

## Peculiarities of Scoliosis of Black Children and Adolescents

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### Abstract

**Introduction:** Scoliosis is a pediatric pathology characterized by a deformation of the spine exerting a twist around its axis. Its expression is variable and multifactorial. When they are severe, they can become disabling and therefore justify appropriate care. However, the African literature is scarce on the subject.

**Objective:** The objective of our work was to draw up the epidemiological, radio-clinical and evolutionary profile of scoliosis in black children and to highlight their singularities.

**Patients and Methods:** We conducted a retrospective descriptive and analytical study over a 10-year period including all patients aged 0 to 17 years with scoliosis at the NCRPD.

**Results:** We collected 69 cases with a female predominance. The prevalence of scoliosis in children was 0.4% and that of adolescents was 4.2%. The average age was 4.88 years for children and 15.16 years for adolescents. The average time of the 1st consultation was one year for children and 3 years for adolescents. They were severe and very severe (Cobb angle > 35°) in 76.8% of cases and symptomatic in 78.3% of cases with gibbosities of up to 6 cm in children and 11 cm in adolescents. 5 risk factors for severity were identified in the black subject.

**Conclusion:** Despite much work on the subject, more targeted epidemiological research is needed to improve the prevention and management of this disabling condition.

**Keywords:** Scoliosis; Black Race; Child; Teenager; Spine

### Introduction

Scoliosis is an unsightly three-dimensional deformation of all or part of the spine resulting in a twisting of one or more vertebrae

on themselves. Etiopathogenesis is not yet well known but it seems to be multifactorial. In children, congenital scoliosis is the most common while in adolescents, idiopathic scoliosis accounts

for 80% of cases [1]. The prevalence of adolescent idiopathic scoliosis (AIS) varies between countries and ranges from 0.47% to 5.2% [2-4], much more common than congenital child scoliosis (CES) whose global prevalence is estimated at 0.1% [5]. Very little associated with painful symptomatology, scoliosis can however result in a variable functional impact, often related to their location, severity, speed of evolution and malformations or other associated disorders. Despite numerous meta-analyses on the subject, many studies have been conducted on child scoliosis through the prism of racial origin particularly in order to identify possible singularities [2,3,6,7]. Our work therefore had a double objective: to draw up the epidemiological, radio-clinical and evolutionary profile of scoliosis in black children and to identify their particularities in order to improve their management on the African continent.

## Patients and Methods

We conducted a retrospective descriptive and analytical cross-sectional study at the National Center for the Rehabilitation of Persons with Disabilities (NCRPD) in Yaoundé over a period of 10 years (2010-2020) whose main objective was to draw up the epidemiological, radio-clinical and evolutionary profile of Scoliosis in black children and to bring out the singularities.

We included all records of patients aged 0 to 17 years with scoliosis. Excluded were all patients with spinal deformity other than scoliosis, those with scoliotic attitudes and those whose parents had not consented to participate in the study. Sampling was consecutive and extensive.

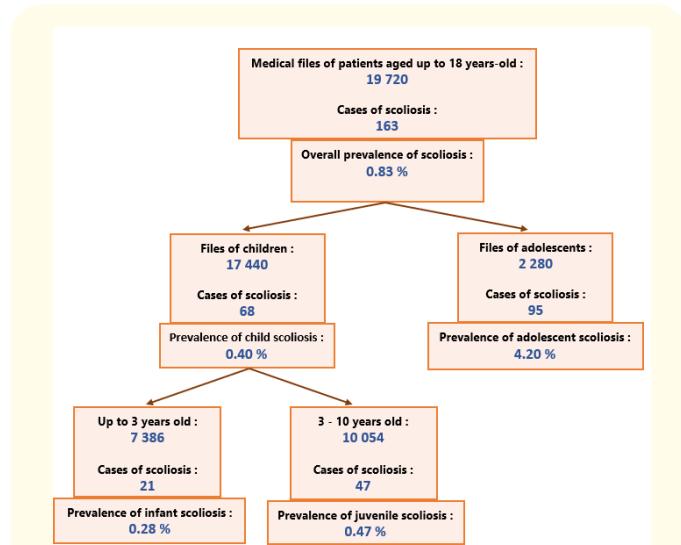
The variables studied were: prevalence; age; gender; the financial income of parents or guardians; the reason and average time of consultation; the Cobb angle (to assess severity); the number, orientation and seat of curvatures; the number and height of gibbosities; etiology; the type of structural anomaly (hemivertebra, vertebral hemiblock, wedge vertebra, butterfly wing vertebra,...); prescribed treatment; treatment applied and factors associated with the severity of scoliosis.

