

BACK PAIN AND THE POSTURAL AND BEHAVIORAL HABITS OF STUDENTS IN THE MUNICIPAL SCHOOL NETWORK OF TEUTÔNIA, RIO GRANDE DO SUL

Matias Noll¹, Cláudia Tarragô Candotti², Bruna Nichele da Rosa³,
Maira Cristina Wolf Schoenell⁴, Carlos Leandro Tiggemann⁵, Jefferson Fagundes Loss⁶

Abstract

Objectives: to investigate the prevalence of back pain during a prior three-month period; to identify postural and behavioral habits; to assess whether a relationship exists between back pain and the postural and behavioral habits of elementary school students in the municipal school network in the city of Teutônia, Rio Grande do Sul (RS). **Methods:** this was an epidemiological population study in which 833 5th to 8th grade students from schools in the municipal school network in Teutônia participated. The students completed a Back Pain and Body Posture Evaluation Instrument (BackPEI) questionnaire that assessed back pain and postural and behavioral habits. The analysis was performed using descriptive statistics, calculating prevalence ratios (PR) and confidence intervals at the 95% level. The dependent variable was back pain, and the independent variables were postural and behavioral habits. The PR was calculated using a multivariate analysis with robust variance ($\alpha = 0.05$). **Results:** the prevalence of back pain in the previous three months was 54.1%. The majority of students reported feeling pain once per month, and 17.4% of the students reported that pain impaired their performance of daily activities. The multivariate analysis showed a correlation between back pain and time spent per day watching television ($p = 0.046$), sleeping posture ($p = 0.048$) and sitting down to write ($p = 0.032$). **Conclusions:** these results demonstrate a high prevalence of back pain in schoolchildren, suggesting an urgent need to develop educational and preventative programs in schools.

Key words: back pain; posture; adolescent health; epidemiology.

INTRODUCTION

Back pain is a common occurrence in young students¹⁻³, reaching a prevalence of over 60%⁴⁻⁶, and it is a phenomenon that has been reported in several countries⁷. There are many risk factors that predispose students to back pain, including gender^{3,8,9}, age⁹⁻¹¹, intense and competitive physical exercise^{3,12,13}, abdominal force and resistance¹⁴, flexibility¹⁵, smoking^{12,15}, being overweight^{5,16}, psychosocial factors such as depression and anxiety^{17,18}, family history of back pain^{13,19} and postural habits²⁰⁻²³. With regard to postural habits, it has been shown that the use of heavy backpacks

and carrying them in an asymmetrical manner; the length of time in a seated position^{9,12}; and the amount time spent per day watching television²⁴, using the computer and playing video games^{13,25,26} represent important risk factors for back pain in schoolchildren.

Given that the postures adopted in activities of daily living (ADLs) (1) determine the amount and distribution of stress on the musculoskeletal system and may exacerbate or alleviate the harm and loads imposed on these structures²⁷ and (2) have important implications for human health and welfare²⁸⁻³⁰, it is speculated that the back pain reported by students¹⁻³ may be associated with the

- 1 Mestre em Ciências do Movimento Humano pelo Programa de Pós-Graduação em Ciências do Movimento Humano da Escola de Educação Física da Universidade Federal do Rio Grande do Sul (ESEF/UFRGS). Porto Alegre, RS, Brasil.
- 2 Doutora em Ciências do Movimento Humano pelo Programa de Pós-Graduação em Ciências do Movimento Humano da Escola de Educação Física da Universidade Federal do Rio Grande do Sul (ESEF/UFRGS) e professora do curso de Fisioterapia e Educação Física desta Instituição. Porto Alegre, RS, Brasil.
- 3 Acadêmica do Curso de Fisioterapia da Escola de Educação Física da Universidade Federal do Rio Grande do Sul (ESEF/UFRGS). Porto Alegre, RS, Brasil.
- 4 Mestre em Ciências do Movimento Humano pelo Programa de Pós-Graduação em Ciências do Movimento Humano da Escola de Educação Física da Universidade Federal do Rio Grande do Sul (ESEF/UFRGS). Porto Alegre, RS, Brasil.
- 5 Doutorando em Ciências do Movimento Humano pelo Programa de Pós-Graduação em Ciências do Movimento Humano da Escola de Educação Física da Universidade Federal do Rio Grande do Sul (ESEF/UFRGS). Porto Alegre, RS, Brasil.
- 6 Doutor em Engenharia Mecânica pela Universidade Federal do Rio Grande do Sul e professor do curso de Fisioterapia, Educação Física e Enfermagem e do Programa de Pós-Graduação em Ciência do Movimento Humano (Mestrado e Doutorado) desta instituição. Porto Alegre, RS, Brasil.

