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Analysis of Postural Changes in 2nd Cycle Students of Elementary School

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Abstract

Background: The prevalence of postural changes is increasingly evident in our society, early detection plays an extremely important role in preventing complications in adult life. Thus, the objective of this study was to analyse the prevalence of postural deviation and risk factors in 2nd cycle students. Sample of 19 students aged between 10 and 11 years old.

Methodology: The collection methods used were postural evaluation through SAPO software, analysis of plantar pressure by Podoprint software and behavioural risk factors through the Back PEI questionnaire.

Results: The prevalence of postural deviations found in all body segments (pelvis, neck, shoulders, trunk, feet, and center of gravity) occurred in more than 70% of participants. Regarding the distribution of the plantar pressures and the maximum pressure point, the majority of individuals had the highest-pressure area in both heels and a high prevalence of foot cavus. 84.2% had a BMI below normal, and 57.9% had severe thinness. Most students take an improper posture when sitting at the table and lifting objects off the floor.

Conclusion: Several aspects related to the postural postures and habits of the children are determinant for the musculoskeletal development, especially in the period of osteoarticular growth, when the equilibrium search for the new proportions of the body occurs. This high prevalence of postural deviations, both lateral and anteroposterior, in the present study, the results obtained by other authors report a prevalence of around 70% for postural changes in children and adolescents.

Keywords: Postural changes; School age children; Back pain; Back-PEI questionnaire

Introduction

Postural changes are considered a public health problem, as they may be a factor predisposed to adult degenerative conditions [1-3]. Many postural problems, especially those related to the spine, have their origin in the period of body growth and development, that is, in childhood and adolescence [4,5].

In these phases occur the peaks of growth, critical moments for the appearance of postural deviations resulting from the various adjustments, adaptations and physical and psychosocial changes characteristic of this phase of development, besides intrinsic and extrinsic factors, such as heredity, environment, physical conditions, emotional and socioeconomic factors [6]. The cases of postural changes in adolescence are growing considerably, it is at this stage that children and adolescents remain for long periods sitting in a school context [7,8], being exposed to increasing overloads, such as the support of school backpacks [8,9] which coupled with the tendency of a sedentary lifestyle adopted in the school phase [10], may also favour the emergence of Postural changes. Such behaviors can lead to lateral and anteroposterior postural changes [11,12].

According to Desouzart et al. [13], postural education programs can influence the physical health of children and it is necessary to include in the curricula of Physical Education this same program, in order to incorporate exercises aiming at the improvement of the corporal self-consciousness in the children.

In this way, with the intention of contributing with the literature of the area and, mainly, to be able to intervene later, the purpose of this study was to estimate the prevalence of lateral and anteroposterior postural deviations in students and to verify if such deviations are associated with certain anthropometric and behavioral factors.

Methodology

Aim

This paper aimed to present a study that analysed the prevalence of postural changes and postural habits adopted by 5th and 6th school grade students from both gender of the School Group Infante D. Henriques from Viseu.

This 5th and 6th grade population was chosen according to two different school periods, the entrance and exiting level for the twice Basic Education Cycle, these dues to our intent of seeing if there was already possible to find any postural changes in both of this stages.

Study sample

Dating from July 2015, there were 836 students enrolled in the school, 314 of which attending the 2nd Basic Education Cycle, in the 5th and 6th grade [146 and 168, respectively].

This study population, as mentioned earlier, represent the beginning of the 2nd Basic Education Cycle [5th grade] and the end of the same Basic Education Cycle [6th grade], which were chosen in order to establish if there were already postural changes, or even spine musculoskeletal related problems, by analyzing and comparing pain complaints in both school periods.

Our sample consisted of 19 participants [11 male and 8 female subjects, with ages between 10 and 11-year-old [10.47± 0.513 years old].

Approved by the ethical comity of Piaget Institute, this study asked for informed consents for students' parents and guardians. All our procedures followed the Helsinki Declaration, to what human related studies should comply.