The data was collected in CSPRO version 7.1 and Microsoft Excel 2010 software. The Chi2, Fischer and Student tests were used for statistical analysis with a p-value < 0.05 considered significative.

## Results

Over the study period, nous listed 19. 720 cases of children and adolescents including 163 cases of scoliosis; an overall hospital prevalence of scoliosis of 0.83%.

According to figure 1, the prevalence's of adolescent, child, infantile scoliosis and juvenile scoliosis were 4.20%, 0.40%, 0.28% and 0.47%, respectively.



**Figure 1:** Prevalence's of different types of scoliosis.

Of these 163 cases, 69 were selected and make up our study population (Figure 2).

**Figure 2:** Determination of the study's population.

### Epidemiological characteristics

We regained a female predominance with 43 girls (62.3%) and 26 boys (37.7%); a sex ratio of 0.62. This distribution varied by age group: boys were three times more affected by childhood scoliosis than girls, but girls predominated in juvenile and adolescent scoliosis (Table 1).

A peak was observed in patients aged 10 – 15 years who account for 50.72% of cases (Figure 3).

The average age was  $4.88 \pm 3.75$  years with extremes of 2 and 10 years in children. Among adolescents, the average age was 15.  $16 \pm 1.71$  years old with extremes of 11 and 17 years old.

**Figure 3:** Age distribution of our study population.

Sex	Children n (%)			Adolescents n (%)	Total
	Infantile	Juvenile	Total		
Male	6(24%)	3(12%)	9(36.0%)	17(38.6%)	26(37.7%)
Female	2(8%)	14(56%)	16(64.0%)	27(62.3%)	43(62.3%)
Total	8(32%)	17(68%)	25(100%)	44(100%)	69

**Table 1:** Breakdown of our series according to sex and type of scoliosis.

### Clinical features

The average consultation time was one year with extremes of 0 and 5 years in children compared to three years with extremes of 1 and 7 years in adolescents.

According to the table 2, 3, the most frequent reason for consultation was aesthetics for adolescents (52.3%) of cases and delay in walking in children (62.5%). Respiratory signs (dyspnea of effort, chronic cough, repeated respiratory infection,...) were the prerogative of the adolescent's scoliosis of which they represented 22.7% of the reasons for consultation.

In the history, psychomotor delay was reported in 80% of children (20 cases) including 8 (out of 8) with infantile scoliosis (0-3 years). A family history of scoliosis was found in 13.04% of our series (9 cases) including 16% in children and 11.4% of cases in adolescents.

Regarding the clinical picture during the first consultation, it was dominated by the respiratory signs present in 66.28% of our

series, 72.7% of adolescents and 52% of children. Stunting was present in 56% of children's scoliosis while pubertal retardation, according to Tanner's classification, was found in 63.6% of adolescent scoliosis. 54.5% of adolescents had a psychological impact (malaise, shyness, introversion, difficulty reaching out to others, discomfort during sports activities, etc.) and 11.8% of children aged 3-10 were victims of taunts. 21.7% of scoliosis in our series was asymptomatic and without repercussions.

Gibbosity was found in all scoliosis of children and 90.9% of adolescents; an overall frequency of 94.2% in our series. The average height of these gibbosities was 3.72 cm in children with extremes of 0.5 cm and 6 cm compared to 3.51 cm in adolescents with extremes of 0.5 cm and 11 cm.

Malformations and/or deformities were common, associated with 76% of adolescent scoliosis and 61.4% of children's scoliosis. Kyphosis led the way affecting 36.8% of children and 59.3% of adolescents followed by angular knee deviations in 31.6% of children and 18.5% of adolescents (Figure 4).

