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Early detection of school aged children spine deficiencies and physical therapist intervention

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Abstract

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In postural reconstruction in kinetotherapy, the assessment of the morphological balance starts with the analysis of observable surface indicators, *i.e.* visual information of patient morphology. The various elements of this balance may provide information that will contribute to the early detection of risks associated with the apparition of spine deficiencies in school-aged children. The assessment of the apparition and the early detection of these deficiencies demands the development of a system based on objective standards to monitor the detection of such problems. The purpose of this transverse pilot study is the experimentation with processes of standardization for a limited number of somatometric indicators based on measurements and data obtained on a sample of 114 subjects aged between 7 and 10 years (65 boys and 49 girls), using common statistical methods for the distribution of observations and the generation of standards. Preliminary results produced by our study reveal that 39 (34.2%) of 114 subjects display multiple spine posture flaws. Based on these results, the main conclusion of the study is that more attention needs to be paid to the normal development of the spine in children of school age between 7 and 10 years old.

Keywords: Spine; normal; posture; vertebral; biometric; deformations.

1. Introduction

Specialists agree that each period of the human life influences in some way the structure and functionality of the spine due to congenital or acquired age-specific illnesses. In these cases the kinetotherapist intervention is performed based on directions from a medical specialist. Often, these structural and functional changes of the spine can be caused by something trivial such as a faulty posture. If neglected, it can cause structural changes of the spine, which affects its morphological changes and normal development and inherently leads to strains of various degrees, which in turn drastically affect the long-term functionality of the spine. The analysis of body posture concluded that keeping constant the equi-librium and stability relations between body segments and the external environment are achieved via several biomechanical, physiological and psychological mechanisms (Mihăilă, 2009). In kinetotherapeutical postural reconstruction, the assessment of the morphological balance begins with the analysis of observable surface indicators, *i.e.* visual information of patient morphology. The various elements of this analysis may provide information that will contribute to the early detection of risks associated with the apparition of deficiencies (Nisand, 2009). The motivation underlying the theme choice consists in the author's desire to offer a wide range of statistically analyzed reference data included in a standards-based monitor. The monitor will facilitate the detection of problematic situations and justify the preventive and curative interventions of kinetotherapists, for school-aged children with ages between 7 and 10 years - an age when postural defects have a significant occurrence.

2. General considerations

The axial skeleton of a human being forms the backbone, being a powerful and flexible support, which in turn constitutes the spinal cord protection with an important role on locomotor motility (Papilian, 2003). The anatomically normal developed spine in an adult individual contains four curvatures with a concave base in the sagittal plane, two backward concave curvatures in the cervical and lumbar areas, and two forward concave curvatures in the thoracic and sacral areas. The spine is vertical in the frontal plane (Papilian, 2003; Clin, 2010; Neter, 2010). The static function of the spine is possible explained by its transformation into a solid shaft, supple but able to stiffen as required by the contribution of the capsule-ligament complex and particularly by its muscle system and their satellites (the neighboring segments), which are inserted into these segments and the backbone (Baciu, 1972; Iliescu, 1984; Sbenghe, 1996).

3. The motor function of the spinal cord

The spinal cord contains basic structures and circuits to control motor activity. These are partly organized in segments as such, and the fundamental unit of this system is the á motoneuron located in the anterior horn of the spinal cord, which sends an axon that directly connects with the skeletal muscle at the level of the cholinergic neuromuscular junction (Bioulac and Lamour, 2001). A typical neuron is composed of 3 parts: the cell body, the axon and the dendrites. The cell body contains the nucleus, the cellular extensions, the dendrites and the axon, which radiates from the cell body (Wilmore and Costill, 2002). According to Bioulac and Lamour (2001), the motoneuron receives information from the peripheral sensory fibers, which penetrate the marrow via dorsal roots. The back roots contain axons originated from motoneurons. The *medullar reflexes* are responsible of the articulation between some of these sensory fibers and spinal motoneurons. The ventral horn of the spinal cord contains motoneurons, which control the striated skeletal muscles. The recurrent collaterals of motoneurons activate an interneuron called the Renshaw cell, which can directly inhibit motoneurons, limiting their activity and also that of the inhibitor motoneurons, thus facilitating the activity of antagonist muscles. The proprioceptive afferents are monosynaptically articulated with the motoneuron. They also emit

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collaterals to interneurons (Guénard, 2001).