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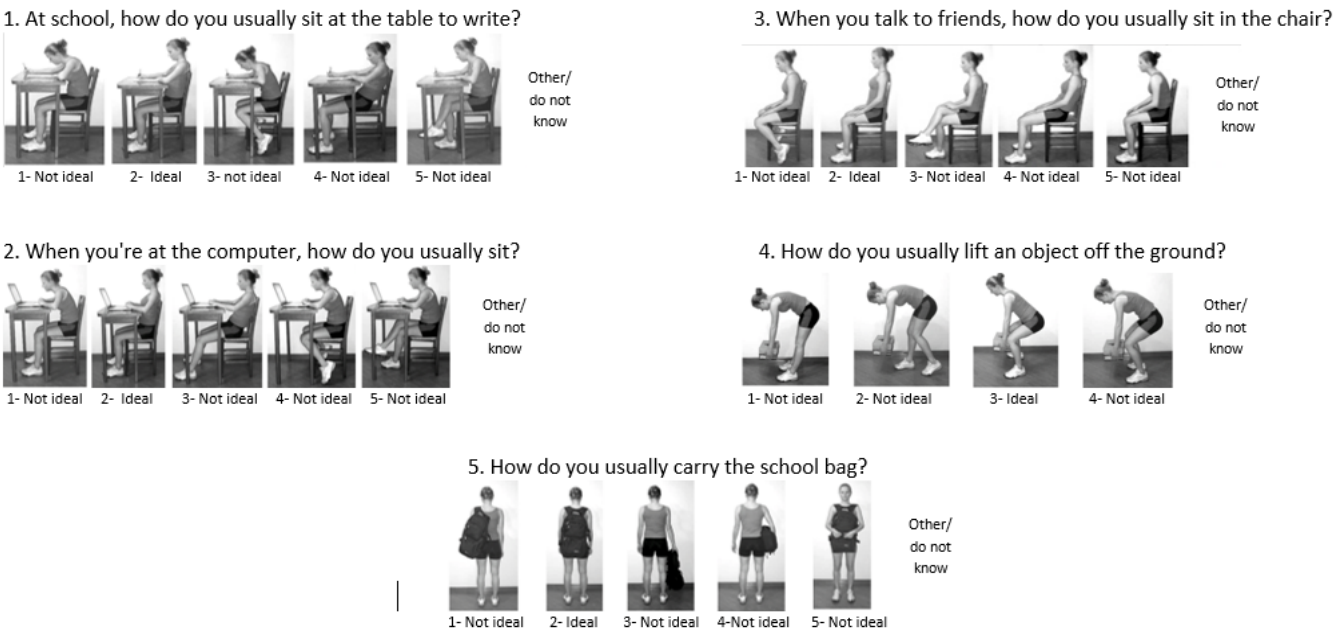

Figure 1: Ideal and not ideal postures.

The inclusion criteria are: i) to be aged between 10 and 11 years; ii) understand the aims of the study and agree to participate voluntarily. As exclusion criteria: i] Presence of pathology a known health condition of rheumatological, orthopaedic, cardio-respiratory, oncological pathology and / or diagnosed coronary disease; ii) the provision of informed consent by students' parents and guardians

Procedures

This study have taken one month from participant selection process, personal identification questionnaire fill, the Visual Analogue Scale [VAS] was used to measure the intensity of Back Pain [14-16] and Back Pain and Body Posture Evaluation Instrument [BackPEI] according Noll et al. [17] in order to identify the presence of back pain in the last three months and evaluates demographic [age and sex] and behavioral risk factors [level of physical exercise and competitive practice of physical exercise; daily hours watching television and using the computer; hours of sleep; habit to read and / or study in bed; sleeping posture; sit on the chair to write; sit on the chair to talk; use the computer; take object from the ground; means of transport used to transport school supplies and mode of transportation of the school backpack.

