Postural deviations of students in Southern Brazil

Desvios posturais em escolares de uma cidade do Sul do Brasil

Desvíos posturales en escolares de una ciudad del sur de Brasil

Rita de Cássia de S. Bueno[1], Ricardo Rodrigo Rech[2]

ABSTRACT

Objective: To verify the prevalence of trunk postural deviations (lumbar hyperlordosis, dorsal kyphosis, and scoliosis) in scholars aged eight to 15 years-old from the city schools of Caxias do Sul, Southern Brazil.

Method: A total of 864 students were evaluated in a cross-sectional study. The variables studied were trunk postural rating by visual inspection; body mass index (weight and height); backpack weight on digital scale and how students used to carry the school supplies (questionnaire); gender; and age. Descriptive and bivariate statistics (prevalence ratio and confidence interval) were applied.

Results: The prevalence of postural deviations was 16.6% for dorsal kyphosis, 27.9% for lumbar hyperlordosis, and 33.2% for scoliosis. The ages of eight to 12 years-old were a risk factor for lumbar hyperlordosis, tripling the chances of this outcome (3.41 prevalence ratio). The same age was a protective factor for dorsal kyphosis. Scholars of this age group presented 52% less chances for dorsal kyphosis. The female gender had 47% less chances of having dorsal kyphosis than males. Scoliotic attitude did not show significant association with the independent variables.

Conclusions: These findings confirm the need for interventions by health and education professionals, seeking to correct bad postural habits, which could in the future cause irreversible damages.

Key-words: school health; adolescent health; spine; posture.

RESUMO

Objetivo: Verificar a prevalência de desvios posturais do tronco (hiperlordose lombar, hipercifose dorsal e escoliose) em escolares de oito a 15 anos da rede municipal de ensino de Caxias do Sul, Rio Grande do Sul, Brasil.

Método: Avaliaram-se 864 estudantes, por meio de um estudo transversal. As variáveis estudadas foram análise postural do tronco por inspeção visual; índice de massa corpórea (peso e altura); peso da mochila (balança digital); a forma como os escolares transportavam o material escolar (questionário); sexo e idade. Foi utilizada estatística descritiva e bivariada, representada por razão de prevalência e intervalo de confiança.

Resultados: As prevalências de desvios posturais observadas foram de 16,6% para hipercifose dorsal, 27,9% para hiperlordose lombar e 33,2% para atitude escoliótica. A idade de oito a 12 anos apresentou-se como fator de risco para hiperlordose lombar. Os escolares pertencentes a tal faixa etária demonstraram 3,41 vezes mais chance de ter o desfecho em questão. Para a hipercifose dorsal, a mesma idade mostrou-se como fator de proteção. Os estudantes 8-12 anos tiveram 52% menos chances de desenvolver hipercifose dorsal. O sexo feminino apresentou 47% menos chances de ter hipercifose dorsal em relação ao masculino. A atitude escoliótica não apresentou associação significativa com as variáveis independentes.

Conclusões: Os achados confirmam a necessidade de intervenções por parte dos profissionais de saúde e educação, buscando corrigir hábitos inadequados de postura corporal, os quais, com o tempo, podem se agravar e causar danos irreversíveis.

Palavras-chave: saúde escolar; saúde do adolescente; coluna vertebral; postura.

Instituição: Universidade de Caxias do Sul (UCS), Caxias do Sul, RS, Brasil
[1]Licenciada em Educação Física pela UCS, Caxias do Sul, RS, Brasil
[2]Doutorando do Programa de Pós-Graduação em Ciências da Saúde da Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA); Professor do Curso de Educação Física da UCS, Porto Alegre, RS, Brasil

Endereço para correspondência:
Rita de Cássia Souza Bueno
Rua João Novello, 95 – Castelo
CEP 95058-240 – Caxias do Sul/RS
E-mail: ritabuenno@yahoo.com.br

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RESUMEN

Objetivo: Verificar la prevalencia de desvíos posturales del tronco (hiperlordosis lumbar, hipercifosis dorsal y escoliosis) en escolares de ocho a 15 años de la red municipal de enseñanza de Caxias do Sul, Rio Grande do Sul, Brasil.