### Etiological, radiological and lesional features

In children, 20 had congenital scoliosis (80%), 4 had scoliosis secondary to a neuromuscular condition (16%) and 1 patient had idiopathic scoliosis (4%).

In adolescents, the etiologies in descending order of frequency were idiopathic scoliosis (33 cases; 75%), scoliosis secondary to a condition (7 cases; 15.9%) and finally, neglected congenital scoliosis (4 cases; 9.1%).

In our series, 76.8% of scoliosis was severe (Cobb angle = 35°-60°) and very severe (Cobb angle > 60°). Very severe scoliosis affected 45.5% of adolescents and 47.1% of children.

Single-curvature scoliosis predominated in 95.6% of the cases in our series, was thoracolumbar localization in 62.3% of cases and right convexity in 73.9% of cases.

Of the 24 congenital scoliosis, 62.5% (15) were due to hemivertebra and 37.5% (9) to vertebral hemiblock. In adolescents, all 4 congenital scoliosis were due to hemivertebra while in children, hemivertebra was found in 55% (11) of congenital scoliosis and vertebral hemiblock in 45.0% (9) of cases.

Concerning the 11 secondary scoliosis of our study, 7 were due to Pott's disease (63.6%) and affect only the adolescents; 3 were associated to spina bifida (27.3%), only to children ; the last case was correlated to neurofibromatosis

### Therapeutic features

Table 4 shows that 91.3% of the child and adolescent scoliosis in our series was progressive scoliosis. The most prescribed management was based on orthopaedic treatment combined with physiotherapy (62.3% of cases). But those most performed were therapeutic expectation (33.3% of cases) and physiotherapy alone (27.5% of cases).

In so-called «surgical» scoliosis (Cobb angle greater than 35 degrees), surgical treatment was systematically recommended but performed in only 1.9% of cases. Orthopaedic treatment combined with physiotherapy was prescribed in 64.2% of cases and applied in 7.5% of cases. The most common treatment applied was therapeutic adherence (37.7%) followed by physiotherapy alone (32.1%).

As for the so-called «orthopedic» scoliosis (Cobb angle between 15-35 degrees), the most prescribed care was orthopedic restraint coupled with physiotherapy (56.3% of cases) but was applied in only 31.3% of cases. Therapeutic expectation accounted for 18.8% of cases (Table 4).

We identified 5 risk factors associated with the severity of scoliosis (Table 6) with a p-value < 0.05: a consultation time greater than 1 year (OR 8.148), female sex (OR 3.854), scoliosis associated with another malformation (OR 3.582) and evolutionary acter of scoliosis (1,59). A monthly income of parents < 150,000 FCFA (\$300, €230) also identified as a risk factor for severity (p = 0.011) but not the age or etiology of scoliosis (p > 0.05).

**Figure 4:** Malformations associated with scoliosis.

**Figure a:** Very severe and unsightly adolescent scoliosis in a 16-years-old girl with Cobb angle to 71°.

**Figure b:** Juvenile scoliosis in a 10-years-old boy.

**Figure c:** Very severe evolutive idiopathic scoliosis in a 37-months-old boy with a Cobb angle which increased from 51° to 65° 12 months later.

