Observational study regarding the spine deviations in frontal plane, in a school population

Tatiana Dobrescu [a]*, "Vasile Alecsandri" University of Bacau, 157, Calea Marasesti Street, Bacau 600115, Romania

Nela-Tatiana Balint [b], "Vasile Alecsandri" University of Bacau, 157, Calea Marasesti Street, Bacau 600115, Romania

Mihaela-Alina Cristuta [c], "Vasile Alecsandri" University of Bacau, 157, Calea Marasesti Street, Bacau 600115, Romania

Mihaela Anghel [d], "Vasile Alecsandri" University of Bacau, 157, Calea Marasesti Street, Bacau 600115, Romania

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Abstract

Physical deficiency represents deviations from the normal that lead to unbalances and disharmonious progress through morphofunctional disturbances. Various national studies show that most spine deviations are functional, representing deficient positions through supervision, correction of the position and physical therapy, which can regress, preventing an unfavorable progress and allowing a normal growth and a harmonious physical development. The purpose of this study is to spot and observe the spine deviations in the frontal plane, in a school population. For this, several subjective and objective methods were used. Based on the recorded results, it can be said that the number of children identified with these deviations is growing. Considering these facts, the authors of this study think that the teachers, the parents and the school physician should put more effort into the early prevention and correction.

Keywords: Study, deviation, pupil, frontal plane.

* ADDRESS FOR CORRESPONDENCE: **Tatiana Dobrescu,** "Vasile Alecsandri" University of Bacau, 157, Calea Marasesti Street, Bacau 600115, Romania.
E-mail address: snopek@utb.cz / Tel.: +420576032008

1. Introduction

Posture is an essential element for a normal balance that keeps the mechanical effectiveness of the neuro-musculoskeletal system in an anti-gravitational position. A good standing and sitting position helps the body function better and increases the effectiveness of muscles, thus reducing fatigue. Posture modifications or weak muscle development can cause alignment modifications of the spine. Muscle contractures can cause postural imbalances in the static and dynamic muscles.

According to the statistical data presented by the Orthopaedic Society of the Russian Federation, up to 96.7% of the children have various spine functional disorders and diseases: posture disorders 52.2%, type I scolioses 24.9%, type II 6.7%, type III–IV 2.1% and approximately 11% other spine deformities, according to Садовая, 2010 and Сарнадский, 2010, as cited in Kusturova (2016).

The theoretical support of this paper is based on the presentation of a few traits related to the evolution of body posture. It starts with the body posture being a function of the human body that is based on a series of sensory-motor reflexes, according to Fozza (2003). They start from the impulses received by the proprioceptors of the periarticular tissue, tendons and muscles and by the skin interceptors and visual or acoustic-vestibular analyzers. All these excitations are transmitted to the perceptive structure of the cerebral cortex that retains them and sends them on a motor, effector path to the spinal cord, impulses through which the muscle tone is modified in the human body, needed to maintain the same posture under various conditions

The posture function is performed through multiple mechanisms: biomechanical, physiological and mental. Biomechanically, the most important force acting on the human body is gravity. It acts on the support surface, generating a reaction, with equal force and contrary. The human body is in balance only when the forces acting upon it are equal.

Regarding the body's centre of gravity in relation to the supporting polygon, two types of balance can be distinguished: stable balance when the centre of gravity is below the support surface and unstable balance when the centrr of gravity is above the support surface.

In normal situations, the body is in unstable balance. This balance varies as value according to the height of the general centre of gravity in relation to the support surface, the size of the support surface and the point where the vertical axis falls on the support surface. Through a prompt and precise adaptation, the body divides its passive and active forces in most economical way possible to maintain or re-establish the mechanical or physiological formula of the posture.

The posture tone results from the permanent conflict between muscles and gravity that acts to tear the balance and stability relations between the body and its segments during very different moves and positions. Posture is conditioned, however, according to Duma (1997), by constitutional and temperamental characteristics, the state of the organs and systems, sex, age, weight, height and other internal and external factors.