3.1 Educational objectives

From a study on detection of pediatric orthopedic abnormalities, we note two important aspects of a methodological and indicative nature, namely: "learning objectives" and summarizing "the essential of the whole" in 7 points" (Vialle, 2012). The educational objectives of this study are: (1) the knowledge of normal growth of the limbs and spine; (2) finding inequalities of length and spine defor-mities; (3) the adoption of a code of conduct for the consideration of discrepancies with regard to length or spine deviation; (4) the knowledge of how to relate to the root cause of spinal or limb pain.

3.2 The essential

The essential aspects of this work are summarized below: (1) In children and adolescents, growth is inextricably linked to the musculoskeletal apparatus; (2) Leg length inequality should be detected on time; (3) Scoliosis is a three-dimen-sional deformation of the spine; (4) Kyphosis is a spinal curvature with tan inward concavity; (5) Spinal pain is sufficiently common in children; (6) Thoracic defor-mations in children are of two types: *Pectus carinatum* ("barrel breast") and *Pectus excavatum* ("funnel thorax"); (7) Popliteal synovial cyst is discovered accidentally or via chronic pain of mechanical origin. From a survey aimed to highlight the different variables likely to create spinal pain in children and ado-lescents, we selected a method focused on the usage of a set of informative "biometric measurements" (Stagnara, 1984; Maigne, 1997; Hamimi, 2008).

3.3 Biometric measurements

The following biometric measurements are considered in this work: (1) *Height and weight, followed by static examination*: stand with both feet spread apart at the hip level; (2) *Lower limb defects (for the leg, knee, etc.)*: when are asymmetrical and cause imbalance in the pelvis; (3) *The pelvis (the base of the spine)*: if necessary, balance the pelvis by horizontal repositioning using plates to eliminate compensatory curves due to unequal legs. The pelvic landmarks are the anterior-superior iliac spine (front) and the posterior superior iliac spine (back). The evaluation of the ante-version angle is performed using a goniometer. The significance values of this angle are: at 10º, the pelvis is in retroversion (tilted up and backwards), between 12º and 18º the pelvis is in neutral, and above 20º, the pelvis is in ante-version (angled downwards and forward). The evaluation of possible right/left rotations of the pelvis is achieved using a plumb line (plummet).

All positional changes of the pelvis, either in the sagittal (anteroposterior) sense or towards the front end, cause changes in the spine and whole body postures due to its key role in achieving a correct or incorrect posture of the body. The pelvis is considered to be the "key to the correct body posture" (Ionescu, 1994). In children, spine deformations occur or exacerbate before puberty, since the skeletal growth is accelerating while the muscular system doesn't strengthen at the same pace. Therefore the role of kinetotherapy and physical exercises is to prevent this phenomenon. The most common strains in children of school age are scoliosis, kyphosis and lordosis, while the former is the predominant one. As a pathological manifestation, scoliosis is a progressive disease characterized by one or more lateral curvatures of the spine. The evolution of scoliosis can be attributed to mechanical factors. Up to an angle of curvature of 25-30 degrees, structural, vertebral, ligament and muscular deformities are moderated. The 30 degrees angle of the scoliosis curvature is a mechanical threshold. Above this value the defor-mation includes specific progressive factors until bone maturity is reached, follo-wed by stabilization (Ojoga and Suciu, 2006).

4. Associated therapeutic and curative methods, opinions and clarifications

Along with specific kinetotherapy procedures, the "chiropractic" is recommended as a curative and preventive intervention methodology for treating pain in the spine. We note that the application process requires special attention to the cervical area. We also acknowledge the existence, in a larger context, of criticism and controversies with respect to chiropractic theoretical principles, its effectiveness and safety (Gaucher and Parny, 1985; Monvoisin, 1992; Blanchard, 2002). Simi-larly, mechanical vibration therapy is efficient and can be easily and without risk applied to the spine for pain caused by degenerative diseases, especially for early and advanced stages (Pâncotan, Ilie, Chiriac, Cristea & Tarcau, 2012). On the issue of applying massage therapy in the treatment of the spine, this is an issue still subject to controversy since 1993 (Codemard, 2008). Given inadequate adaptation to spinal defect characteristics and the stage of its evolution, massage therapy can be harmful. The advancement of professional acts and practices in kinetotherapy led to an increased responsibility towards consecutive risks. There-fore, a large collection of legislative materials, which aim to allow all physical therapists to be aware of the legal regulations of the profession, are contained in the Code of Public Health (Cazenoves and Bonnot, 2008). As a motivation for choosing this research topic, we advance the idea that in the case of pathological changes in the structure or functioning of the spine, the work performed by a kinetotherapist must be done only under medical practitioner supervision. To conclude our general considerations, we note that in the context of the applied research methodology for this study, we considered the opinions and recommen-dations contained in recent studies focused on the application of statistics in kinesiology (Estrade, 2008a; Estrade 2008b).