In order to assess body weight, a Body mass index was conducted [18,19]. For the measurement of body weight, a Seca® scale was used with a capacity of 150 kg and a precision of 100 gr. The height was collected using a stadiometer [200 cm]. In both measurements, students remained erect, with no footwear and bathing suit, and for height measurement, the students were with their backs to the measuring instrument, and the heads were positioned in the horizontal plane of Frankfurt. BMI was calculated and the subjects were classified as follows: obesity, normal weight, light thinness, moderate thinness, and severe thinness according to the proposed limits.

The postural evaluation was performed using the Postural Assessment Software [PAS / SAPO], version 0.68 developed by Duarte [15,20]. This software allows the import and calibration of images, marking of points in the photograph according to protocol, interval measurement and free marking of points to determine body angles [21]. This instrument evaluates the curvatures of the spine in a non-invasive way in order to quantify the posture, registering small alterations for the evaluation and monitoring in a clinical setting [21,22]. For data collection, a Sony Cybershot 14.1 Megapixel camera adapted to a tripod [KONIG KN-TRIPOD40®] was required.

For the postural evaluation, the individuals were photographed in an anterior, posterior and lateral view. The camera was positioned on a tripod 3 m away and at a height of 1 m from the ground [21]. For the photographic record, the students were instructed to remain in the usual standing posture of the day, with the arms along the body and the weight of the body distributed equally on the two parallel feet. For evaluation in the lateral view and to facilitate the visualization of the marked points, shoulder flexion was requested at 45˚. To control possible parasitic variables, it was considered that the collection environment remained the same and no distractions to the participant.

The images were then entered SAPO software, followed by vertical axis calibration, using a distance of 45 cm marked on the pendulum. For this calibration, a 150% zoom was used. The analysis follows points defined by the SAPO protocol but with free markings in order to evaluate: inclination, rectification and cervical protrusion, shoulder drop and pelvic tilt, horizontal alignment of the pelvis and projection of the body.

The last analysis was plantar pressure. The Podoprint Stabilometric Platform from Namrol® Print was used to evaluate the distribution of load on the plantar surface of the displacement of the force center.

The variables analysed are: center of forces, pressure peaks, contact area, support base and distribution of forces by foot area [ante-foot, mid-foot and back foot]. Each barefoot individual was positioned in front of the platform and oriented to climb to the platform with both feet independently, keeping them comfortable, erect posture and upper limbs extended parallel to the trunk.

In order to simplify the data and tables representing the different active postures, the BackPEI images were classified as ideal and not ideal (Figure 1).

SPSS, 23.0 version was used in order to treat all the statistical data. Descriptive statistics were performed, considering all the variables

obtained. Due to the small number of the sample and to facilitate the analysis, the variables of posture habits were grouped, and we considered two groups: Ideal posture and not ideal posture. The statistically level of significance was establish in $p \leq 0.05$.

Results

The sample consisted of 19 individuals, aged 10 to 11 years old [10.47 ± 0.513], 11 males [57.9%] and 8 females [42.1%]. 84.2% have an abnormal BMI value, and 57.9% have a BMI corresponding to severe thinness [<16] and only 15.8% have a normal BMI (Table 1).

		n	%
BMI	Severe slimness [<16]	11	57.9
	Moderate slimness [16 a 16.9]	1	5.3
	Light slimness [17 a 18.4]	4	21.1
	Normal [18.5 a 24.9]	3	15.8
	Total	19	100.0

Table 1: BMI analysis.

Variable / Response	Gender		Total
	Male	Female	
Regular practice of physical exercise / sport (in or out of school)			
Yes	42.1%	26.3%	68.4%
No	15.8%	15.8%	31.6%
Days per week that you exercise / sport			
1-2 days/week	15.4%	30.8%	46.2%
3-4 days/week	38.5%	7.7%	46.2%
5 or + days/week	7.7%	0.0%	7.7%

Table 2: Distribution of physical exercise according to gender.

