<sup>2</sup>. Namely, most surgical interventions on children's spine affect the further growth and development of the spine. Therefore, the choice of optimal time for surgery is one of the most relevant preconditions for successful treatment outcome<sup>2</sup>.

In spine deformity domain there are three-dimensional (scoliosis) and one-plane deformities (lordosis and kyphosis). A sideways spine deformities points to scoliosis<sup>1</sup>, which can be either non-structural or structural.

The non-structural scolioses also include postural scolioses which do not require treatment<sup>3</sup>. The prevalence of postural scolioses in adolescent population is estimated to be up to 40%<sup>4</sup>.

The diagnosis of a structural scoliosis is based on a case history, physical examination and an x-ray of the spine. The lateral curvature of the spine is expressed in degrees, according to Cobb<sup>3</sup>. Since the minimal curvature level amounts from 5 to 10 degrees, depending on author<sup>5–10</sup>, the prevalence of structural scoliosis considerably varies depending on the threshold set by individual author. The prevalence of scoliosis, with a curvature amounting 20 degrees or more, is usually reported to be 0.2–0.5%<sup>11,12</sup> which is important since they require a more aggressive treatment. The prevalence of curvatures of 20 degree or more is six times more frequent in women than in man<sup>1</sup>.

The aim of scoliosis treatment is to stop the curving process. The selection of therapy depends on the age of the patient, on his/her sexual and skeletal maturity as well as on the size and the type of the curvature. For curvatures within the range of 10–19 degrees, a physical

therapy is indicated aimed to improve the general strength of the organism but not as a method of stopping the progress of scoliosis. For scolioses between 20 and 45 degrees, treatments by means of orthoses proved to be successful. Wearing corset is recommended in the adolescent age<sup>2</sup> because in that period of fast growth the deformities occur the most rapidly<sup>13</sup>. Surgical treatment is applied for scolioses over 45 degree. Optimal time for treatment is the moment when the adolescent growth spurt finish, i.e. the majority of the expected height has been reached (between 12 and 14 years of age)<sup>2</sup>.

The essential requirement in treating scolioses is that treatment should not start too late. Therefore in many countries a screening of schoolchildren is carried out. The aim of screening is to detect the scolioses of early stages when a conservative treatment could be sufficient. That reduces the possibility of developments of more serious spine deformities and consequently the need for surgical treatment<sup>11,14</sup>.

## Subjects and Methods

Within the framework of regular biannual general check-ups of primary-school children in Mostar, Bosnia and Herzegovina a prospective epidemiological study of spine deformities were carried out at the Department for School Medicine of the Mostar Health Center, in the period between September 2002 and May 2003. Each school-year general check-ups are performed on pupils from the first, the third, the fifth and the seventh class of the primary school. In that way pupils get checked up four times in the course of their eight-year primary school education.

The investigation encompassed all urban and suburban primary schools in the communes of Mostar (Bosnia and Herzegovina) with a predominantly Croatian population. In the communes with a predominantly Bosnian population general check-ups are not performed in primary schools. A total of 2,652 children attend the first, the third, the fifth and the seventh classes of the seven primary schools. However, 2,517 children (94.9%) were examined because 135 children did not attend the general check-up, mainly due to flu epidemics raging in the area at the time of examination.

Preceding the start of the project all headmasters and teachers from schools included in the project obtained detailed explanations concerning the importance and the methods of the check-ups, which they in turn presented to the parents and children. The schools also provided the general data of the children (name, date and place of birth, permanent address and occupation of parents). The specialists for school medicine examined the health status of each child and all aberrations from normal physical and mental status were recorded.

The examination of children's spine was performed as follows. First the posture of the body is observed, the child being asked to stand upright in a relaxed position. Special attention is paid to the horizontal position of the shoulders and the pelvis, the balance of the trunk and

the position of blade bones. After that the bend forward is tested by making the child bend with his knees straight and his arms hanging downwards. The physician is first sitting behind, then beside the patient, observing the surface of the back tangentially. In case any asymmetry between the shoulders and between the blade bones is noticed while the patient is erect and there is no *gibbus* during the forward bend – the status is registered as scoliotic (irregular) posture. A positive symptom of scoliosis includes asymmetry between the two shoulders and the blade bones (which stand clear of the body), asymmetry of the iliac crest, a difference in the distance between the arm and the hip, different leg-length in the standing position as well as lateral spine deviation at the forward bend test.

