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PREVALENCE AND DETERMINANTS OF IDIOPATHIC SCOLIOSIS IN A PRIMARY AND SECONDARY SCHOOL IN TIRANA, ALBANIA

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Abstract:
Backgournd: *It was decided to carry out the first screening project on idiopathic scoliosis and possible comorbidity with temporomandibular joint dysfunction in Tirana.* **Methods**: *The cases of scoliosis previously diagnosed were subsequently subjected to diagnostic tests for comorbidity with the temporomandibular joint by referring to the Helkimo indexes.* **Results**: *Of the 26 females who were positive to the examination objective, only 11 had radiological examination and found that out of 11, 8 showed scoliosis, with a margin of error of 3 subjects. Of the 24 males, who were positive to the examination objective, 7 continued with the radiological investigation, to which they were all positive. Finally, 100% of subjects with concurrent diagnosis of scoliosis have at least one of the protomembrane symptoms of mandibular temporomandibular dysfunction.* **Conclusions**: *Eighteen of the 50 positive children on the target examination have performed the X-ray examination and in fifteen cases the diagnosis of scoliosis has been confirmed. Concerning the scoliosis ATM correlation, 100% of subjects with concurrent diagnosis of scoliosis have at least one of the protomembrane symptoms of mandibular temporomandibular dysfunction.* **Limitations**: *The socio-economic impact has been the most important limit.*

Keyword: *idiopathic scoliosis; screening; prevalence; Tirana, Albania, temporomandibular joint, comorbidity.*

INTRODUCTION

Scoliosis is a spinal pathology characterized by a twist of the vertebrae on the three planes of space; on the frontal plane there is a lateral flexion movement, on the sagittal plane the alteration of the curves, on the axial plane a rotation movement [1-3].

The classic definition of the Scoliosis Research Society, defines scoliosis as a curve with more than 10 ° Cobb on the frontal plane [1,4]. It can be classified in different typologies depending on age of onset, etiology, severity and

type of curve. Each type has different characteristics, such as the frequency of the Sion progression curve, the degree and pattern of three-dimensional deformity.

The most common form of scoliosis is idiopathic (80% -90% of scoliotic subjects) [5] that does not have a clear causal agent and is generally considered to originate from multifactorial causes, although genetic factors play an important role [6].

It is defined by the WHO according to the ICF classification and the "disease" criteria can be distinguished: impairment, reduction of activity and limitation of participation [7]. Several studies have described the natural history of the disease during growth [4, 8-13].

They indicate that age, gender, curve size (Cobb angle), menarche status, and Risser sign are the most critical factors to predict the progression of the curve during growth. According to Lonstein and Carlson, the risk of progression can be calculated for curves between 20° and 29° [10]. This calculation is the basis for current guidelines [14, 15].

Since 1984, the American Academy of Orthopaedic Surgeons (AAOS) and Scoliosis Research Society (SRS) have formally approved early detection of scoliosis in children whose deformities may have gone unnoticed.

In 2007, the American Academy of Orthopedic Surgeons (AAOS), the Scoliosis Research Society (SRS), the Pediatric Orthopedic Society of North America (POSNA) and the American Academy of Pediatrics (AAP) approved an informative statement explaining aspects relevant to the issue of screening for scoliosis [16].

Although AAOS, SRS, POSNA and AAP have recognized that scoliosis screening support has limits, however, they state that the potential benefits that patients with idiopathic scoliosis receive with early treatment may be considerable. The importance of early diagnosis, based on effective rehabilitation therapy, in this particular age range, is even more evident if the scoliosis diagnosis associates the comorbidity of the temporomandibular joint.

Indeed, the correlation between postural disorder and stomatognatic apparatus has been highlighted by a large number of studies and related publications [17-19]. These works, which associate the two pathologies, are significant and describe the pathognomic signs. The jaw is mechanically and anatomically connected to the skull through symmetrical joints with great freedom of movement through mandibular condyles. Clicks, a rubbing noise, a blockage to the opening or closing of the mouth, the mandibular deviation in altered motion, are all expressions of a distress of the joint system and more specifically of an incoordination between meniscus and articulation.

The causes are multiple but often due to poorly positioned jaws that work with an altered cervical-cranial trim. Mechanisms may also have an inverse course, or muscle imbalance may occur from other bodily districts that exhibit muscular connections with the temporomandibular articulation. Dental arches can also be decisive for posture. On a sagittal plane mandibular conformation and dental occlusion affect the position of the head and shoulder blades [20].