The processes of growth and development of the body, the superior nervous activity, the lifestyle and work and other complex and variable factors contribute to the development of posture.

The active elements of posture are represented by the muscles and nerves that work together to the adopting and maintaining of positions, to their change and to performing motions.

The passive elements of posture are the passive elements of the musculoskeletal system: the bones and joints. Any alteration of the organs' function or structure that ensures the body posture determines modifications in it. Any modification of the form and structure of bones and joints determines an alteration of the relation and position between the various body segments.

The bone pulleys, engaged through joints, are maintained in a correct position, static and dynamic by muscles through corresponding contractions. The muscles, however, can contract and maintain the corresponding tone only because of the motor stimuli transmitted from the peripheral nervous

system. As a result, any nervous system disorder will affect the muscle tone and contraction, which will not be able to act on the body correspondingly.

Physical deficiency represents the deviation from the normal body shape. This deviation perturbs the balanced growth and development of the body, modifying its external aspect, reducing one's skills and ability to adapt to the environment and one's ability to work. These deficiencies represent deviations from the normal that lead to unbalances and disharmonious progress through morphofunctional disturbances. Various national studies show that most spine deviations are functional, representing deficient positions through supervision, correction of the position and physical therapy, which can become normal, preventing an unfavourable progress and allowing a normal growth and a harmonious physical development.

After consulting the professional literature, the authors of this study felt that a study of this kind was necessary, to identify the asymmetries of body segments in frontal plane, in a school population.

2. Materials and Methods

The purpose of this study is to spot the spine deviations in the frontal plane, in a school population. Also, the aim of this study is to emphasize the morphofunctional development conditions of future generations of adults.

For this, several subjective and objective methods were used.

The hypothesis that formed the basis for this research is the following:

- Presumably, through the assessment of the body segments, one can identify the frontal spine deviations in a school population.

On the occasion of the International Day of Sport for Development and Peace, on April 6, 2017, within a project organized by the Faculty of Movement, Sports, and Health Sciences, at the "Vasile Alecsandri" University of Bacau, this team of authors has assessed the bio-motor potential in a school-age population.

The research subjects were 70 primary school pupils (7–10 years old), 35 female pupils and 35 male.

The research methods used were: the study of the specialized literature, the observation method, the inquiry method, the measuring and assessment method, the data interpretation method and the graphical representation method.

The somatic-functional assessment consisted of conducting an anamnesis general clinical examination, completed by a visual and a palpatory examination based on Cordun (1999). The assessment tests used were: the Schober's test, the finger-ground distance, the acromion-ground height, the iliac spines–ground height, the lateral inclination of the trunk (dactylion ground) and the Dotte's test (trunk rotation) based on Cordun (2009).

3. Results and discussion

3.1. Presentation and graphical interpretation of the Schober's test results

The following statistical values were recorded during the Schober's test (Figure 1): arithmetical mean (M = 4.72), median, med = 4, mod = 2. As one can see in the frequency table, the distribution is unimodal, asymmetrical to the right (skewness is positive), the results tending towards low values. The kurtosis has a positive value, indicating a leptokurtic distribution, thus a high degree of homogeneity in the group of subjects. The minimum value was 1, and the maximum value was 25, the standard deviation being 3.589.