**Figure d:** Severe adolescent scoliosis in a 17-years-old girl stabilized by a custom made corset.

Variables	Children n(%)			Adolescents n(%)	Total
	Infantile n = 8	Juvenile n = 17	Total n = 25		
Reason for consultation					
Aesthetic	0(0,0%)	7(41,2%)	7(29,2%)	23(52,3%)	30 (41,1%)
Delay in walking	7(87,5%)	8(47,0%)	15(62,5%)	0(0,0%)	15 (22,1%)
Respiratory	0(0,0%)	0(0,0%)	0(0,0%)	10(22,7%)	10 (14,7%)
Pain	0(0,0%)	0(0,0%)	0(0,0%)	8(18,2%)	8 (11,8%)
Neurological	1(12,5%)	2(11,8%)	3(8,3%)	3(6,8%)	5 (7,4%)
Background					
Psychomotor retardation	8(100,0%)	12(70,6%)	20(80,0%)	3 (6,8%)	23(33,3%)
Low birth weight	4(50,0%)	2(11,8%)	6(24,0%)	2 (4,5%)	8(11,6%)
Prematurity	3(37,5%)	1(5,9%)	4(16,0%)	4 (9,10%)	8 (11,6%)
Twinness	1(12,5%)	1(5,9%)	2(8,0%)	3 (6,8%)	5 (7,2%)
Family history of scoliosis	1(12,5%)	3(17,6%)	4(16,0%)	5 (11,4%)	9 (13,0%)
Signs present at the time of the consultation					
Respiratory	3(37,5%)	10(58,8%)	13(52,0%)	32(72,7%)	45(66,28%)
Psychological	0(0,0%)	2(11,8%)	2 (8,0%)	24(54,5%)	26(37,7%)
Stunting	2(25,0%)	12(70,6%)	14(56,0%)	33(75,0%)	47(68,11%)
Neurological	1(12,5%)	3(17,6%)	4(16,0%)	5(11,4%)	9(13,0%)
Cardio-circulatory	0(0,0%)	3(17,6%)	3(12,0%)	4(9,1%)	7(10,0%)
Pubertal delay	0(0,0%)	0(0,0%)	0 (0,0%)	28(63,6%)	28(40,6%)
No	2(25,0%)	3(17,6%)	5 (20,0%)	10(22,7%)	15(21,7%)
Malformation associated					
Yes	6(75,0%)	3(76,5%)	19 (76,0%)	27(61,4%)	46(66,7%)
No	2(25,0%)	4(23,5%)	6 (24,0%)	17(38,6%)	23 (33,3%)
Presence of gibbositis					
Yes	8(100,0%)	17(100,0%)	25(100%)	40 (90,9%)	65 (94,2%)
Not	0(0,0%)	0(0,0%)	0 (0,0%)	4 (9,1%)	4 (5,8%)

**Table 2:** Clinic characteristics of scoliosis in children and adolescents.

Variables	Childish by Infantile n(%)			Adolescents n = 44	Total N = 69
	Infantile n = 8	Juvenile n = 17	Total n = 25		
Gravity (COBB angle)					
Light (10-15°)	1(12,5)	0(0,0%)	1(4,0%)	4 (9,1%)	5(7,2%)
Moderate (15-35°)	3(37,5)	1(5,8%)	4(16,0%)	7(15,9%)	11(15,9%)
Severe (35-60°)	4(50,0)	8(47,1%)	12(48,0)	13(29,5%)	25(36,2%)
Very severe >60°	0(0,0%)	8(47,1%)	8(32,0%)	20(45,5%)	28(40,6%)
Number of curvatures					
Unique curvature	8(100)	17(100%)	25(100,0%)	41(93,2%)	66(95,6%)
Double curvature	0(0,0%)	0(0,0%)	0(0,0%)	3(6,8%)	3(4,3%)
Triple curvature	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)
Location of curvatures					
Thoraco-lumbar	3(37,5%)	13(76,5%)	16(64,0%)	27(61,4%)	43(62,3%)
Pure thoracic	5(62,5%)	3(17,6%)	8(32,0%)	16(36,3%)	24(37,7%)
Pure lumbar	0(0,0%)	1(5,8%)	1(4,0%)	1(2,3%)	2(2,9%)
Other	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)
Orientation of curvatures					
Dextroconvexe	6(75,0%)	14(82,3)	20(80,0%)	31(70,5%)	51(73,9%)
Levoconvexe	2(25,0%)	3(17,7%)	5(20,0%)	13(29,5%)	18(26,1%)