The children with at least one positive symptom were directed to the Orthopedic Department of the University Hospital in Mostar where the further examinations of the children were carried out by an orthopedist. An anterior-posterior as well as a profile x-ray of the whole vertebral column in standing position was performed for children for whom it was indicated. Based on an x-ray shot the angle of lateral spine curvature was expressed in degrees according to Cobb. A curvature of 10 degrees or higher was defined as a threshold for structural scoliosis. The course of the treatment for each child was based on the size of the scoliotic curvature.

The children with a curvature of 10–19 degrees were directed to the Department for Physiatrists of the University Hospital in Mostar, where physical therapy was pursued following an orthopedic examination. Every 4 to 6 months the patients were called to undergo orthopedic check-ups.

For children affected with spine curvature over 20 degrees or more, orthosis was indicated in addition to physical therapy. After the application of orthosis an anterior-posterior x-ray in standing position was taken in order to check and correct the position of the pelote. Control check-ups were arranged according to indications. No routine control x-rays were executed. Radiographic tests were indicated by the orthopedist at control check-ups (not more often than every three months).

The present epidemiological study of scoliosis was carried out on 2,517 children aged 7–14 within the framework of regular biannual general check-ups of primary-school children in Mostar, Bosnia and Herzegovina. The aim of the study was to establish the prevalence of incorrect posture and structural scoliosis in primary-school children of Mostar and to analyze the age and sex structure of the affected persons, the degrees and localizations of scolioses as well as to detect the proportion of children with scoliosis that are affected with some other abnormality of the muscular-skeletal system.

## Results

The general check-up of primary school children carried out at Mostar Health Center from September 2002 to May 2003 covered a total of 2,517 children (1,272 boys

and 1,245 girls) aged 7–14. The examinees were the primary school pupils from Mostar from the first form (born in 1995 and 1996), the third form (born in 1993 and 1994), the fifth form (born in 1991 and 1992) and the seventh form (born in 1989 and 1990).

The general check-up included an examination for scoliosis and a particular attention was paid to the body posture. It was established that 1,676 children (66.6%) out of the total number of 2,517 examined children had a correct posture, while 841 child (33.4%), out of which 404 boys (31.8%) and 437 girls (35.1%) had an incorrect posture. The prevalence of incorrect posture differed from class to class i.e. with the age of the patients: in the first class it amounted to 28.3%, in the third class to 28.9%, in the fifth class to 35.9%, and in the seventh class to 28.9%. The prevalence of incorrect posture did not differ by sex (Table 1).

The children with incorrect posture in which the possibility of scoliosis was excluded were not examined further. Avoiding incorrect static postures and pursuing sports were recommended to them. In 298 (11.8%) children the structural scoliosis was suspected and they were directed to orthopedic examination.

Radiographically confirmed structural scoliosis (curvature of 10 degrees or more) was confirmed in 79 children or in 3.1% of all examined children (Table 2). Ac-

cording to sex, scoliosis was diagnosed in 25 (1.9%) boys and 54 (4.3%) girls. The prevalence of scoliosis showed to be the highest at 13 and 14 years of age (Figure 1).

Scoliosis with the curvatures of 10–19 degrees is found in 71 children (2.8% of all children), while the scoliosis with curvature of 20 degrees or more is found in 8 children (or in 0.3% of all examined children). Children with

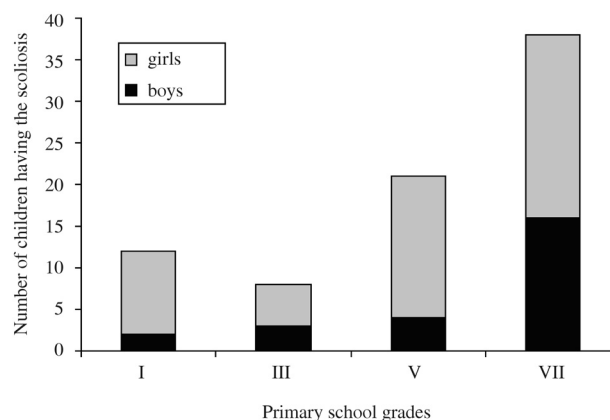


Fig 1. Prevalence of scoliosis in girls and boys attending 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> classes of primary schools in Mostar (Bosnia and Herzegovina).