5. Methodological and applied contributions: a transverse pilot study

Our study is focused around the following premises: (1) It is established and widely accepted that children of school age suffer from spine deformations. These deformations become more accentuated before puberty and may continue during puberty; (2) During school age small spine deformations are often caused by postural defects; (3) Without timely prevention and treatment, they become one of the predominant sources of deformations, very common during adulthood. Such deformations affect the economic and social performance of a wide range of active citizens.

5.1 Objectives and tasks

Objectives. Here we define the following objectives: (1) Prevention of static disorders of the spine and the trunk; (2) Development of a system of standards, based on morphological measurements (anthropometric) to monitor and detect problem cases.

Tasks. In this study we identify the following tasks: (1) Awareness of postural control; (2) Justification of the need for preventive and curative interventions; (3) Establishment of anthropometric parameters undergoing morphological measu-rements; (4) Development of research methodology; (5) Application of research results for the pilot study.

Research plan. The research was conducted in Bacau County, at "George Bacovia" School. The investigations were conducted outside school hours. Student parental consent was obtained for this study. The data collection process encoun-tered some difficulties mainly due to some parents who could not meet the agreed work program. Given the nature of this pilot research study these obstacles are acceptable.

5.2 Subjects and methods

Subjects. A sample of 114 students (65 boys, 49 girls) was selected for this study from a total population of 157 students in grades I to IV. We used a stratified sampling approach with random sampling applied for each stratum.

Methods. Table 1 shows the parameters for anthropometric, somatoscopic and functional assessment for this study. The functional assessment is performed using a functional indicator (FC).

Table 1. Anthropometric and somatoscopic parameters

Laterality	Height (size)	Weight	BMI	Chest height	Anterior-superior iliac spine height (left)	Anterior-superior iliac spine height (right)	Acromial height (L)
Acromial height (left)	Acromial height (right)	Upper left limb length	Upper right limb length	Lower left limb length	Lower right limb length	Scale	Bi-acromial diameter
Iliac crest diameter	Chest diameter	Antero-posterior chest diameter	Thorax perimeter - rest	Thorax perimeter - inspiration	Thorax perimeter - expiration	Chest elasticity	Thigh perimeter (left)
Thigh perimeter (right)	Abdominal perimeter	Heart rate	Finger-ground index	Cervical arrow	Lumbar arrow	Observation balance	

The following standard statistical techniques are used in this study: trend indicators (average and median) dispersion (range, standard deviation, coefficient of variation, quartile deviation QD, the median criterion ± QD), tests of statistical significance (Pearson test of association and the Student distribution). The infor-mation is graphically represented using histograms, frequency curves and various statistical indicator charts. In our methodology we provide special attention to the features of the sequence of observations distribution in general, compared with a normal (parametric) or abnormal (non-parametric) distribution. These charac-teristics determine the statistical techniques used in relation to the number of observations. A small volume of observations, as it is in our case, requires the utilization, where appropriate, of non-parametric techniques, particularly appli-cable to the statistical significance of reference values. But we must respect the conditions upon which a distribution can receive the "non-parametric" label, having as a starting point the analysis of frequency curve asymmetries. The normality for asymmetric distributions is labeled "accept" or "reject" based on the *quartile deviation (QD)* = Q3 - Q1 / 2 and the *median criterion* (± QD). The observations must be within one half of the distribution range, arranged symme-trically around the median. This relationship is represented graphically in *Table 2*, *Table 3* and *Table 4*.

Table 2. Height frequencies.

Height	Frequency
110	1
114.11	2
118.22	2
122.33	7
126.44	11
130.55	10
134.66	3
138.77	3
146.99	1

Table 3. Weight frequencies.

Weight	Frequency
24	1
26	4
28	8
30	13
32	3
34	1
36	3
38	3
40	3
42	1

Table 4. BMI frequencies.