Variable / Response	Gender		Total
	Male	Female	
Hours a day sitting watching TV			
At least 1 hour / day	31.6%	26.3%	57.9%
2 to 3 hour / day	15.8%	10.5%	26.3%
I do not know how to respond. It depends on the day	10.5%	5.3%	15.8%
Hours per day sitting at PC			
At least 1 hour / day	42.1%	26.3%	68.4%
2 to 3 hour / day	0.0%	10.5%	10.5%
I do not know how to respond. it depends on the day	15.8%	5.3%	21.1%
Hours per day to sleep			
Less than 8 hours / day	0.0%	0. %	0.0 %
From 8 to 9 hours / day	42.5%	36.4%	78.9%
More than 8 hours / day	12.8%	8.3%	21.1%

Table 3: Frequencies of rest habits according to gender.

Variable / Response	Gender		Total
Sleep posture position	**Male**	**Female**	
Lateral position	10.5%	31.6%	42.1%
Ventral position	31.6%	5.3%	36.8%
Dorsal position	5.3%	5.3%	10.5%
I do not know how to respond. it depends on the day	10.5%	0.0%	10.5%
At school. sitting at the table to write			
Not ideal 1	26.3%	21.1%	47.4%
Ideal 2	10.5%	0.0%	10.5%
Not ideal 3	10.5%	15.8%	26.3%
Not ideal 4	0.0%	5.3%	5.3%
Not ideal 5	10.5%	0.0%	10.5%
Sitting at work on the computer			
Not ideal 1	31.6%	15.8%	47.4%
Ideal 2	5.3%	5.3%	10.5%
Not ideal 3	10.5%	0.0%	10.5%
Not ideal 4	10.5%	15.8%	26.3%
Not ideal 5	0.0%	5.3%	5.3%
Sitting on a chair or bench to chat with friends			
Not ideal 1	5.3%	5.3%	10.5%
Ideal 2	10.5%	5.3%	15.8%
Not ideal 3	5.3%	5.3%	10.5%
Not ideal 4	21.1%	15.8%	36.8%
Not ideal 5	15.8%	10.5%	26.3%
Lift an object off the ground			
Not ideal 1	5.3%	10.5%	15.8%
Not ideal 2	10.5%	26.3%	36.8%
Ideal 3	26.3%	5.3%	31.6%
Not ideal 4	15.8%	0.0%	15.8%
Carrying the school backpack			
Not ideal 1	0.0%	10.5%	10.5%
Ideal 2	57.9%	31.6%	89.5%

Table 4: Frequencies of postural habits according to gender.

The practice of physical activity was reported by 68.4% of the participants and 36.8% of them practice physical exercise as competition and it is the male who practices more and more time per week dedicates to his practice (Table 2).

Regarding the sedentary lifestyle and rest / sleep, as shown in Table 3, the main results were: 57.9% of subjects reported spending at least 1 hour watching TV, 68.4% staying at least 1 hour on the computer. In relation to rest and hours of sleep, 78.9% do so from 8 to 9 hours a day.

Regarding the back pain reported by the participants, only 10.5% had back pain in the last three months, with intensity of pain varying between intensity 1 and intensity 6 in the Visual Analogue Scale (VAS), with only one individual presenting a frequency of episodes 2 to 3 times per week. This presented pain did not limit the performance in daily life activities.

With regard to postural habits (Table 4), 41.7% study or read in bed. In relation to the preferred position to sleep 36.8% has a habit of sleeping in the ventral position. The data revealed that 89.5% of subjects did not maintain an ideal posture to write at the table (Figure 1 - Question 1 - Answer 1). This same percentage (89.5%) of students do not assume ideal postures to work on the PC (Figure 1 - Question 2 - answer 1) and do not assume ideal postures when they sit around talking (Figure 1 - Question 3 - Answer 4). Table 4 represents in percentage the different postural habits of the respondents.

With regard to the load and transport habits, all the individuals use backpacks of two handles for transport of the school material, of which only 10,5% do not carry the transport of the backpack of ideal form, placing it in a single shoulder (Figure 1 - Question 5 - Answer 1) and 68.4% did not pick up objects from the floor in an ideal and ergonomic way (Figure 1 - Question 4 - Answers 1, 2 and 4).