Método: Se evaluaron 864 estudiantes mediante un estudio transversal. Las variables analizadas fueron evaluación postural del tronco por inspección visual; índice de masa corporal (peso y altura); peso de la mochila (balanza digital); la forma cómo los escolares transportaban el material escolar (cuestionario); sexo y edad. Se utilizó estadística descriptiva y bivariada, que fue representada en razón de prevalencia e intervalo de confianza.

Resultados: Las prevalencias de desviaciones posturales observadas fueron de 16,6% para la hipercifosis dorsal, 27,9% para la hiperlordosis lumbar y 33,2% para la actitud escoliótica. La edad de ocho a 12 años se presentó como factor de riesgo para hiperlordosis lumbar. Los escolares pertenecientes a esa franja de edad demostraron más que el triple de chances de tener el desfecho en cuestión (razón de prevalencia igual a 3,41). Para la hipercifosis dorsal, la misma edad se mostró como factor de protección. Los estudiantes de la misma franja de edad tuvieron el 52% menos posibilidades de desarrollar hipercifosis dorsal (razón de prevalencia igual a 0,48). El sexo femenino presentó el 47% menos posibilidades de tener hipercifosis dorsal respecto al masculino (razón de prevalencia igual a 0,53). La actitud escoliótica no presentó asociación significativa con las variables independientes.

Conclusiones: Los hallazgos confirman la necesidad de intervenciones por parte de los profesionales de salud y educación, buscando corregir hábitos inadecuados de postura corporal, los que con el tiempo pueden agravarse y causar daños irreversibles.

Palabras clave: salud escolar; salud del adolescente; columna vertebral; postura.

Introduction

Postural changes are prevalent problems in the adult population that also commonly affect children and adolescents[1]. Postural deviations assessed in epidemiological studies are usually anteroposterior changes (scoliotic attitude), dorsal kiphosis, and lumbar hyperlordosis[1-3]. Bad posture may be related to muscle and emotional issues, which could generate positional or structural deviations if the individual remains in inappropriate positions for a long time[4]. Among the main factors associated with postural changes and back pain in schoolchildren, the following should be mentioned: gender (depending on the deviation to be assessed)[1-5], body composition, time spent watching television, and socioeconomic status[2].

Some investigations have found an association of the way students carry their school backpack and its total weight (below or above 10% of total body weight) with back and shoulder pain[6-8]; however, its influence on postural changes in children and adolescents has not been elucidated.

With this in mind, the aim of the present study was to verify the prevalence of trunk postural deviations (lumbar hyperlordosis, dorsal kyphosis, and scoliosis) in schoolchildren aged eight to 15 years-old and its association with backpack weight and the way children and adolescents carry it.

Method

This was an epidemiological cross-sectional study of schoolchildren from four municipal public schools of a city in Southern Brazil, using a sample of 864 students of both genders aged between eight and 15 years. Data collection was conducted from August to October 2010.

The population of enrolled students aged between eight and 15 years in 2009 in the city of Caxias do Sul, state of Rio Grande do Sul, Brazil, was 40,140. Sample size was calculated using a mean prevalence of the outcomes (trunk postural deviations) of 20%, according to the mean found in analogous studies[1-3], considering a 95% confidence interval (95% CI), an 80% power, and a 3% standard error. The minimum number calculated was 672 children. Anticipating possible losses and refusals and in order to better control confounding factors, a design effect of 1.3 was applied. Thus, the target sample would be 874 children. This calculation was performed using the Epi-Info 6.0 statistical software (Atlanta, USA).

The four schools that participated in the present study were selected due to their geographical positions in the city, with each of them located in a different region of the municipality. All schoolchildren of the predetermined age group were invited to participate in the study; however, the analysis included only those who had returned the free and informed consent form (FICF) signed by parents or guardians and who volunteered for the study.

Postural deviations were evaluated as proposed by Santos[9], by visual inspection, in which subjects remain in the standing position, in their natural posture, in front of a wall or a large white surface, looking at the horizon, and with arms aligned with their bodies. The analysis considered anterior, lateral and posterior views.

In addition to postural assessment, other variables were examined: total body mass, height, gender, age, weight of school supplies, and how they were carried. In order to evaluate this last variable, participants were shown a poster including pictures of different ways of carrying school supplies and were asked to point out the picture corresponding to the way they used to carry their supplies. Data were collected through a structured interview covering the mentioned items, as well as postural assessment and anthropometric measurements.