BMI	Frequency
14	1
15.66	1
17.32	11
18.98	8
20.64	6
22.3	6
23.96	1
25.62	2
27.28	1
28.94	1
More	2

6. Results and discussions

Statistical results on raw values of anthropometric measurements and somato-scopic evaluations are presented in summary tables, totaling over 3,500 bare values and 1,240 statistical indicators.

6.1 Relevant anthropometric parameters

A first interesting aspect of our study shows the role played by height, weight and body mass index (BMI) in the growth and development of children. As an example, for height and weight studies we chose grade I (boys and girls, n = 40 subjects), whereas for BMI, we selected all subjects in grades I-IV (boys and girls, n = 114 subjects). Statistical indicators used for the three anthropometric parameters are presented in *Table 5*.

Table 5. Statistical indicators for anthropometric parameters.

Grade I	Height	Weight	BMI
Xmin	110.00	24.00	14.00
Xmax	147.00	42.00	29.00
median	126.00	30.00	18.00
Q1	121.50	27.75	17.00
Q3	129.00	34.25	21.00
Q3-Q1	7.50	6.50	4.00

Anthropometric parameters and some analytic elements are presented in *Figure 1, Figure 2, Figure 3* and the corresponding tables (*Table 2, Table 3, Table 4*).

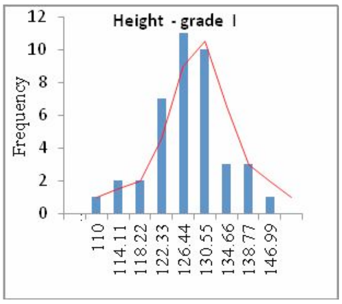


Fig 1. Height distribution (histogram).

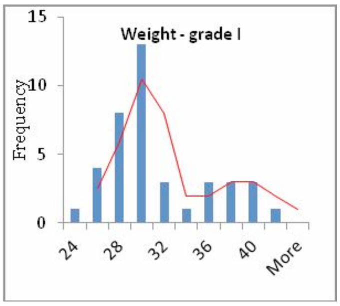


Fig 2. Weight distribution (histogram).

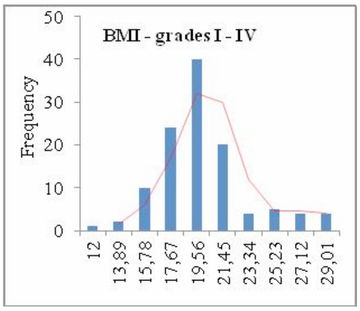


Fig 3. BMI distribution (histogram).

With respect to height (stature), the frequency curve indicates a relative left asymmetry and a central peak. The median criterion (± QD = 126 ± 3.75), repre-senting the interval [122.25 … 129.25] includes more than 50% of the subjects (*i.e.* 28) distributed asymmetrically around the median. Consequently the distri-bution cannot be labeled as “normal”. The weight distribution analysis shows a frequency curve that is clearly asymmetric to the right and with a large number of values asymmetrically distributed to the right. The median criterion (± QD) comprises over 50% of the subjects asymmetrically distributed in the interval [26.75 … 33.25]. Thus the label of normality is rejected. The body mass index (BMI) analysis aimed at the entire study sample follows a frequency curve with right asymmetry and a large number of values on the left caused by a significant number of subjects with weight deficiencies (overweight). The median criterion (± QD) range for grade I students (16 - 20) comprises over 50% of subjects asymmetrically distributed with respect to the median. The verdict is also ab-normal nonparametric distribution. We present a comparison of median values and quartile ranges between grades I and IV (*Table 6*). The differences between these grades are not significant. For medians, the values are located on the border between normal weight and weight deficiency, while the interquartile range (Q3 - Q1) shows a slight improvement in the homogeneity for ageing subjects.

Table 6. Median and quartile range values for BMI.

Body Mass Index (BMI)		
Grade	Median	Q3 – Q1
I	18	4
II	17.5	3
III	19	3
IV	18	2.5

We consider these three anthropometric indicators very important in terms of static and dynamic monitoring of spinal disorders in children of school age, something that was constantly omitted to date, although there are enough reasons for doing so. Therefore, we will focus on exploring this problem further. Weight deficiencies reduce muscle weight, muscle tone and normal morphological deve-lopment of the spine, especially during growth periods. Conversely, excess weight constantly threatens to breakdown the overall balance of the body, usually by moving the center of gravity, from the normal projection point located in the middle of the pelvis, to different lateral or anterior-posterior points with negative consequences. We support our observation by presenting BMI values for the 114 subjects studied here, grouped into 6 categories (*Table 7*).