In the postural evaluation using Podobarometry and photography, there is a large discrepancy regarding the number of footwear of the individuals in the sample ranging from 33 to 41.5 (Mean 36.28). From the obtained results we can infer that the majority of the evaluated individuals presents both foot cavus with 63.2%.

In the evaluation of pressure areas, taking the standard values

a pressure area> 75%, we can observe that 42.1% of the individuals present the greatest area of pressure in both heels. From this evaluation and according to the results obtained we can determine that the point of maximum pressure is found for 42.1% of the individuals in the right calcaneus, 47.4% in the left calcaneus. In relation to the center of gravity, 52.7% of the individuals presented the center of gravity, and 26.3% of them presented anterior displacement to the right (Table 5).

Regarding postural evaluation, Table 6 represents the results of the postural deviations presented by the individuals who performed the postural evaluation. 90.9% of the individuals presented lateral inclination of the head. None of the individuals evaluated had a normal horizontal alignment of the head in relation to the C7 vertebra and that 72.7% presented anterior cervical spine.

In the postural evaluation of the trunk, it was observed that 63.6% of the individuals evaluated presented right acromion higher than the left one. In relation to the Antero Superior Iliac Spines (ASIS), 81.8% did not present horizontal ASIS alignment. Thus, all individuals presented alterations in the angles between the ASIS and the acromion, and 72.7% presented right bending of the trunk. Changes were found in the horizontal alignment of the pelvis of all individuals, and the majority (90.9%) presented pelvic anteversion (Table 6).

Discussion

One of the most frequent factors of postural deviations is shoulder asymmetry, some authors associate the presence of this asymmetry to the lateral and dominant hand of the individual, as it promotes more pronounced muscular hypertrophy on the dominant side, which can cause an increase of this shoulder [7,22], while others, as is the case of the authors Sacco et al. [21] report that the asymmetry of the shoulder is related to the transport of the backpacks, the way each individual carries his load can be determined by factors such as weight and size, transport time, orographic and environmental conditions, the physical constitution of the individual because postural imbalances generated in these situations are aggravated by the fact that the loaded weight is often disproportionate to the weight of the body itself.

Variables	%
Type of foot	
normal	31.6
Both feet caves	63.2
Normal right foot. left foot cavus	5.3
Maximum Pressure Point (M)	
Right Heel	42.1
Left Heel	47.4
Front Right	5.3
Front Left	5.3
Pressure Area> 75%	
Heels	42.1
Heels and forefoot	36.8
Heels and forefeet Right	15.8
Heels and forefeet Left	5.3
Gravity center	
Lined up	15.8
Preceded to the left	21.1
Preceded to the right	26.3
A posterior left	15.8
A posterior right	5.3
A posterior	10.5
Prioritized	5.3

Table 5: Descriptive analysis of podo-barometry variables.

Variables	%
Inclination of the head	
Right inclination of the head	72.7
Left inclination of the head	18.2
Normal head inclination (0°)	9.1
Horizontal head alignment (C7)	
Head hyperflexion (> 45°)	90.9
Head hyperextension (<45°)	9.1
Horizontal head alignment (45°)	0
Cervical spine vertical alignment	
Anterior Cervical Spine	72.7
Rectified Cervical Spine	9.1
Normal alignment of the cervical spine (0°)	18.2
Horizontal alignment of the acronyms	
Left acromion higher than right	36.4
Right acromion higher than the left	63.6
Horizontal alignment of the acronyms (0°)	0
Horizontal alignment of EIAS	
Left EIAS higher than right	45.5
Horizontal alignment of EIAS	36.4
Horizontal alignment of EIAS (0°)	18.2
Inclination of trunk	
Right trunk slope	72.7
Left slope of trunk	27.3
Normal trunk alignment (0°)	0
Horizontal alignment of the pelvis	
Pelvic anteversion	90.9
Pelvic retroversion	9.1
Horizontal alignment of the pelvis	0

Table 6: Distribution of postural deviations.