Table 1 - Prevalence of postural deviations in the study population

	n	%
Trunk: lateral dorsal view		
Normal	691	80
Kyphosis	143	16.6
Rectified	30	3.5
Trunk: lateral lumbar view		
Normal	590	68.3
Hyperlordosis	241	27.9
Rectified	31	3.6
Inversion	2	0.2
Trunk: anterior and posterior views		
Normal	577	66.8
S- shaped scoliosis	103	11.9
C-shaped scoliosis	184	21.3
Schoolchildren without postural deviations	20	2.3
Schoolchildren with at least one postural deviation	844	97.7

Total body mass and weight of school supplies were measured with a G-Life portable digital scale with 180kg capacity and 0.1kg accuracy. Height was measured using a Sanny wall-mounted measuring tape and a set square. Body mass index (BMI) was obtained by dividing body mass by height squared (BMI=weight/height^2). Anthropometric measurements were employed to characterize the sample.

The evaluation team comprised eight trained evaluators (Physical Education teachers, physical therapists, and Physical Education and Physical Therapy students). Three training sessions were conducted with these professionals to standardize postural assessment, and one session was conducted for the remaining variables (anthropometry and interview). Additionally, evaluators received an evaluator handbook. After these two events, a pilot study was carried out with 15 children who did not participate in the study in order to verify logistical issues of the project, such as: verification of the language used in the questionnaire, sequence of evaluation, and standardization of measurements.

Data were analyzed by the Statistical Package for Social Sciences (SPSS) statistical package, version 18.0. Initially, a descriptive analysis was performed, followed by a bivariate analysis (Pearson's chi-square test) between independent variables and outcome (postural deviations), described as prevalence ratio (PR) and 95% CI. Significance level was set at 5%.

The research project was submitted to the Research Ethics Committee of Fundação Universidade de Caxias do Sul (CEP-FUCS) and approved under protocol number 392/10. All schoolchildren who participated in the study provided the

Table 2 - Distribution of the outcomes according to age in girls

	Trunk: lateral view (dorsal)			Trunk: lateral view (lumbar)			Trunk: anterior and posterior views		
Age	Normal	Kyphosis	Rectification	Normal	Hyperlordosis	Rectification	Normal	Hyperlordosis	Rectification
8	65 (18.3%)	14 (26.9%)	2 (12.5%)	42 (14.8%)	39 (31.0%)	–	42 (14.8%)	39 (31.0%)	–
9	67 (18.9%)	8 (15.4%)	2 (12.5%)	44 (15.5%)	28 (22.2%)	4 (30.8%)	44 (15.5%)	28 (22.2%)	4 (30.8%)
10	50 (14.1%)	7 (13.5%)	4 (25.0%)	35 (12.4%)	24 (19.0%)	2 (15.4%)	35 (12.4%)	24 (19.0%)	2 (15.4%)
11	51 (14.4%)	3 (5.8%)	3 (18.8%)	44 (15.5%)	11 (8.7%)	2 (15.4%)	44 (15.5%)	11 (8.7%)	2 (15.4%)
12	39 (11.0%)	7 (13.5%)	2 (12.5%)	36 (12.7%)	9 (7.1%)	3 (23.1%)	36 (12.7%)	9 (7.1%)	3 (23.1%)
13	35 (9.9%)	6 (11.5%)	1 (6.3%)	34 (12.0%)	6 (4.8%)	2 (15.4%)	34 (12.0%)	6 (4.8%)	2 (15.4%)
14	37 (10.4%)	5 (9.6%)	1 (6.3%)	39 (13.8%)	4 (3.2%)	–	39 (13.8%)	4 (3.2%)	–
15	11 (3.1%)	2 (3.8%)	1 (6.3%)	9 (3.2%)	5 (4.0%)	–	9 (3.2%)	5 (4.0%)	–

FICF signed by their parents or guardians and voluntarily accepted to participate in the study.

Results

The population of selected students was 908, but 25 children did not provide the FICF signed by their parents and 19 questionnaires had to be excluded due to missing information. The total of losses and refusals was 44 (4.7%), and with this exclusion the final sample resulted in 864 participants. The population was distributed according to gender, with 423 females (49%) and 441 males (51%). Mean values for weight, height, BMI and age were, respectively, 41.8±13.8kg, 1.45±0.13m, 19.2±3.7kg/m^2, and 10.7±2.1 years.