Table 7. BMI values for the studied subjects, available for all grades.

Membership	**Weight insufficiency**				**Normal**	**Overweight**
	Category I	**Category II**	**Category III**	**Category IV**		
	Number of subjects into categories and degrees, in absolute values and (%)					
Grade I	14 35 %	4 10 %	3 7.7 5	n.a. n.a.	14 35 %	5 12.5 %
Grade II	7 23.5 %	5 16.6 %	5 16.6 %	1 3.3 %	11 36.6 %	1 3.3 %
Grade III	6 25 %	1 4.2 %	1 4.2 %	n.a. n.a.	15 62.4 %	1 4.2 %
Grade IV	7 35 %	n.a. n.a.	4 20 %	n.a. n.a.	6 30 %	3 15 %
Total	34 29.8 %	10 8.8 %	13 11.4 %	1 0.87 %	46 40.3 %	10 8.8 %

Legend: n.a. = data not available.

The results are relevant and show a real problem with the normal development of the spine in 7-10 year old children. Only 40.3% of the subjects had a BMI within the normal range, while 50.9% had weight deficiencies of varying severity. The only positive aspects that we can observe here is a reduced percentage of overweight subjects (only 8.8%). Based on these results we propose two standar-dization methods for this anthropometric index (BMI) to be used in monitoring of disorders that may occur in the development of the spine in 7 to 10 years children, namely the Deciles method (Gibbs and Maher, 1967) and the Statistical Standard Nine Normal Distribution (STANINE) method (Salkind, 2006).

Table 8. The Deciles Method (Gibbs and Maher, 1967)

Categories	IV	III	II	I	Normal			Overweight		
Deciles	12	15 .66	17.32	18.98	20.64	22.30	23.96	25.62	27.28	28.94
BMI	12 - 13	14 – 15	16 -17	18 - 19	20 - 21	22	23 - 24	25 - 26	26 -27	28-29
Score	1	2	3	4	8	10	9	7	6	5

Table 9. The Statistical Standard Nine Normal Distribution (STANINE) Method (Salkind, 2006)

Categories	IV	III	II	I	Normal			Overweight		
Deciles	12	13.89	15.78	17.67	19.56	21.45	23.34	25.23	27.12	29.01
BMI	12	13 - 14	15 - 16	17 - 18	19 - 20	21 - 22	23 - 24	25 - 26	27 -28	29
Score	1	2	3	4	8	10	9	7	6	5

Based on the results presented in *Table 8* and *Table 9*, the difference is insignificant between the two standards of evaluation. Therefore both can be used depending on preferences. The kinetotherapist and where appropriate, the physical education teacher, can use the BMI to focus and monitor students with severe underweight or overweight problems. In this study, we present some aspects considered relevant for the intended purpose and a coherent system of standards, based on several anthropometric and somatometric indicators. The following are some aspects of anthropometric and somatometric indicators, which should be compiled in an appropriate standard to be truly useful. To achieve this goal we return to the importance of height. At first glance, height cannot be incriminated a priori as a negative factor, whereas, height excesses can be incriminated to a certain extent. It is not difficult to predict that a long spine is vulnerable to deformation processes or joint laxity, or a short column is less elastic, nevertheless intuitive insights must be further elucidated.

6.2 Lumbar spine elasticity

In general, the lumbar area is home to many disorder phenomena such as damage to spinal statics and dynamics. For children of school age such phenomena are caused by a sedentary lifestyle, especially those exempted by their parents to attend physical education classes, often without good reason. Other causes include bad posture, inadequate school furniture, prolonged computer work and TV wat-ching, and improper transportation of a school bag. One way to prevent these hazards is to ensure a functional elasticity (mobility) of the lumbar spine characte-rized by its "rigid" and "lax" joints. Besides laboratory methods based on gonio-metry and objective standards, a field method is the so-called *"finger–ground index" (FGI)* method commonly used in physical education and sport due to its practicality and ease of interpretation. Regarding this well-known method, we consider necessary a discussion particularly focused on the application of standar-dization to improve its insufficiency. Our proposed standardization measures not only the elasticity of the lumbar spine but also the contribution of anthropometric parameters involved, but ignored by FGI.