In this study, 89.5% of the participants reported using a backpack with support at both shoulders, results that at the outset denote a balance of loads in the transportation of school supplies. However, even when used properly, the possible excessive weight of the backpack can influence posture, particularly in children and adolescents with misfit weight [23]. Studies carried out in schools have associated the use of backpacks, especially when the weight is over 15% of body weight, and their transport is done unilaterally [24]. It is noteworthy that only 10.5% of the individuals in the present study reported feeling back pain in the last three months.

Other alterations identified in this study (cervical tilt, cervical protrusion and pelvic tilt) are described as compensatory mechanisms of posture, considering the centrality of the line of gravity [24,25]. These compensatory mechanisms occur due to muscular imbalances, explained by the difference in strength and flexibility between muscle groups acting on the same joint, that is, when a particular muscular group presents stronger and more tensioned than its respective antagonist [13,24].

Regarding risk habits for postural alterations, morphology and growth velocity are indicated as influencing factors in the appearance of lateral alterations, so that ectomorphic children and adolescents and those with a higher growth peak velocity are more susceptible to such postural changes [26,27].

Several authors have studied the inadequate postures of children and adolescents in daily life, but did not perform a study of the association between these postures and postural alterations [5,28]. Detsch and Candotti [11] report that the habit of watching television for 10 hours or more was associated with the presence of postural alterations in the sagittal plane, although the same did not occur with the posture seated

in the college. In addition, it should be noted that, when analyzing specifically the inadequate postures assumed during the sitting posture habit, it was observed that for all the inappropriate postures there is a tendency of young people to assume a flexor trunk pattern.

Another relevant aspect regarding posture is the postural habit of sleeping. According to Vasconcelos et al. [29], ventral decubitus is the position adopted at sleep that causes a higher incidence of postural alterations in the sagittal plane, and that scoliosis was more prevalent in the subjects who adopted the dorsal decubitus position. Despite this, there was no association between postural changes and the position used for sleep [30], while other authors relate sleeping postures with spinal pain [13,31]. Most of the participants in our study (42.1%) sleep in the lateral position, where if there is no adequate support system can generate postural changes [30,32]. Nevertheless, it seems that adequate sleep time (approximately eight hours) can be considered a protective factor for the development of postural alterations [31].

Another object of study as a risk factor in postural changes is the practice of physical activity, where 68.4% reported regular practice of physical activity, 46.2% practice 1-2 days per week and another 46.2% do it 3-4 times a week, indicating one of the aspects recommended by the World Health Organization (WHO, [14]), that young people present a level of physical activity weekly.

Regarding the distribution of plantar pressures and the maximum pressure point, 42.1% of individuals presented the highest-pressure area mainly at the heels and the 63.2% prevalence of foot cavus in the individuals evaluated through baropodometry is high. Several studies indicate this same result, with a prevalence of foot cavus and greater pressure in the calcaneus [33-35].

This high prevalence of postural deviations, both lateral and anteroposterior, in the present study, the results obtained by other authors report a prevalence of around 70% for postural changes in children and adolescents [11,36,37].

Conclusion

Several aspects related to the postural postures and habits of the children are determinant for the musculoskeletal development, especially in the period of osteoarticular growth, when the equilibrium search for the new proportions of the body occurs [7]. Appropriate and inadequate patterns of posture begin to be determined in childhood, are practiced in adolescence and soon become habitual.

Several studies carried out in Portugal corroborate the high prevalence of postural changes in students, finding that there is a high prevalence of spinal alterations as postural habits related to low back pain [5,8,37,38].

The variation in the results of these studies may possibly be due to the differences in the age groups of the samples and to the different methodologies used, isolated or combined, for postural evaluation. Despite the differences between the prevalence indicated, all the studies show a worrying reality regarding the health of children and adolescents. These literature data corroborate the findings of the present study, since all had high rates of prevalence of postural changes. In addition, the two studies investigating changes in planes separately pointed to the existence of changes in the sagittal plane more frequently.