As shown in Figure 2, most results are low, the highest value being 15.9% (11 subject) for Result 2, followed by 14.5% (10 subjects) for 3. The Results 5 and 6 were each recorded by 13% (nine subjects), while Result 1 by 11.6% (eight subjects). The Results 4 and 7 were each recorded by 10% (seven subjects each), while Result 8 by 7.2% (five subjects). There were three subjects (1.4%) that recorded the Results 10, 15 and 25.
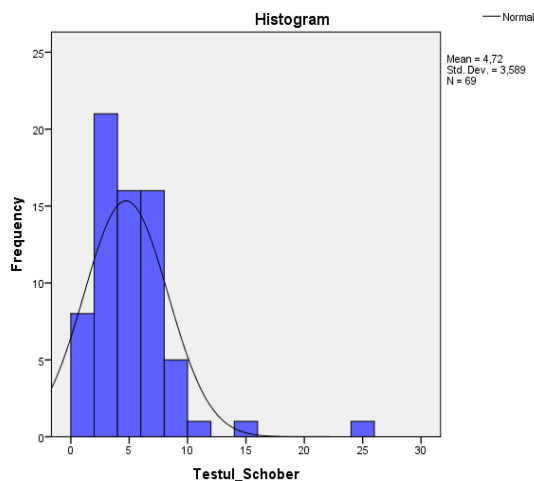

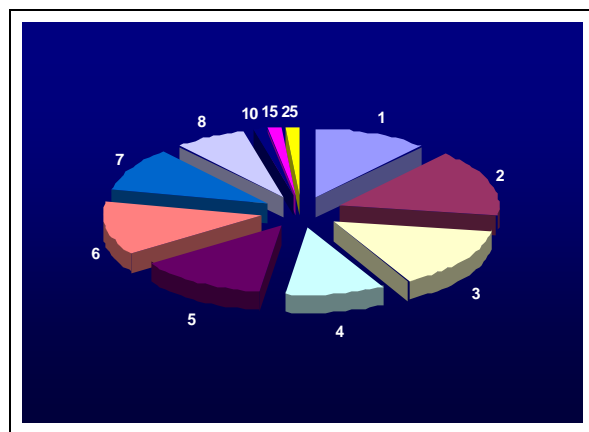**Figure 1. Result progress dynamics for the Schober's test**

Figure 2. Diagram of the Schober's test

3.2. Presentation and graphical interpretation of the finger-ground distance results

The following statistical values were recorded during the finger-ground distance test (Figure 3): arithmetical mean (M = 3.99), median, med = 4, mod = 0. As one can see in the frequency table, the distribution is unimodal, slightly asymmetrical to the left (skewness is negative −0.514), the results tending towards positive values. The kurtosis has negative values, −0.347, indicating a normal, platykurtic distribution. The minimum value was 1, and the maximum value was 25, the standard deviation being 12.281.

As one can see in Figure 4, 53 subjects (75.7%) recorded positive values, and 15 subjects (21.4%) recorded negative results.

Also the highest values were 15.7%, representing 11 subjects, with the recorded result of 0 centimetre, followed by 7.2%, representing five subjects, with the result of 18 centimetre.
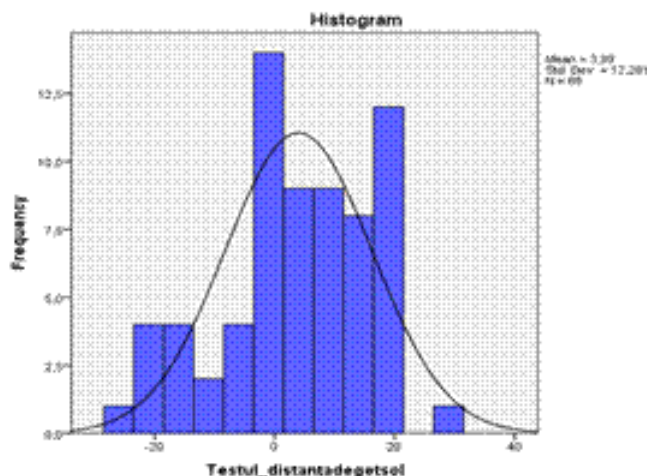
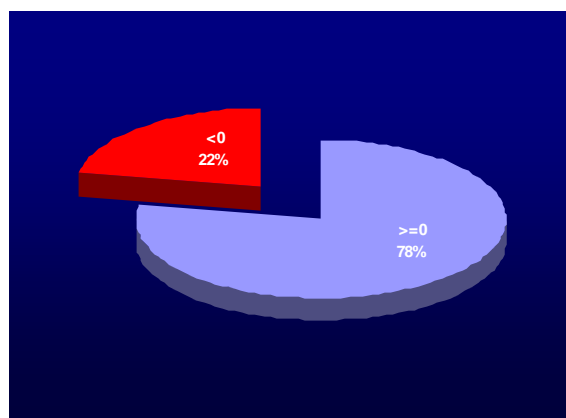**Figure 3. Result progress dynamics for the finger-ground distance test**