**TABLE 1**  
BODY POSTURE OF CHILDREN WHICH UNDERWENT THE GENERAL CHECK-UP IN MOSTAR HEALTH CENTER IN THE PERIOD FROM JUNE 2002 TO MAY 2003

Primary school class	Total number (%) of examined children			Normal posture Number (%) of children			Incorrect posture Number (%) of children		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1 <sup>st</sup>	386 (15.3)	388 (15.4)	774 (30.8)	294 (11.7)	261 (10.4)	555 (22.1)	92 (3.7)	127 (5.0)	219 (8.7)
3 <sup>rd</sup>	289 (11.5)	306 (12.2)	595 (23.6)	209 (8.3)	214 (8.5)	423 (16.8)	80 (3.2)	92 (3.7)	172 (6.9)
5 <sup>th</sup>	312 (12.4)	280 (11.1)	592 (23.5)	205 (8.1)	174 (6.9)	379 (15.0)	107 (4.2)	106 (4.2)	213 (8.4)
7 <sup>th</sup>	285 (11.3)	271 (10.8)	556 (22.1)	160 (6.4)	159 (6.3)	319 (12.7)	125 (5.0)	112 (4.4)	237 (9.4)
Total	1272 (50.5)	1245 (49.5)	2517 (100)	868 (34.5)	808 (32.1)	1676 (66.6)	404 (16.1)	437 (17.3)	841 (33.4)

**TABLE 2**  
CHILDREN WITH INCORRECT POSTURE WITH AND WITHOUT CONFIRMED DIAGNOSIS OF STRUCTURAL SCOLIOSIS

Primary-school class	Children with incorrect posture without signs of structural scoliosis*			Children with incorrect posture with at least one sign of structural scoliosis (N=298, 11.8%)**					
				Number (%) of children with confirmed structural scoliosis			Number (%) of children without structural scoliosis		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1 <sup>st</sup>	63 (2.5)	79 (3.1)	142 (5.6)	2 (0.1)	10 (0.4)	12 (0.5)	27 (1.1)	38 (1.5)	65 (2.6)
3 <sup>rd</sup>	54 (2.1)	58 (2.3)	112 (4.4)	3 (0.1)	5 (0.2)	8 (0.3)	23 (0.9)	29 (1.2)	52 (2.1)
5 <sup>th</sup>	73 (2.9)	66 (2.6)	139 (5.5)	4 (0.2)	17 (0.7)	21 (0.9)	30 (1.2)	23 (0.9)	53 (2.1)
7 <sup>th</sup>	82 (3.3)	68 (2.7)	150 (6.0)	16 (0.6)	22 (0.8)	38 (1.4)	27 (1.1)	22 (0.9)	49 (2.0)
Total	272 (10.8)	271 (10.7)	543 (21.5)	25 (1.0)	54 (2.1)	79 (3.1)	107 (4.3)	112 (4.5)	219 (8.8)

\*children that underwent only general check up by specialist of school medicine

\*\*children that underwent orthopedic examination

curvatures of 10–19 degrees were directed to a physiatrist examination and after that to physical therapy, while for children with curvature of 20 degrees or more were treated by means of orthoses and simultaneous physical therapy.

The maximal registered spine curvature in our study amounted 32 degrees. Scoliosis in girls as compared to boys was found to be twice as frequent for curvatures 10–19 degrees, and seven times more frequent for curvatures 20 degrees or more (Figure 2).

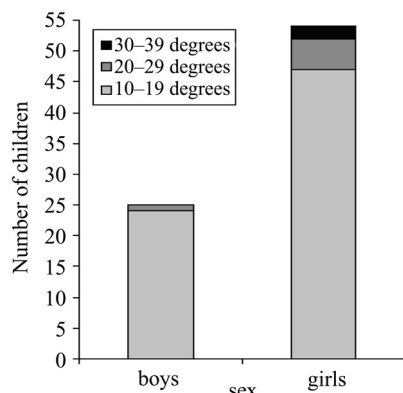


Fig. 2. Distribution of scoliosis in boys and girls according to curvature size.

The thoracal and thoraco-lumbar curves are the most frequent types of curvature while the incidence of a single curvature is 4.6 times more frequent than a double curvature. Out of 79 diagnosed scolioses 31 (39.2%; 21 right and 10 left) were thoracal, 31 (39.2%; 10 right and 21 left) thoraco-lumbar, 3 scolioses (3.8%; 1 right and 2 left) were lumbar, a 14 scolioses were double. Out of these 32 were right curves (40.5%) and 33 left curves (41.8%). Regarding double curvatures, the most frequent was the right thoracal and the left lumbar scoliosis (in 11 patients). Out of 8 children with a spine curvature of 20 degrees or more, 3 children had a right thoracal curves and 5 children a double curvature (the right thoracal and left lumbar scoliosis was found in 4 children, and the right thoracal and left thoraco-lumbar in one child).