As for backpack weight, 3.2% of schoolchildren carried a very heavy backpack (above 15% of total body mass), 20.7% of them carried a backpack with an acceptable

Table 3 - Distribution of the outcomes according to age in boys

	Trunk: lateral view (dorsal)			Trunk: lateral view (lumbar)			Trunk: anterior and posterior views		
Age	Normal	Kyphosis	Rectification	Normal	Hyperlordosis	Rectification	Normal	Hyperlordosis	Rectification
8	67 (19.9%)	9 (9.9%)	1 (7.1%)	43 (14.0%)	30 (26.1%)	4 (22.2%)	52 (17.5%)	10 (23.3%)	15 (14.9%)
9	65 (19.3%)	13 (14.3%)	4 (28.6%)	48 (15.6%)	33 (28.7%)	1 (5.6%)	47 (15.8%)	13 (30.2%)	22 (21.8%)
10	52 (15.5%)	9 (9.9%)	1 (7.1%)	46 (15.0%)	16 (13.9%)	–	43 (14.5%)	4 (9.3%)	15 (14.9%)
11	42 (12.5%)	12 (13.2%)	4 (28.6%)	44 (14.3%)	12 (10.4%)	2 (11.1%)	42 (14.1%)	4 (9.3%)	12 (11.9%)
12	43 (12.8%)	9 (9.9%)	1 (7.1%)	38 (12.4%)	13 (11.3%)	2 (11.1%)	36 (12.1%)	5 (11.6%)	12 (11.9%)
13	29 (8.6%)	15 (16.5%)	–	33 (10.7%)	6 (5.2%)	4 (22.2%)	34 (11.4%)	–	10 (9.9%)
14	28 (8.3%)	16 (17.6%)	2 (14.3%)	39 (12.7%)	4 (3.5%)	3 (16.7%)	28 (9.4%)	7 (16.3%)	11 (10.9%)
15	10 (3.0%)	8 (8.8%)	1 (7.1%)	16 (5.2%)	1 (9%)	2 (11.1%)	15 (5.1%)	–	4 (4.0%)

Table 4 - Bivariate analysis between postural deviations and independent variables

		Lumbar hyperlordosis	Dorsal kyphosis	Scoliosis
Age				
8 to 12 years	PR	3.41*	0.48*	1.02
	(CI)	(2.19–5.31)	(0.32–0.70)	(0.73–1.42)
13 to 15 years		Reference	Reference	Reference
Gender				
Female	PR	1.20	0.53*	0.94
	(CI)	(0.89–1.62)	(0.37–0.78)	(0.71–1.26)
Male		Reference	Reference	Reference
Backpack weight				
Up to 15% of body weight	PR	1.16	1.19	0.53
	(CI)	(0.49–2.78)	(0.40–3.50)	(0.21–1.34)
Above 15% of body weight		Reference	Reference	Reference
Type of backpack used				
Two-strap backpack on the back	PR	1.10	0.79	0.85
	(CI)	(0.75–1.61)	(0.51–1.23)	(0.59–1.23)
Other forms of carrying school supplies		Reference	Reference	Reference

*p<0.05; PR: prevalence ratio; CI: confidence interval

weight (10 to 15% of total body mass), and 75.9% of them carried a backpack with an appropriate weight. As for the type of backpack used, 80.7% of subjects used a two-strap backpack attached to their back, while 19.3% of them used other forms of carrying school supplies.

Table 1 shows outcome prevalence in terms of postural deviations. Only 20 children (2.3%) had no postural deviations. Tables 2 and 3 show outcomes by gender and age.

For the purpose of statistical analysis, study variables were divided into dichotomous groups, according to the classification presented in Table 4. It could be observed that gender and age were the only variables that showed statistically significant association with the outcomes. The ages of eight to 12 years were found to be associated with lumbar hyperlordosis. Schoolchildren from this age group were more than three times more likely to have this outcome (PR=3.41). The same age was a protective factor for dorsal kyphosis, since students of this age group presented 52% less chance for dorsal kyphosis (PR=0.48) than those aged 13 to 15 years old. The female gender had 47% less chances of having dorsal kyphosis than males (PR=0.53). Scoliotic attitude did not show significant association ($p>0.05$) with the independent variables. Backpack weight, type of backpack used, and nutritional status did not show statistically significant association with the outcomes.