This study aims to better understand the incidence of idiopathic scoliosis in Albania through the screening of a randomized sample of children ages 6 to 15 and comorbidity with dysfunctional temporomandibular joint. This paper analyzes scoliotic pathology in the age of development in Albania where there are no statistical studies on the prevalence of these pediatric diseases, their types and their rehabilitation treatments. The goal we have advocated has been to raise awareness in educational institutions supervising child growth.

Since there are no statistical studies on the incidence of scoliosis in Albania, nor do we know the methods by which we evaluate a scoliotic subject; the project has become a major source of data as it is the first epidemiological survey on scoliosis in Albania and can be a starting point for further studies and future follow ups.

METHODS

2.1 Design

Observational and transverse study

2.2 Sample

The screening was carried out from January 2015 to September 2015 at the "Amhet Gashi" school in Tirana, after evaluating the following parameters:

- age range from 6 to 15 years of both sexes;
- average social class on the basis of the district taken into account;
- number of students 228 of which 100 are male and 128 are female.

The study was approved by the Albanian Ministry of Health and all participants received detailed information about the study goal.

2.3 Measurements

Before going to detect any morphological alterations, a questionnaire was provided to highlight inaccurate and potentially harmful habits and lifestyles.

The fields under investigation were:

- sport practiced;
- type of backpack used;
- times and places dedicated to study;
- time sitting at the counter;
- recreation time;
- time spent in front of tv / pc.

Afterwards, a clinical evaluation of the child was used to evaluate the morphological changes in the frontal, sagittal and posterior morphology.

The primary scoliotic patient evaluation test is the Adams (forward bending test) test. Its positivity is pathognomonic of scoliosis [21]. The positive predictive value of this test is variable, being proportional to the degree of curvature and dependent on the examiner's experience [22].

A meta-analysis and a 10-year follow-up evaluation of the effectiveness of scholastic screening comes from the conclusion that Adam's test has a sensitivity of 84.3%, which suggests that Adam's test is relatively effective when it is positive. The test has a specificity of 93.44%. These numbers are for a cobb angle > 10°. Studies also argue that the test has too many false negative results to be a safe diagnostic criterion for early diagnosis of scoliosis. [23-26]

The inclinometer is another evaluation tool that has been widely used in the screening program.

This instrument measures the angle of inclination of the torso (ATI) and is equipped with a very high inter-examiner repeatability, which allows the determination of the threshold beyond which to intervene with a radiograph. Its sensitivity is estimated around 100% and its specificity around 47% if you choose an ATI of 5°. A 7° ATI instead has a sensitivity of 83% but a specificity of 86% [27-29]. The radiographic assessment was performed after having found positivity to the Adams test.

As scientific literature has highlighted a significant correlation between postural disorder and stomatognatic apparatus [30,31], this study wanted to accurately quantify the incidence of this correlation. The cases of scoliosis previously diagnosed were subsequently subjected to diagnostic tests for comorbidity with the temporomandibular articulation referring to Helkimo's indexes [32].

It is particularly focused on subjects with asymmetries of shoulder heights and myocardial spine on the frontal plane and asymmetries on the sagittal axis between the cheekbone and the manubrium of the sternum, as stated by Rocabado's study "Biomechanical relationship of the cranial, cervical and hypoid regions" [33].

Therefore, the inspection was carried out with a specific target examination aimed at the search for and detection of particular signs and symptoms by detecting the existence of pains in chewing muscles in the pre-uricular region of the temporomandibular joint, limitation and alteration of the normal function mandibular, the presence of joint noises and the misalignment of mandibular condyles [34].

RESULTS

Following the evaluation of the Adams test of 228 children, including 100 males (43.9%) and 128 females (56.1%):

- 76% males negative;
- 24% males positive to examination objective;
- 80% females negative;
- 20% females positive in the examination objective.

Out of the 128 females examined, 26 were positive for the examination objective and were asked to conduct a second-level investigation; 11 performed the radiological examination and 8 subjects were positive to scoliosis, with a margin of error of 3 subjects.

Of the 100 males, 24 were positive, 7 and continued with the radiological examination to which they were all positive.Table 1 and 2 below shows the descriptive statistics for the study population and the diagnosed population (positive and negative).