This descriptive study aimed to identify postural deviations present in 2nd cycle students, be they physiological or compensatory. In view of the complexity of the subject, this research had some limitations (eg. reduced sample size) but could open the way to new discoveries and more in-depth studies in the field of Physiotherapy.

The results of the study may be useful for future research and help in the development of intervention programs related to postural education and school health exercise programs to prevent or treat early changes / deviations.

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References

1. Braccialli L, Vilarta R (2000) Aspetos a serem considerados na elaboração de programas de prevenção e orientação de problemas posturais, Rev Paul Educ Fis 16-18.
2. De Vitta A, Martinez MG, Piza NT, Simeão SF, Ferreira NP (2011) Prevalence of lower back pain and associated factors in students. Cad Saude Publica 27: 1520-1528.
3. Lis AM, Black KM, Korn H, Nordin M (2007) Association between sitting and occupational LBP. Eur Spine J 16: 283-298.
4. Guedes D, Guedes J, Barbosa D, De Oliveira J (2001) Levels of regular physical activity in adolescents. Rev Bras Med Esporte 187-199.
5. Widhe T (2001) Spine: Posture, mobility and pain. A longitudinal study from childhood to adolescence. Eur Spine J 10: 118-123.
6. Prins Y, Crous L, Louw QA (2008) A systematic review of posture and psychosocial factors as contributors to upper quadrant musculoskeletal pain in children and adolescents. Physiother Theory Pract 24: 221-242.
7. Penha PJ, João SM, Casarotto RA, Amino CJ, Penteado DC (2005) Postural assessment of girls between 7 and 10 years of age. Clinics 60: 9-16.
8. Minghelli B, Oliveira R, Nunes C (2014) Non-specific low back pain in adolescents from the south of Portugal: prevalence and associated factors. J Orthop Sci 19: 883-892.
9. Grimmer K, Dansie B, Milanese S, Pirunsan U, Trott P (2002) Adolescent standing postural response to backpack loads: a randomised controlled experimental study. BMC Musculoskelet Disord 3: 1-10.
10. Kratenová J, Zejglicová K, Malý M, Filipová V (2007) Prevalence and risk factors of poor posture in school children in the Czech Republic. J Sch Health 77: 131-137.
11. Detsch C, Luz A, Candotti C, Oliveira D, Lazaron F, et al. Prevalence of postural changes in high schoolstudents in a city in southern Brazil. Rev Panam Salud Publica 21: 231-238.
12. Lemos AT, Santos FR, Gaya AC (2014) Lumbar hyperlordosis in children and adolescents at a privative school in southern Brazil: Occurrence and associated factors. Cad Saude Publica 28: 781-788.
13. Desouzart G, Filgueiras E, Matos R, Dagge R (2016) Postural education: Correlation between postural habits and musculoskeletal pain in school age, in advances in ergonomics in design in Proceedings of the AHFE 2016 International Conference on Ergonomics in Design, July 27-31, 2016, Walt Disney World®, Florida, 2016.
14. WHO (2011) Global Recommendations on Physical Activity for Health: World Health Organization.
15. Ferreira E, Duarte M, Maldonado E, Burke T, Marques A (2010) Postural Assessment Software (PAS/SAPO): Validation and Reliabiliy. Clinics 675-681.
16. Sousa F, Silva J (2005) The metric of pain: Theoretical and methodological issues. Pain 6: 469-513.
17. Noll M, Candotti C, Vieira A, Loss J (2013) Back pain and body posture evaluation instrument (BackPEI): Development, content validation and reproducibility. Int J Public Health 58: 565.
18. Viester L, Verhagen EA, Oude Hengel KM, Koppes LL, Van Der Beek AJ, et al. (2013) The relation between body mass index and musculoskeletal symptoms in the working population. BMC Musculoskelet Disord 14: 238.
19. Desouzart G, Filgueiras E, Matos R, Marques A (2016) Relationship between BMI, regular physical activity and musculoskeletal back pain indication in college students, in Occupational Safety and Hygiene IV, CRC Press 545-548.