**Table 3:** Radioclinic features of scoliosis in children and adolescents.

Variables	Infantile n (%)			Adolescents n (%)	Total
	Childish n = 8	Juvenile n = 17	Total n = 25		
Estimation of evolution					
Progressive scoliosis	8(100,0%)	17(100,0)	25(100%)	38(86,4%)	63(91,3%)
Non-progressive scoliosis	0(0,0%)	0(0,0%)	0(0,0%)	6(13,6%)	6(8,7%)
PRESCRIBED SUPPORT					
Orthopedic + Physiotherapy	2(25,0%)	9 (52,9%)	11(44,0%)	32(72,7%)	43(62,3%)
Orthopedic alone	4(50,0%)	3(17,6%)	7(28,0%)	1(2,3%)	8(11,6%)
Surgical	0(0,0%)	4(23,5%)	4(16,0%)	2(4,5%)	6(8,7%)
Physiotherapy alone	2(25,0%)	1(5,8%)	3(12,0%)	9(20,5%)	12(17,4%)
No	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)	0(0,0%)
Supported					
Orthopedic + Physiotherapy	0(0,0%)	2(11,8%)	2(8,0%)	7(15,9%)	9(13,0%)
Orthopedic alone	4(50,0%)	3(17,6%)	7(28,0%)	9(20,5%)	16(23,2%)
Surgical	0(0,0%)	1(5,8%)	1(4,0%)	1(2,3%)	2(2,9%)
Physiotherapy alone	1(12,5%)	4(23,5%)	5(20,0%)	14(31,8%)	19(27,5%)
No	3(37,5%)	7(41,2%)	10(40,0%)	13(29,5%)	23(33,3%)

**Table 4:** Therapeutic indications according to the severity of scoliosis: treatment prescribed vs treatment performed.

Recommended treatment:		
Orthopedic + Physiotherapy	34(64,2%)	9 (56,3%)
Orthopedic alone	5(9,4%)	3 (18,8%)
Surgical	53(100%)	2(12,5%)
Physiotherapy alone	10(18,9%)	2(12,5%)
None	0(0,0%)	0(0,0%)
Treatment carried out:		
Orthopedic + Physiotherapy	4(7,5%)	5(31,3%)
Orthopedic alone	11(20,8%)	5(31,3%)
Surgical	1(1,9%)	1(6,3%)
Physiotherapy alone	17(32,1%)	2(12,5%)
None	20(37,7%)	3(18,8%)

**Table 5:** Therapeutic indications in our NCRPD series.

Variables	Cobb >35° (severe scoliosis)	Cobb <35° (mild and moderate benign scoliosis)	OR	IC (95%)	p value
Consultation periods					
>1 year (n = 50)	44(88,0%)	6(12,0%)			
<1 year (n = 19)	9(47,4%)	10(52,6%)	8,148	2,357-28,167	0,001
Sex					
F (n = 43)	37(86,0%)	6(14,0%)			
M (n = 26)	16(61,5%)	10(38,5%)	3,854	1,197-12,415	0,019
Age					
Infant (n = 25)	20(80,0%)	5(20,0%)			
Adolescent (n = 44)	33(75,0%)	11(25,0%)	1,333	0,404-4,401	0,636
Progression					
Progressive scoliosis (n = 63)	53 (84,1%)	10(15,9%)			
Non-progressive scoliosis (n = 6)	0(0,0%)	6(100%)	1,59	1,09-2,80	0,000
Parents' financial income (FCFA)					
<150.000 (n = 47)	41(87,2%)	6(12,8%)			
150-300.000 (n = 17)	10(58,8%)	7(41,2%)			
>300.000 (n = 5)	2(40,0%)	3(60,0%)			
Scoliosis associated with other malformations					
Yes (N = 46)	39 (84,8%)	7(15,2%)			
No (n = 23)	14 (60,9%)	9(39,1%)	3,582	1,121-11,439	0,027
Etiologies					
Congenital (n = 24)	18(75,0%)	6(25,0%)			
Acquired (n = 11)	11(100%)	0(0,0%)			
Idiopathic (n = 34)	24(70,6%)	10(29,4%)			

**Table 6:** Factors associated with the severity of scoliosis in our series.

## Discussion

We conducted a descriptive and analytical cross-sectional study at the NCRDP whose goals were to draw up the epidemiological, radio-clinical and evolutionary profile of scoliosis in black children and to highlight their particularities in order to improve their charge on the African continent.

We collected 69 patients including 25 cases of scoliosis in children and 44 in adolescents. The overall hospital prevalence of scoliosis in the paediatric population was estimated at 0.83%. It predominated in adolescents with a prevalence of 4.2% and was less common in children with a prevalence of 0.4%. Girls were significantly more affected than boys (sex ratio 0.62). These results are similar to those found in the literature [2-8].