Table 1: ***Descriptive characteristics of the study population***

	Total (n=228) **Mean (Standard deviation)**
Age	12.06 (2.05)
Weight	43.14 (11.92)
Height	146.43 (13.84)
Sport Frequency (Weeks)	3.379 (1.74)
Pc/Tv X Day	151.16 (111.79)
Back Pack Weight	4.11 (3.59)
Time to go to School	17.24 (13.21)
Sitting Time	270.5 (129.1)
Study Hours	144.64 (71.1)
School Time Break	86.75 (149.0)

	Total (n=228) **Median**
Back Pain	2.00 (No)
Sport Type	2.00(Basketball)
Back Pack Type	1.00(Backpack)
Study Place	2.00 (Living room)

Table 2: Descriptive statistics of diagnosed-positive and diagnosed-negative Population

	Total (n=228) **Mean (Standard deviation)**	**Total (n=228)** **Mean (Standard deviation)**
	Diagnosed-positive	**Diagnosed-negative**
Age	12.40 (2.01)	11.96 (2.06)
Weight	44.44 (13.50)	42.78 (11.454)
Height	147.84 (15.71)	146.03 (13.2)
Sport Frequency (Weeks)	3.66 (1.73)	3.30 (1.74)
Pc/Tv X Day	171.79 (122.9)	145.36 (108.1)
Back Pack Weight	3.45 (2.31)	4.30 (3.86)
Time to go to School	15.93 (11.02)	17.60 (13.77)
Sitting Time	282.6 (174.3)	267.16 (113.6)
Study Hours	139.6 (72.2)	146.067 (70.99)
School Time Break	95.8 (192.7)	84.21 (134.87)
	Total (n=228) **Median**	**Total (n=228)** **Median**
	Diagnosed-positive	**Diagnosed-negative**
Back Pain	2.00(No)	2.00(No)
Sport Type	1.00(Football)	2.00(Basketball)
Back Pack Type	2.00(Shoulder bag)	1.00(Backpack)
Study Place	1.00 (Bedroom)	2.000(Living room)

3.1 Prevalence

Out of 26 females that test positive to screening test,8 tested positive to X-ray examination making the prevalence of scoliosis to be 0.3% for female and out of the 24 males who tested positive to the screening test, 7 tested positive to the X ray examination making the prevalence of male to be 0.29%, which shows that the prevalence of scoliosis is higher in female than male. The overall prevalence of Scoliosis for the studied population is 0.3%

Predictors Scoliosis from logistic regression model

Variables in the Equation						
	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Age	-.752	.729	1.065	1	.302	.471
Weight	.082	.101	.662	1	.416	1.086
Height	.131	.099	1.761	1	.184	1.140
Back pain	-.380	1.779	.046	1	.831	.684
Sport frequency	.512	.461	1.236	1	.266	1.669
Sport	-.477	.538	.785	1	.376	.621

Pctv	.027	.014	3.830	1	.050	1.028
Back pack weight	-.540	.431	1.571	1	.210	.583
Back pack type	1.230	.677	3.294	1	.070	3.420
Time to school	-.048	.061	.626	1	.429	.953
Sitting time	.004	.007	.267	1	.605	1.004
Study hours	.020	.015	1.802	1	.179	1.020
Study place	1.990	1.635	1.481	1	.224	7.317
School time break	.009	.019	.206	1	.650	1.009
Gender	4.868	2.943	2.736	1	.098	130.076
Constant	-30.578	22.776	1.802	1	.179	.000

Out of the total 50 children that tested positive to the Bending the test, a binary logistic regression was fitted to identified factors that contribute to the positively and negatively X-ray examination (scoliosis).The significant factors on scoliosis were obtained by carrying out binary logistic regression. The results obtained from the logistic regression shows that none of the above mentioned factor play a significant role on scoliosis with a p-value greater than 0.05.

3.2 Type of scoliosis

Of the 15 boys who had positive results for scoliosis, 10 showed left convex and 5 right convex scoliosis; the average degree of scoliosis is 5° and a single case of scoliosis has 10° Cobb. There were two cases of dislocation of the iliac crests. Both have been found that the highest iliac ridge is the right one, 5 mm in one and 7 mm in the other. 38% of females have a thoracic scoliosis, 37% lumbar and 25% are affected by toracolombar scoliosis. (Table 3). In males, it's interesting to note how the data is different. 43% suffer from thoracolombular scoliosis, 29% from thoracic, while lumbar and lumbosacral scoliosis are only present in 14% of cases. (Table 4)