20. Braz R, Goes F, Carvalho G (2008) Confiabilidade e validade de medidas angulares por meio do software para avaliação postural. FisioterMov 21: 117-126.

21. Sacco I, Melo M, Rojas G, Naki I, Burgi K, et al. (2003) Biomechanical and kinesiological study of postures trough digital photographs: cases report. R BrasCi e Mov 11: 25-33.

22. Rodrigues L, Fernandes M, Barros J, Shimano A, Moreira F, et al. (2003) Utilização da técnica de Mire para detectar alterações posturais. RevFisioterUniv São Paulo 10: 16-23.

23. Ries L, Martinello M, Medeiros M, Cardoso M, Santos G (2012) Os efeitos de diferentes pesos de mochila no alinhamento postural de crianças em idade escolar. Motricidade 8: 87-95.

24. Limon S, Valinsky LJ, Ben-Shalom Y (2004) Children at risk: Risk factors for low back pain in the elementary school environment. Spine 29: 697-702.

25. Weis G, Ul M (1994) Dinamizando a prática do exame biométrico: cuidados necessários a uma postura correta. Rev Professor 40: 36-44.

26. Le-Blanc R, Labelle H, Rivard CH, Poitras B (1997) Relation between adolescent idiopathic scoliosis and morphologic somatotypes. Spine 22: 2532-2536.

27. Ylikoski M (2003) Height of girls with adolescent idiopathic scoliosis. Eur Spine J 12: 288-291.

28. Cardon G, De Clercq D, De Bourdeaudhuij I, Breithecker D (2004) Sitting habits in elementary schoolchildren: a traditional versus a moving school. Patient EducCouns. Patient EducCouns 54: 133-142.

29. Vasconcelos G, Fernandes P, Oliveira D, Cabral E, Silva L (2010) Postural evaluation of vertebral column in deaf schoolkids from 7 to 21 years old. Fisioter Mov 23: 371-380.

30. Haex B (2005) Back and Bed: Ergonomic Aspects of Sleeping, London: Routledge: Taylor & Francis Group.

31. Auvinen JP, Tammelin TH, Taimela SP, Zitting PJ, Järvelin MR (2010) Is insufficient quantity and quality of sleep arisk factor for neck, shoulder and low back pain? A longitudinalstudy among adolescents. Eur Spine J 19: 641-649.

32. Desouzart G, Matos R, Melo F, Filgueiras E (2016) Effects of sleeping position on the back pain in physically active seniors: A controlled pilot study. Work 53: 235-240.

33. Riddiford-Harland DL, Steele JR, Storlien LH (2000) Does obesity influence foot structure in prepubescent children?. Int J Obes 24: 541-544.

34. Echarri J, Forriol F (2003) The development in footprint morphology in 1851 Congolese children from urban and rural areas, and the relationship between this and wearing shoes. J PediatrOrthop B 12: 141-146.

35. Pfeiffer M, Kotz R, Ledl T, Hauser G, Sluga M (2006) Prevalence of flat foot in preschool-aged children. Pediatrics 118: 634-639.

36. Santos C, Cunha A, Braga V, Saad I, Ribeiro M, et al. (2009) Occurrence of postural deviations in children of a school of Jaguariúna, São Paulo, Brazil. Rev Paul Pediatr 27: 74-80.

37. Ruivo RM, Pezarat-Correia P, Carita AI (2014) Cervical and shoulder postural assessment of adolescents between 15 and 17 years old and association with upper quadrant pain. Braz J Phys Ther 18: 364-371.

38. Trigueiro MJ, Massada L, Garganta R (2012) Back pain in Portuguese schoolchildren: Prevalence and risk factors. Europ J Public Health 23: 499-503.