Figure 4. Diagram of the finger-ground distance test

3.3. Presentation and graphical interpretation of the acromion-ground height results

During the acromion-ground height test (Figure 5), as a result of the analysis of the left and right asymmetries, the following statistical values were recorded: arithmetical mean (*M* = 0.15), median, med = 0, mod = 0. As one can see in the frequency table, the distribution is unimodal, asymmetrical to the right (skewness is positive, 0.183), the results tending towards negative values, corresponding to the asymmetries towards left. The kurtosis has a positive value, 0.436, indicating a mesokurtic distribution. The minimum value was −4, and the maximum value was 4, the standard deviation being 1.478.

Figure 6 shows that 38% (27 subjects) do not have asymmetries, 33% (23 subjects) have asymmetries to the right, and 29% (20 subjects) have asymmetries to the left.
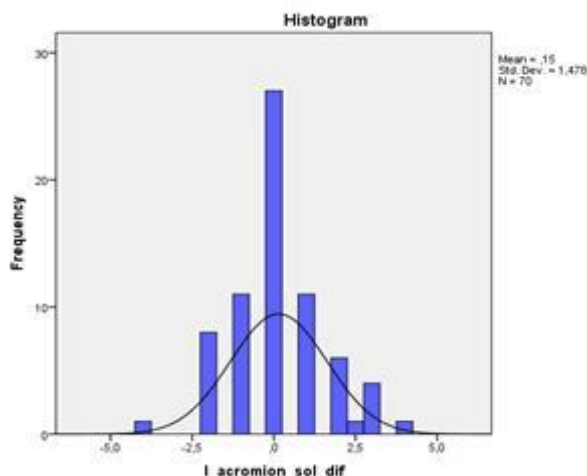
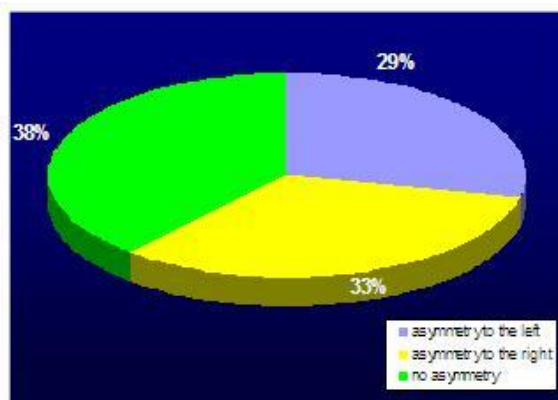**Figure 5. Result progress dynamics for the acromion-ground height test**

Figure 6. Diagram of the acromion-ground height test

3.4. Presentation and graphical interpretation of the iliac spines–ground height

During the iliac spines–ground height test (Figure 7), as a result of the analysis of the left and right asymmetries, the following statistical values were recorded: arithmetical mean (*M* = −0.06), median, med = 0, mod = 1. As one can see in the frequency table, the distribution is unimodal, slightly asymmetrical to the left (skewness is negative, −0.736), the results tending towards positive values, corresponding to the asymmetries towards right. The kurtosis has a positive value, 0.796, indicating a mesokurtic distribution. The minimum value was −5, and the maximum value was 3, the standard deviation being 1.606.