Table 3: Females

Age of subject	Type of scoliosis	Degrees of scoliosis	Dysmetria of iliac crests
10 years	Left convex lumbar	4°	
15 years	Left convex thoracic	7,4°	
11 years	Left convex lumbar	2°	
13 years	Left convex thoracic	4°	
14 years	Left convex thoracolumbar	9°	
11 years	Right convex lumbar	6°	
14 years	Right forearm thoracic	2°	Right higher by 5mm
12 years	Left convex thoracolumbar	6°	

Table 4: Males

Age of subject	Type of scoliosis	Degrees of scoliosis	Dysmetria of iliac crests
13	Right forearm thoracic	2°	
12	Left convex thoracic	3°	
11	Lumbar right convex torso	3°	
13	Right-aligned lumbar	5°	Destra più alta di 7mm
13	Left convex thoracolumbar	10°	
14	Left convex lumbosacral	5°	
15	Left convex thoracolumbar	6°	

3.3 Results of Correlation between Scoliosis and ATM Disorders

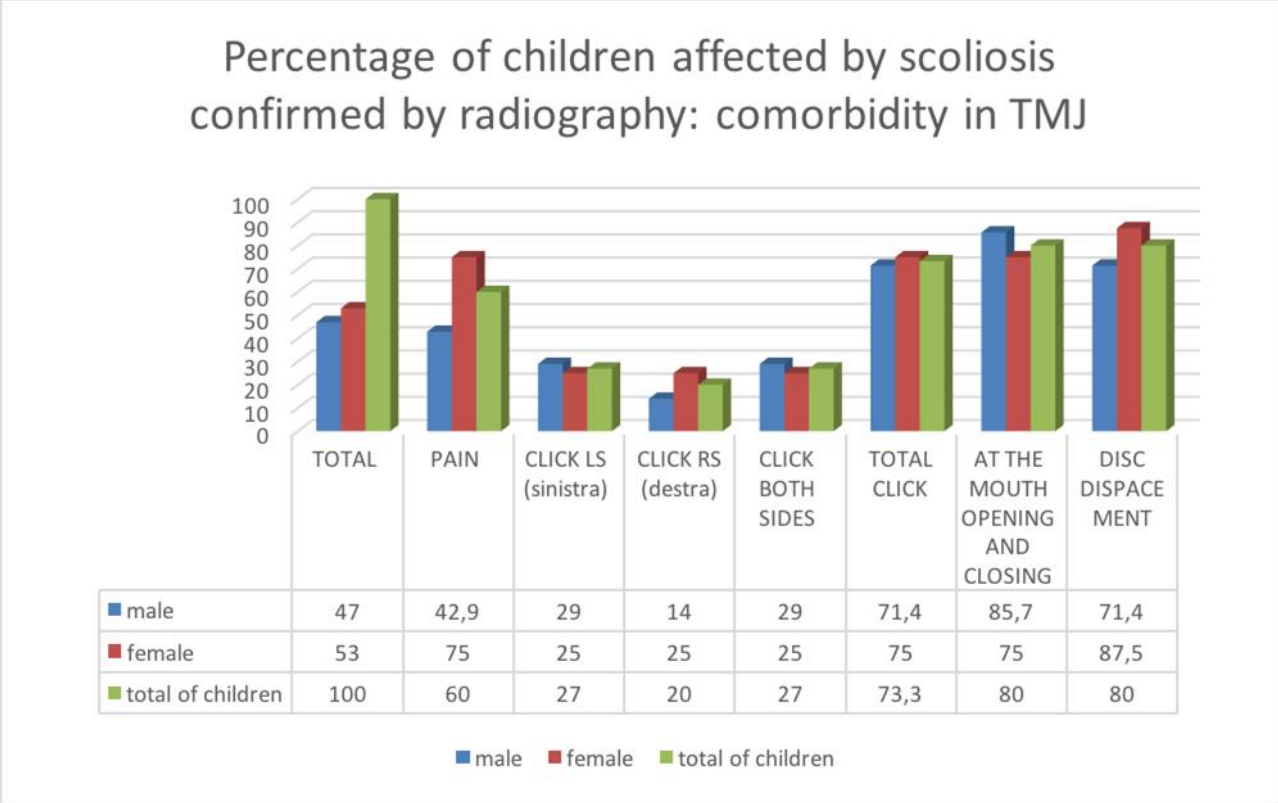
Patients with a positive outcome for scoliosis (6.6%) were subjected to a second study aimed at detecting comorbidities of dysfunction of the thrombocytic joint and the stomatognathic apparatus. These dysfunctions are associated with similar symptoms. Therefore the inspection (Table 1) was carried out with specific tests aimed at identifying particular signs and symptoms:

- Pain in chewing muscles in the pre-ear region, temporomandibular joint
- Limitation and / or alteration of normal mandibular function.
- Presence of joint noises (clik).
- Misalignment of mandibular condyles

Each of these key symptoms can in itself constitute a significant diagnostic sign of dysfunction of temporomandibular joint whose probability increases if the symptoms are associated with each other. As we can see from the chart (Chart 1) of the 15 children with scoliosis, following the functional evaluation of the stomatognathic apparatus, it emerged that:

- 100% of subjects exhibit heterogeneous dysfunction of the stomatognathic apparatus;
- 60% showed pain in the chewing muscle.
- 73.3% found the presence of joint clicks with a slight female prevalence. 27% of subjects of both sexes showed clicks on both sides;
- 80% of subjects exhibited irregular mandibular motion and condylases during opening and closing of the mouth, resulting in a dysplasia of the articular disc, with a mild male prevalence of 10.7% more than in females;
- 80% of the subjects showed an accentuated misalignment of mandibular condyles on the frontal plane with a female prevalence of 16.1% more.

Chart.1



	TOTAL	PAIN	CLICK LS (sinistra)	CLICK RS (destra)	CLICK BOTH SIDES	TOTAL CLICK	AT THE MOUTH OPENING AND CLOSING	DISC DISPACEMENT
male	47	42,9	29	14	29	71,4	85,7	71,4
female	53	75	25	25	25	75	75	87,5
total of children	100	60	27	20	27	73,3	80	80

CONCLUSIONS

The final balance of this epidemiological survey is positive, in its strengths and also in its weakness.

The first important objective was to find cases of suspected scoliosis through objective examination, 50 out of 228. Analyzing the data, it is evident that in 50 children positive for the examination objective, in fifteen, diagnosis was confirmed radiographic examination.

However, it must be remembered that fifty positive children examined, only 18 performed x-rays, and this is a fact that, on the one hand, it can distort the actual statistical values of the phenomenon analyzed, on the other hand it becomes a data that contains equally important information.

It is interesting to note that more than a quarter of a school population of about 200 pupils was at risk of scoliosis or had scoliosis. From this figure we can see how it is necessary to have a prevention strategy at school age, in all countries that believe in the right to health for all and school institutions and health services should synergistically unite.

However, in this context of final evaluation, we can not ignore the figure that corresponds to the thirty-two out of fifty pupils to whom the invitation was addressed to perform radiography because of positive physical examination for scoliosis. This figure is missing because the families involved did not accept the invitation.

We do not know the reasons for this choice, probably they depend impediments or economic or socio-cultural factors. Concerning the scoliosis ATM correlation, this study showed in percentage terms that 100% of subjects with concurrent diagnosis of scoliosis have at least one of the protomembrane symptoms of mandibular temporal dysfunction confirming the results of similar studies [35].

The data in this case are also loaded with an important socioeconomic variable linked to the fact that not all subjects involved in the study could undergo the necessary radiographic investigations needed for a certain diagnosis. However, the totality of subjects undergoing radiography and then having positive results, as well as attached to the table, isolated or associated symptoms of mandibular temporal dysfunction [36].

Interestingly then in analyzing the questionnaires that the pupils completed before the objective test on habits and lifestyle that could favor this type of comorbidity. The rehabilitation approach has started precisely from this analysis, explaining to children how, for example, excessive use of chewing gums [37,38] or taking a bent posture can cause misalignment and dysfunction in this precise bodily segment [39].

I hope that the work done represents the beginning of a wider and widespread process of information and prevention in the healthcare area, with particular attention to school age, at which time the different vertebral deformities appear with the largest incidence in order to identify and take all the therapies needed to correct them early.

LIMITATIONS

There have been several factors that have led to limitations during the study. The socio-economic impact has been one of the most important limitations, as the population has no sensitivity to the importance of disease prevention, and this shortage has led to a decrease in the initial sample. This factor has been crucial to the selection of the number of screening participants, which is not the result of a specific calculation.

In addition, in spite of the economic demand for the radiological investigation, many of the positive cases for the target examination were rejected: 26 females and 24 males in the first level survey conducted a second level survey of 11 and 7 children.

However, taking into account the minimum error margin, or three of the 18 subjects who performed rx in which the diagnosis of scoliosis has not been confirmed, we are confident that these results can be considered as a starting point for further future studies.

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