### Epidemiological and clinical features

These scoliosis was found quite early with an average age of onset of 4.88 years in children with extremes of 2 and 10 years and 15.16 years in adolescents with extremes of 11 and 17 years.

More than 2/3 of the patients' parents (68.1%) had a financial income of less than 150,000 CFA francs (\$300, \$230) per month. This economic difficulty has certainly been a factor in the consultation delays observed in our series. Indeed, the average consultation time was important: one year in children but went to 5 years in some and 3 years in adolescents or even 7 years. We think that this latency would be multifactorial: the limited financial resources, the lack of social security but also the passivity of the parents because many of them had noticed this «deformation» but hoped for a spontaneous regression while others suspected in this, a mystical origin, therefore privileging the care of the marabouts and prayer. These data have not been discussed in the literature. However, this reinforces the plea of several authors to initiate the early detection of malformations, including in schools [10-12].

Scoliosis in black children is mostly severe to very severe (76.8%). Our results are corroborated by those of Suh., *et al.* in Korea [13], Pokharel., *et al.* in Nepal [11], where the mild form was predominant.

Gibbosities, present in 94.2% of scoliosis, measured on average 3.72 cm in children and 3.51 cm in adolescents. But in extreme cases, they measured up to 6 cm in children and 11 cm chez in

adolescents, these values were 0.5 cm and 11 cm. These values are much higher than those found by Pham., *et al.* [14] who found an average of 1.49 cm with extremes between 0.6 and 3 cm. This could be explained by the delay in late consultation in our context likely to slow down the management and consequently, the aggravation of the torsion.

This severity was responsible for 78.3% of symptomatic scoliosis. Respiratory signs were the most common (66.28%) but pain was reported by 18.2% of patients. Respiratory signs including shortness of breath would be more frequent as soon as the angle of curvature exceeds 50° [1,6,15]. Apart from these severe forms, signs of repercussion are rare [10,16]. This observation is confirmed by the high proportion of scoliosis with an angle of > 60° in our series.

It should also be noted that more than half of adolescents (54.5%) and more than one in 10 children (11.8%) were psychologically affected by their scoliosis. This aspect is little developed in the literature. But some authors observed that psychological harm was underestimated [8,17,18] and was experienced different by sex [15].

### Radiological and etiological characteristics

From an etiological point of view, the causes were different in children and adolescents. In children, congenital scoliosis was predominant (80%) but in adolescents, it was idiopathic scoliosis (75%). Our results are consistent with data from the literature [3,5,19].

The architectural vices found in our series were the hemivertebrate and the vertebral hemiblock. We have not identified any others. This is consistent with the results of Louis., *et al.* [19], which found the hemivertebra in 50% of cases.

### Therapeutic and evolutionary features

In our study, 91.3% of scoliosis was progressive and 76.8% was severe and very severe (Cobb angle > 35°). Although surgical treatment was systematically recommended in these cases, it was only carried out in 1.9%, thanks to North-South medical collaboration. It should be noted that due to the risk of perioperative complications and intraoperative mortality due in particular to cardiorespiratory arrests during the manipulation

of the rib cage, it is necessary to have an adequate surgical and anesthetic technical platform and sometimes anatomical implants [14] whose availability is still limited in some of our countries; this added to the limited financial power of our populations. If surgery is the prerogative of severe scoliosis and can improve spinal curvature by up to 40%, the risk of undergoing a second surgery would range from 6 to 29% [1]. In addition, the main purpose of non-surgical treatment is to slow the progression of the deformity [6,9]. It includes orthotics, physiotherapy, bracing and expectation, which is reserved for scoliosis of less than 20° [6].

We have listed 5 factors of severity of scoliosis in black children: the consultation period of more than one year, the female sex, the monthly financial income of parents less than 150,000 CFA francs, the progressive nature of scoliosis and the association of scoliosis with another malformation. The age of onset of scoliosis and the etiology of scoliosis were not identified as factors of severity of scoliosis ( $p > 0.005$ ) that were not significant.

Our study, despite the size of its population, highlighted that scoliosis in black children and adolescents is particularly severe, progressive, with significant gibbosities, most often symptomatic and highly surgical. It confirms the female predominance and the higher prevalence of scoliosis in adolescents. In addition, it identified 5 factors of severity, all of which nevertheless seem to be directly or indirectly related to the financial power of the parents.