The FGI is measured as a distance (in centimeters) relative to the value 0, which represents the ground level. The distance in centimeters is positive (+) if it exceeds level 0 (*i.e.* +7 cm), and it is negative (-) if value 0 was not attained (*i.e.* -4 cm). This test can only be used correctly to evaluate the performance of each subject in relation to their best result and cannot be used in investigations of samples (groups) subjected to comparative studies because the outcome measu-rement is likely to be influenced by morphological parameters such as chest height and the length of upper and lower limbs, which can have positive or negative effects on the result. We believe in the idea that the finger-ground index, which targets the elasticity of the lumbar spine, has reduced significance and utility, especially considering the fact that the normal tends to the value 0 cm. The standardization of this index requires the inclusion of values of the morphological parameters mentioned above in a mathematical formula that will extend its appli-cability above single subject performance measurements (see *Figure 4*). As a concrete example, we select a subject from grade I with an FGI value of 25 cm. The subject has a height of only 129 cm, but his torso is 71 cm long with relatively long arms (41 cm). We considered necessary to verify the supporting information and to assess the degree of association between anthropometric parameters (height and length) and FGI, using for this purpose the results for grade I subjects - the largest sub-sample from our data set (*Table 10*).

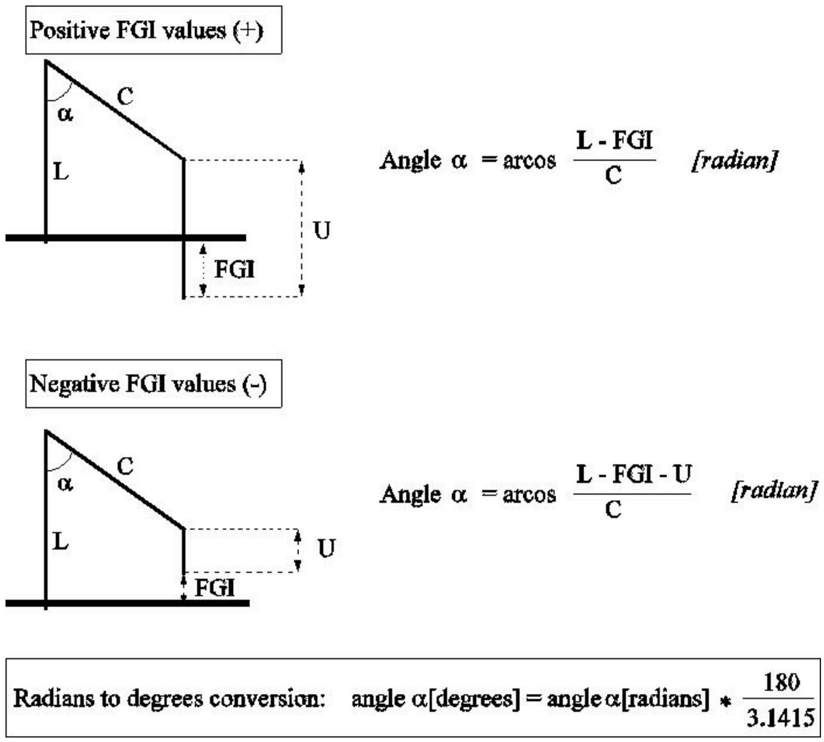
Table 10. Pearson correlation coefficients between the FGI and anthropometric parameters

	Height (size)	**Chest height**	**Left upper limb length**	**Right upper limb length.**	**Left lower limb length**	**Right lower limb length**
Pearson correlation coefficients between the FGI and anthropometric parameters	Values (+) n =9					
	490	748	661	441	557	650
	Values (-) n =7*					
	181	- 002	239	241	329	333

*Legend: * = three subjects have reached 0, considered the border of the normality area.*

Table 10 shows the calculated Pearson correlation coefficients between the FGI and anthropometric parameters. Positive FGI values were obtained for only 9 subjects where negative FGI values were obtained for 27 subjects. For the positive values a direct correlation is observed for all anthropological parameters, with values just below, at or above the tabular values corresponding to a confi-dence level α = .05. For negative values, an insignificant inverse correlation was obtained for the chest height parameter, the rest of the values being much lower compared to corresponding tabular values for the same confidence level (α = .05). These results prove that the standardization of the FGI requires a mathematical formula (*Figure 4*) that takes into consideration the values of anthropological parameters that can mislead the results of the measurements.

Some observations and comments are necessary and the starting point for these is the specification made in connection with the phrase "functional flexi-bility" of the spine, a functionality influenced by joint rigidity and laxity, both being unfavorable for the normal development of the spine and its adequate development. Based on sufficient factual material, the impact of these standards will be validated in time by authorized specialists for prevention and correction of spinal deformations in children of school age, such as kinetotherapists and physical education professors.