At the general check-up and after that at specialist examination (orthopedic and physiatrist) it was established that 25 (out of 79) children were affected with some other disturbance of the muscular- skeletal system be-

sides scoliosis. Six children suffered from disturbances of the spine and the chest, while 19 children suffered from disturbances in lower limbs. Leg shortenings ranging from several millimeters to 2 centimeters were noticed in 13 children (in 11 of them the left leg was shorter, in two the right leg). Five children had an abnormal foot, while in one child *genua valga* was diagnosed. Orthopedic supporters were indicated for nine children with scoliosis.

Out of 79 children with diagnosed scoliosis 13 had been in medical treatment before September 2002, four of them wore orthosis and nine pursued physical therapy (Table 3). This examination discovered 66 new patients with scoliosis: they were either examined for the first time (the first-form pupils) or had not shown any positive symptom of scoliosis at the last general check-up (in 2000/2001). Orthosis was indicated for four children from this group while 62 pursued physical therapy.

### Discussion

The prevalence of incorrect posture in Mostar school-children amounts 33.4%. Among 841 children with incorrect posture the scoliosis was suspected in 298 of them (or in 11.8%). This percentage is somewhat higher than what is usually reported in other countries, where the range is 3–10%<sup>7,8,14,15</sup>, although the same criteria were applied.

Due to suspicion of scoliosis 298 children have been directed to further orthopedic examination which substantially reduced the number of false-positive findings of structural scoliosis. By orthopedic examination the diagnosis of scoliosis was rejected for 73% of children. This has prevented a large number of children to undergo radiography and to be unnecessarily exposed to x-rays.

The prevalence of structural scoliosis, as diagnosed by orthopedist, in Mostar schoolchildren aged between 7 and 14 is 3.1%. The most frequently the scoliosis has been found in children aged 13 and 14, pointing to the progression of scoliosis in adolescence. The results of our investigation show that the most frequently found curvatures are the mild ones i.e. the ones between 10 and 19 degrees, which do not require an aggressive treatment. The study has shown that the prevalence of curvatures exceeding 20 degrees in this population is only 0.3%.

Such findings are compatible with the majority of previous investigations<sup>5-10,14,16-19</sup>. However, the variation of scoliosis prevalence in various populations due to differ-

TABLE 3  
NUMBER OF CHILDREN WITH STRUCTURAL SCOLIOSIS DETECTED BY GENERAL CHECK UP 2002/2003 COMPARED TO THE NUMBER OF CHILDREN WHO ARE ALREADY UNDER MEDICAL TREATMENT

	Orthosis	Physical therapy	Total
Already under treatment	4 (5.1)	9 (11.4)	13 (16.5)
New patients	4 (5.1)	62 (78.5)	66 (83.5)
Total	8 (10.1)	71 (89.9)	79 (100.0)

ent genetic backgrounds must also be taken into consideration<sup>14</sup>.

The prevalence of scoliosis is higher in girls if compared to boys (2.1%:1.0%) which is in accordance with other investigations<sup>14,20,21</sup>. The ratio girls/boys of 7:1, in cases of spine curvatures of 20 degrees and higher is the same as reported for Sweden<sup>6</sup>.

The most common type of scoliotic curvatures in Mostar school children is thoracal and thoraco-lumbar. Such findings differ from those described in Sweden and Norway, where the proportion of single thoracal curves largely prevails over others<sup>6,22</sup>, while the most common type of curvature in Greece is thoraco-lumbar and lumbar<sup>14</sup>.

Our findings that the double curvatures comprise fewer than 20% of observed scolioses comply with the results reported by other authors<sup>6,14,22</sup>. However, double curvatures are the most frequent among the scolioses that require orthotic treatment, and their progress is also the fastest. The total number of right and left directed curves is about the same, but the right/left ratio differs with the type of curvature e.g. while the thoracal scolioses are mostly right, the lumbar ones are mostly left.