Figure 8 shows that 46% (32 subjects) have asymmetries to the right, 30% (21 subjects) have asymmetries to the left, and 24.3% (17 subjects) do not have asymmetries.
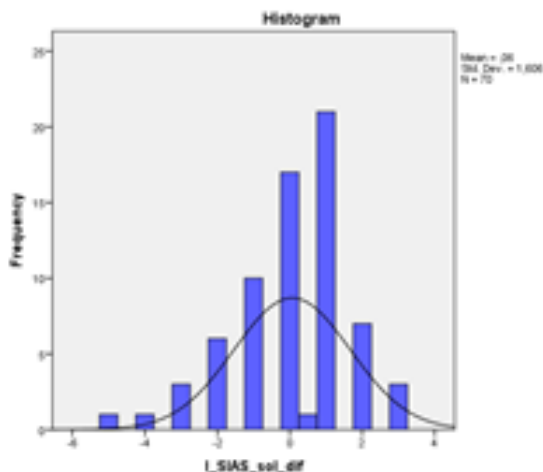
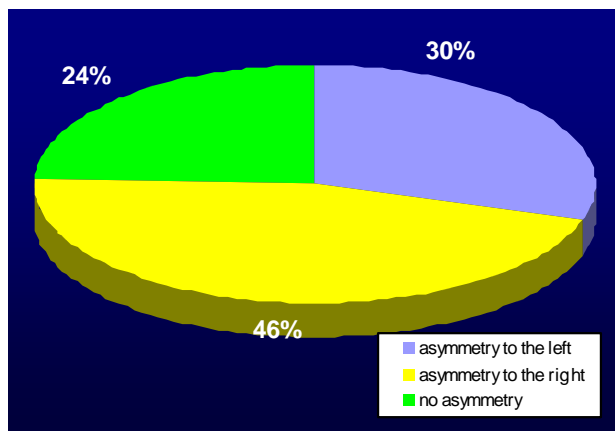**Figure 7. Result progress dynamics for the iliac spines–ground height test**

Figure 8. Diagram of the iliac spines–ground height test

3.5. Presentation and graphical interpretation of the lateral inclination of the trunk results

During the lateral inclination of the trunk (dactylion-ground) test (Figure 9), as a result of the analysis of the left and right asymmetries, the following statistical values were recorded: arithmetical mean (M = −0.34, median, med = −1, mod = −1. As one can see in the frequency table, the distribution is unimodal, asymmetrical to the right (skewness is positive, 0.151), the results tending towards negative values, corresponding to the asymmetries towards left. The kurtosis has a negative value, 0.796, indicating a leptokurtic distribution. The minimum value was −6, and the maximum value was 6, the standard deviation being 3.026.

Figure 10 shows that 51.4% (36 subjects) have asymmetries to the left, 35.7% (25 subjects) have asymmetries to the right, and 12.9% (9 subjects) do not have asymmetries.
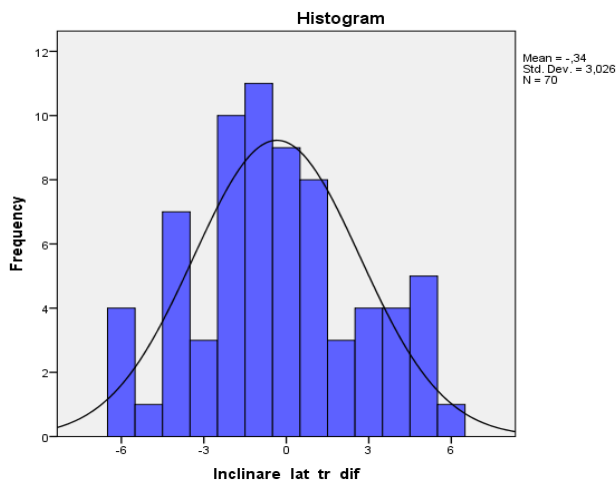
Dobrescu, T., Balint, N. T., Cristuta, M. A. & Anghel, M. (2017). Observational study regarding the spine deviations in frontal plane, in a school population. *New Trends and Issues Proceedings on Humanities and Social Sciences.* [Online]. *4*(8), 115–125. Available from: www.prosoc.eu