Legend: C = chest height, L = lower limb length, U = upper limb length.

Fig 4. Mathematical approximation of the Finger-Ground Index (FGI).

For developing the standards shown in Table 12, we used the following routine implemented in Microsoft Office - Excel, based on the value of statistical indi-cators and trend distribution, such as: X_{min} - Q1, Q2 (median), Q3 - X_{max}, which produces a score with four values (1, 2, 3, 4) convertible into points and levels.

Table 11. Microsoft Office Excel routines.

Excel calculation		+	-
=min (E0 :E00)	=Quartile(E0:E00,1)-1	1 pt.	4 pt.
= Quartile(E0:E00,1)	=Quartile(E0:E00,2)-1	2 pt.	3 pc.
=Quartile(E0 :E00,2)	=Quartile(E0:E00,3)-1	3 pt.	2 pt.
=Quartile(E0:E00,3)	=max(E0:E00)	4 pt.	1 pt.

Table 12. Assessment and Evaluation Scale for the Finger-Ground Index (degrees)

Level		Points	Significance
Negative values (-) above level 0			
96	83	1	Joint stiffness of the lumbar spine
82	77	2	Susceptibility of insufficient lumbar elasticity
76	75	3	Reduced lumbar elasticity
74	69	4	Optimal lumbar elasticity
Positive values (+) under level 0			
55	35	4	Optimal lumbar elasticity
34	31	3	High elasticity
30	26	2	Susceptibility of lumbar joint laxity
25	12	1	Potential lumbar joint laxity

We conclude this article by presenting the results of the somatoscopic obser-vations (*Table 13*).

Table 13. Number of subjects (for each grade) with spinal deformities.

Membership and status	**Grade I**	**Grade II**	**Grade III**	**Grade IV**	**Total**
Normal	26	21	15	13	76
Lordotic posture	1	2	1	n.a.	4
Scoliotic posture - " S" Left	6	2	1	1	10
Scoliotic posture - " S" Right	4	n.a.	1	4	9
Kyphotic posture	2	5	3	1	12
Scoliotic posture - "C" Left	n.a	n.a.	1	n.a.	1
Scoliotic posture - "C" Right	n.a.	n.a.	1	1	2
Down Syndrome	1	n.a.	1	n.a.	2
Total: 39 subjects (34.2%)	14	9	9	7	39

Legend: n.a. = data not available.

The analysis of the results from *Table 13* suggests that the number of children with spine deformities is large given the sample size and indicates that special attention must be given to the problem exposed in our study. If in one school with a total of 157 students in grades I - IV, 114 pupils were examined, and of these 39 (34.2%) have spine problems, we can consider this as an early warning. An extensive and in-depth study of this phenomenon is deemed to be highly necessary.

7. Conclusions

With respect to the results highlighted in this study we arrived at a series of conclusions that touch upon identifying, monitoring and addressing the presented problem. Based on theoretical content and research findings, this article launches a message and a clear rationale for attention to be given to the normal morpho-logical and functional development of the spine in school children with ages between 7 and 10 years. We consider, as a priority, postural attitude deffects, their induced functional changes, and the need for early detection and correction of these defects. Unsuspected and then untreated on time, they become one of the sources of strains – a very common problem during adulthood. The early detection of attitudinal spine defects requires a system of monitoring standards for the normal development of the spine. It is clear since the early stages of this study that the involvement of the three anthropometric parameters: height, weight and the ratio between them (body mass index - BMI), proves to be particularly useful for monitoring the normal growth and development of the spine in young children. We observed that only 40.3% of subjects have a BMI within the normal range while 50.9% are underweight and 8.8% are overweight. The trigonometric impro-vement of the Finger-Ground Index (FGI) measuring the lumbar flexion amplitude in angular degrees provides an objective standard that makes possible (to our best knowledge, for the first time) a direct comparison between subjects. In its former formulation, the FGI produces measurements dramatically influenced and altered by non-essential and confounding factors such as differences in leg, trunk and arm lengths among subjects.

The results based on the somatologic observations of 39 subjects (34.2%) out of a total of 114, with significant flaws in spine posture, prove the importance of this study. We believe this article will raise awareness among the general public, physical education teachers and, last but not the least, among kinetotherapists.

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