Physical examination made it possible to reveal that 25 children (out of 79) who had scoliosis were also affected by other disorders of the muscular-skeletal system, most frequently in lower limbs. Thirteen children with structural scoliosis had a shorter leg. That may or may not have been the primary cause of scoliosis. The length of the legs is made equal by applying an orthopedic supporter. After that we may consider the problem solved and the scoliosis put under control. However, our investigation has shown that in some cases, even after the application of an orthopedic supporter fitting the curvature, the condition continues to progress.

The greatest value of the present study lies in the fact that 66 (out of 79) children with scoliosis have been diagnosed due to here performed examinations. In four patients (out of this number) curvatures of 20 degrees or higher have been recorded and orthosis has been applied. Taking into account the fact that four children were already using orthosis, we can conclude that to each diagnosed case of scoliosis requiring orthotic treatment, there comes one undiagnosed case. These data undoubtedly point to the importance of school scoliosis screenings.

The questions that remain are: at what age to start and how often to perform them? Professional literature

offers different recommendations varying from 9 to 16 years of age, depending on sex<sup>3,10,12,20,23</sup>. One investigation indicated that 43% of children with diagnosed scoliosis showed no symptoms at all just 2 or 3 years before<sup>24</sup>. In Mostar regular general check-ups of children aged 7–14 are performed, each child being examined once in a two-year period. Our research proves this to be sufficient, because the prevalence of curvatures of 20 degrees or higher amounts only 0.3%. Even more relevant is the fact that the maximal diagnosed curvature was 32 degrees, which means that no child has so far been affected by any serious spine deformity (over 45 degrees) requiring surgical treatment. This is primarily owed to regular check-ups as well as timely and adequate treatment. However, since scoliosis has a substantial genetic component<sup>21,25</sup>, the siblings of the affected children ought to be covered by annual spine examinations to make sure the deformities are discovered on time.

## Conclusions

The prevalence of incorrect posture in primary-school children in Mostar is 33.4%. 11.8% of children suspected for scoliosis have been sent to specialist orthopedic examination, while in 3.1% children a genuine structural scoliosis has been diagnosed. The prevalence of scoliosis is the highest between 13 and 14 years of age. Scoliosis with curvatures of 10 to 19 degrees is twice more frequent in girls; it is seven times more frequent for curvatures of 20 degrees and more. The most common types of scoliotic curves are the thoracal and the thoraco-lumbar. One third of scoliotic children are affected by some other abnormality of the muscular-skeletal system. Previous to these general check-ups the scoliosis was diagnosed in only 13 children, whereas 66 (83.5%) of affected children were diagnosed owing to the present study. Regarding scoliosis of 20 degrees or higher, four children had been in treatment before and four were newly-diagnosed. Based on this fact we believe that regular check-ups are particularly important, because to every diagnosed case of scoliosis requiring aggressive treatment there comes a non-diagnosed one. The maximal curvature found in our investigation amounted to 32 degrees, which is considerably lower than 45 degrees (in which case surgical treatment is required). We therefore believe that one examination of schoolchildren in a two-year period is sufficient to prevent serious spine deformities and surgical interventions.

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## **PREVALENCIJA SKOLIOZA U ŠKOLSKE DJECE U MOSTARU, BOSNA I HERCEGOVINA**

### **SAŽETAK**

Tijekom školske godine 2002./2003., provedeno je prospektivno epidemiološko istraživanje, u svrhu procijene prevalencije i raspodjele raznih parametara povezanih sa skoliozom u osnovnoškolske djece iz Mostara. Sistematskim pregledom osnovnoškolske djece pregledano je ukupno 2.517 djece u dobi od 7–14 godina. Djeca s najmanje jedim pozitivnim znakom za skolioze, prilikom fizikalnog pregleda, upućena su na pregled ortopeda, te na radiografiju (ukoliko je indicirano). Nepravilno držanje zabilježeno je u 33,4% djece. Na specijalistički pregled ortopeda upućeno je 11,8% djece. S 10 stupnjeva kao donjom granicom zakrivljenosti kralježnice, prevalencija skolioza iznosi 3,1%. U osmero djece je registrirana krivina od 20 stupnjeva i veća. Omjer dječaci – djevojčice iznosi 1:7. Najčešći tip krivine je torakalni (39%) i torakolumbarni (39%), 14 djece ima dvostruku krivinu (17,8%). Pregledom je u 83,5% djece prvi put identificirana skolioza. Nije zabilježen nijedan slučaj teške deformacije kralježnice, što je rezultat redovitih sistematskih pregleda.