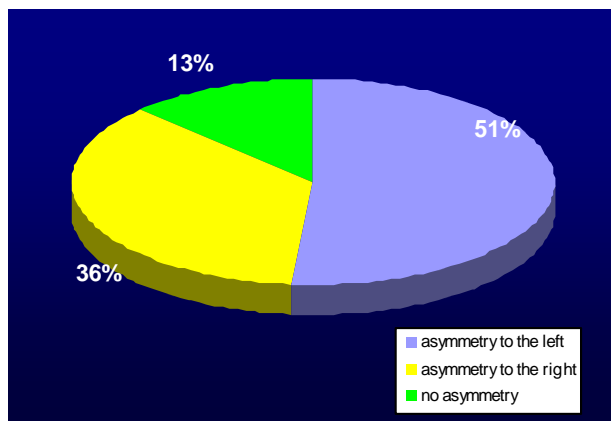**Figure 9. Result progress dynamics for the lateral inclination of the trunk test**

Figure 10. Diagram of the lateral inclination of the trunk test

3.6. Presentation and graphical interpretation of the Dotte's test results

The following statistical values were recorded during the Dotte's test: arithmetical mean ($M = -0.03$), median, med = 0, mod = −1. As one can see in the frequency table, the distribution is unimodal, asymmetrical to the right (skewness is positive, 0.541), the results tending towards negative values, corresponding to the asymmetries towards left. The kurtosis has a positive value, 12.586, indicating a sharp mesokurtic distribution. The minimum value was −12, and the maximum value was 13, the standard deviation being 2.676.

Figure 12 shows that 44.3% (31 subjects) have asymmetries to the left, 31.4% (22 subjects) have asymmetries to the right, and 24.3% (17 subjects) do not have asymmetries.
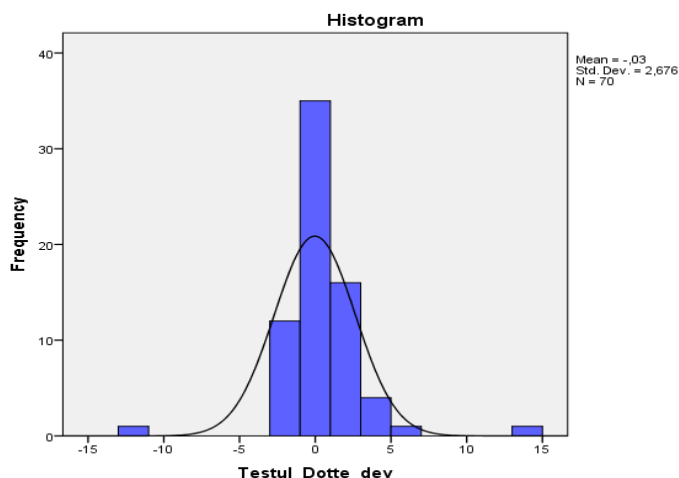
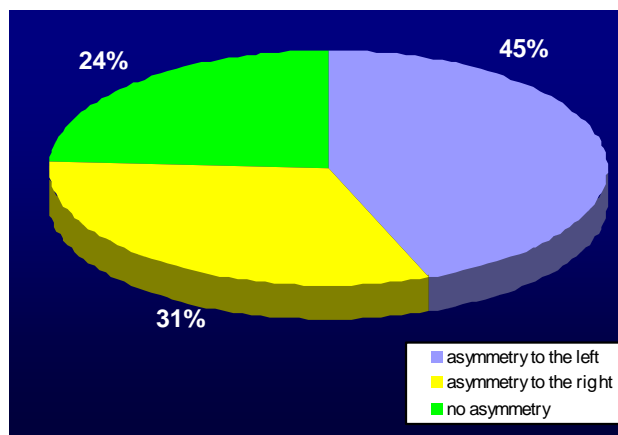**Figure 11. Result progress dynamics for the Dotte's test**