## Conclusion

Scoliosis of children and adolescents is a fairly common pathology in black subjects. A better knowledge of their specificities would make it possible to improve their care, which must be early, multifactorial and adapted. Multicentre and multinational studies would be needed to develop concrete solutions to the health systems concerned and to justify health policies for the early detection of malformations.

## Bibliography

1. Asher MA and Burton DC. "Adolescent idiopathic scoliosis: natural history and long term treatment effects". *Scoliosis* 1 (2006): 2.
2. Nery LS., et al. "Prevalence of scoliosis among school students in a town in southern Brazil". *Sao Paulo Medical Journal* 128.2 (2010): 69-73.
3. Kamtsiuris P., et al. "Prevalence of somatic diseases in German children and adolescents. Results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS)". *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 50.5-6 (2007): 686-700.
4. Jenyo MS., et al. "Prevalence of scoliosis in secondary school children in Osogbo, Osun State, Nigeria". *African Journal of Medicine and Medical Sciences* 34.4 (2005): 361-364.
5. Hedequist D and Emans J. "Congenital scoliosis-A review and update". *Journal of Pediatric Orthopaedics* 27.1 (2007): 106-116.
6. Dunn J., et al. "Screening for Adolescent idiopathic scoliosis: Evidence Report and systematic review for the US Preventive services Task Force". *JAMA* 319.2 (2018): 173-187.
7. Konieczny MR., et al. "Epidemiology of adolescent idiopathic scoliosis". *Journal of Children's Orthopaedics* 7.1 (2013): 3-9.
8. Weiss H-R and Goodall D. "The treatment of adolescent idiopathic scoliosis (AIS) according to the present evidence. A systematic review". *European Journal of Physical and Rehabilitation Medicine* 44.2 (2008): 177-193.
9. Weinstein SL., et al. "Adolescent Idiopathic Scoliosis". *Lancet* 371 (2008): 1527-1537.
10. Jog S., et al. "Congenital scoliosis in a neonate: can a neonatologist ignore it?" *Postgraduate Medical Journal* 78 (2002): 469-472.
11. Pokharel RK., et al. "Detection of Adolescent Idiopathic Scoliosis among Nepalese Children Through the School Screening Program". *Nepal Orthopaedic Association Journal* 3.2 (2013): 14-19.
12. Khouri N., et al. "Scoliose idiopathique. Stratégie diagnostique, physiopathologie et analyse de la déformation". *EMC-Rhumatologie-Orthopédie* 1.1 (2004): 17-44.
13. Suh SW., et al. "Idiopathic scoliosis in Korean schoolchildren: a prospective screening study of over 1 million children". *European Spine Journal* 20.7 (2011): 1087-1094.
14. Pham V., et al. "Évaluation du résultat du corset de Chêneau dans la scoliose idiopathique de l'adolescent Evaluation of the Chêneau brace in adolescent idiopathic scoliosis". *Annales de Readaptation et de Médecine Physique* 50 (2007): 125-133.

15. Jones RS., et al. "Mechanical inefficiency of the thoracic cage in scoliosis". *Thorax* 36.6 (1981) : 456-461.
16. Ghita RA., et al. "Burnei-Gavriliu classification of congenital scoliosis". *Journal of Medical Life* 8.2 (2015): 239-244.
17. Zhang J., et al. "Changes in life satisfaction and self-esteem in patients with adolescent idiopathic scoliosis with and without surgical intervention". *Spine (Phila Pa 1976)* 36.9 (2011): 741-745.
18. Danielsson AJ., et al. "Health-related quality of life in patients with adolescent idiopathic scoliosis: a matched follow-up at least 20 years after treatment with brace or surgery". *European Spine Journal* 10 (2001): 278-288.
19. Louis ML., et al. "Scoliose congénitale: une évaluation dans le plan frontal de 251 patients opérés, âgés de 14 ans ou plus". *Revue de Chirurgie Orthopédique et Traumatologique* Elsevier Masson; 96.7 (2010): 808-815.