Discussion

The overall prevalence of postural deviations of the spine found in this study was 97.7%. In the city of São Leopoldo, state of Rio Grande do Sul, Brazil, Detsch *et al*[2] found a prevalence of 66% for lateral trunk changes and 70% for anteroposterior trunk changes. Another study conducted in Florianópolis, state of Santa Catarina, Brazil, showed a 53.8% prevalence of postural deviations in schoolchildren[1]. The difference between the results of the investigations may be attributed to the different evaluation criteria used in the presented studies (photograph and plumbline[2], and photometry[1]) and in the present study.

The most prevalent deviation observed in this study was scoliosis (33.2%), followed by lumbar hyperlordosis (27.9%) and dorsal kyphosis (16.6%). A study conducted in the Southwestern region of the state of Bahia, Brazil[10], found scoliosis (69.6%), kyphosis (30.5%) and hyperlordosis (17.4%). Another research conducted in the city of Ribeirão Preto, state of São Paulo, Brazil, observed postural changes in 378 schoolchildren aged six to 14 years-old and identified 23.5% of suspected cases of scoliosis[11]. However, a study conducted in Turkey with more than 4,000 children found a 2.5% prevalence of scoliosis[5]. Regardless of the site where postural changes are assessed in schoolchildren, scoliotic attitude is present, and screening studies of this deviation could be highly cost-effective[5].

In this study, lumbar hyperlordosis showed higher prevalence among children aged between eight to 12 years-old (PR=3.41). This change is more frequent in this age group because after the age of nine years it is no longer defined as a change related to development and begins to be considered pathological and should be treated, in order to prevent more severe problems[12].

Dorsal kyphosis is present to a lesser extent in the same age group. Tribastone[13] reported that the children less affected by kyphosis are those experiencing the growth spurt, which occurs between 12 and 16 years for girls and between 13 and 17 for boys. In the same age group (8 to 12 years), girls had a higher percentage of this deviation than boys.

In this study, the female gender had 47% less chance of having dorsal kyphosis than males (PR=0.53). In both genders, schoolchildren aged between 8 and 12 years-old had 52% less chance for dorsal kyphosis than those aged 13 to 15 years-old. A possible explanation for this aspect may be the fact that adolescents experience changes in posture, due to hormonal alterations in the beginning of puberty and to musculoskeletal development.

The type of backpack used by students did not show significant statistical association with postural deviations of the spine. More than 80% of subjects reported to use a two-strap backpack attached to their back, which is the most recommended way of carrying it, due to the better distribution of the weight of the school supplies on student's trunk. The other ways of carrying then usually lead to unilateral overload[14] and may result in the onset of back pain[6]. Evidence points out that positioning the school backpack at the waist level would be the most recommended position to prevent postural displacements[15].

Backpack weight above the recommended range was also not statistically associated with postural changes, since only 3.2% of schoolchildren carried backpacks with inappropriate weight. Some investigations found an statistical association between backpack weight and postural changes[16-18]; however, other authors consider that there is not enough scientific evidence yet to support the argument that backpack load contributes to the development of pain or spinal problems in children and adolescents. In addition to backpack weight, other variables, such as time spent in physical activities, student's health status, and the fact of climbing stairs or not with school supplies, could help to explain these issues(7-8).

The present study showed some limitations. Firstly, it is worth to emphasize that it was a cross-sectional study and, as such, could not establish a causal relationship between variables. Another issue to be considered is the fact that postural assessments were conducted by different evaluators, which could have produced measurement bias, since an objective analysis was not performed. In order to minimize this bias, three training sessions were conducted with the evaluators, who also received an evaluator handbook, and a pilot study was carried out.

Considering the limitations of the study, it can be said that the prevalence of postural deviations was found to be high. In this study, both backpack weight and the type of backpack used by children were not associated with postural deviations. Actions aiming to evaluate students' postures are extremely important, because they can interfere with the development process of possible anomalies through early corrective interventions. Based on that, it is important to point out the need for healthcare professionals to be committed in the search to identify possible postural problems during prevention and health promotion actions. It is suggested to conduct new studies with longitudinal design and to include new variables, such as regular physical activity and climbing stairs or not with school supplies, in order to improve the analysis.

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