Figure 12. Diagram of the Dotte's test

Thus, the recorded results are in agreement with the ones shown by Professor Dr. Mihai Jianu, the Head of the Orthopaedics and Spinal Surgery Clinic at the 'Grigore Alexandrescu' Emergency Paediatric Hospital, that Romania is the country with the highest number of scoliosis and kyphosis in Europe. The conclusion is that, in Romania, there is no concern for an early screening of spine deformations in children. School physicians should be the first ones to identify these disorders. 'Currently, the statistics show that, in Romania, the number of pathological spine deviations in children is very high, over 50% of the total children assessed in various communities, according to the estimation of experts'(Farmacia ta, n.d.).

A study conducted during a National Awareness Campaign for the early observation of spine deviations, in 2009, found that in the records of the 'Grigore Alexandrescu' Emergency Paediatric Hospital of Bucharest alone there are 13,000 cases of children with spine deviations (Sfatul medicului, 2009).

Kratenova, Zejglicova, Maly, and Filipova (2007) conducted a study on 3,600 school children and found that 38.3% of them had a bad posture, more frequently encountered in boys, frontal plane deviations (scolioses) 50% of the children, and sagittal plane (lordoses) 32%.

4. Conclusions

At the end of the study, the following conclusions have been drawn:

- For the Schober's test, most results are low in regards to the mobility of the dorsal-lumbar spine, the highest value being 15.9% (11 subjects), while 3 subjects (1.4%) have recorded results between 10 and 15 centimetre.
- During the fingers-ground test, 53 subjects (75.7%) have recorded positive values, and 15 subjects (21.4%) have recorded negative values.
- During the acromion-ground height test, 38% (27 subjects) did not have asymmetries, 33% (23 subjects) have asymmetries to the right, indicating the direction of the spine convexity, and 29% (20 subjects) have asymmetry to the left, also indicating the direction of the spine convexity. Thus, one can see a high value of 62% (43 subjects) in regards to the dorsal spine asymmetries.
- During the iliac spines–ground height test, 24.3% (17 subjects) did not have asymmetries, 46% (32 subjects) have asymmetries to the right, indicating the direction of the spine convexity, and 30% (21 subjects) have asymmetry to the left, also indicating the direction of the spine convexity. Thus, one can see a high value of 76% (53 subjects) in regards to the lumbar spine asymmetries.
- During the lateral inclination of the trunk test, 51.4% (36 subjects) have recorded asymmetries to the left, 35.7% (25 subjects) have recorded asymmetries to the right, and 12.9% (9 subjects) have not recorded asymmetries.
- During the Dotte's test, 44.3% (36 subjects) have recorded asymmetries to the left, 31.4% (22 subjects) have recorded asymmetries to the right, and 24.3% (17 subjects) have not recorded asymmetries.
- The correlation between the Schober's test and the iliac spines–ground height test represented by the value of the correlation coefficient is 0.245, *p* < 0.05, indicating a direct, weak correlation between the two samples, signifying that the subjects that have recorded low values during the Schober's test had asymmetries to the left, while the subjects that have recorded high values during the Schober's test had asymmetries to the right.
- The correlation between the lateral inclination of the trunk and the acromion-ground height tests represented by the value of the correlation coefficient is 0.243, *p* < 0.05, indicating a direct, weak correlation between the two samples, signifying that the subjects that had asymmetries to the left during the lateral inclination of the trunk test had the same asymmetries also during the acromion-ground height test, while the subjects that had asymmetries to the right during the first test had the same asymmetries during the second test.

Based on the recorded results, it can be said that the number of children identified with asymmetries in their body segments is high. Considering these facts, the authors of this study think that the teachers, the parents and the school physician should put more effort into their early prevention and correction.

Acknowledgements

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