Corresponding Author: matiasnoll@yahoo.com.br

Suggested citation: Noll M, et al. Back pain and the postural and behavioral habits of students in the municipal school network of Teutônia, Rio Grande do Sul; Journal of Human Growth and Development 2013; 23(2): 129-135
Manuscript submitted Aug 01 2012, accepted for publication Aug 19 2012.

adoption of inadequate postural habits during ADLs²³. An example of an inadequate postural habit is related to the long hours that students remain seated, usually with inadequate posture²⁵. It is understood that the back pain arising from improper use of the body in ADLs develops over several years, starting in the school phase and extending throughout life, and the pain worsens to the extent that inactivity has become prevalent in modern society.

Despite being widespread in the literature, the risk factors for back pain are still controversial⁹, and research is still in its early stages, specifically regarding pain related to postural habits and the specific postures adopted by students on a daily basis, such as sitting to write and to use the computer. Thus, the objectives of the present study were to identify the following: (1) the prevalence of back pain in a previous three-month period, (2) the behavioral and postural habits and (3) the existence of an association between back pain and the behavioral and postural habits of elementary school students in the municipal school network of Teutônia, Rio Grande do Sul (RS), Brazil.

METHODS

This was an epidemiological cross-sectional study that was conducted in August and September 2011. All 859 elementary school students from the 5th to 8th grades in all schools (n = 6) in the municipal school network of Teutônia, RS, Brazil, were invited to participate. The study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul (Universidade Federal do Rio Grande do Sul - UFRGS), number 19832, and complied with Resolution 196/96 of the National Health Council (Conselho Nacional de Saúde - CNS).

INSTRUMENTS

To determine the prevalence of back pain and to identify students' behavioral and postural habits, a self-administered questionnaire, the *Back Pain and Body Posture Evaluation Instrument* (BackPEI), was used. This questionnaire is a valid and reproducible instrument consisting of 21 closed questions with different versions for males and females³¹. The questionnaire addresses issues such as the following: (1) back pain in the last three months (occurrence, frequency and intensity), (2) demographics (age and gender), (3) socioeconomic status (educational level of parents/guardians and school type); (4) behavioral factors (physical activity, reading/studying in bed, hours/day watching television and at the computer, hours of sleep per night), (5) postural factors (manner of sitting to write and to use the computer, means and manner of carrying school materials, manner of sleeping and manner of sitting on a bench) and

(6) hereditary factors (occurrence of back pain in parents). In the present study, only questions 4-14, which relate to behavioral and postural habits, and questions 18 to 20, which relate to back pain, were used.

Procedure for data collection and analysis

All schools were invited to participate in the study during a meeting with the City Department of Education (Secretaria Municipal de Educação - SME/Teutônia), where the study objectives and collection procedures were explained. After the consent of the SME/Teutônia was granted, a meeting was scheduled with the board of each school to present the research project³². Once all necessary consents were granted, a date was chosen to conduct the evaluations according to the schedule of the 5th to 8th grade elementary schools of Teutônia. The researcher responsible for the administration of the questionnaires evaluated each class individually in its own classroom. The researcher explained to the group how the questionnaire should be filled out before distributing them to the students. The questionnaires were completed individually. The researcher remained in the room during the completion of the questionnaires, which took an average of 20 minutes, and collected all questionnaires when all the students had finished³².

The data were analyzed using the *Statistical Package for the Social Sciences* (SPSS), version 18.0, using descriptive statistics and calculation of prevalence ratios (PR) and their respective 95% confidence intervals (95%CI). The dependent variable was back pain, and the independent variables were behavioral habits (number of hours per day watching television, using the computer and sleeping; habit of reading or studying in bed; physical exercise) and postural habits (means and manner of carrying a backpack; posture adopted for sleeping; sitting posture adopted when using the computer, talking and writing; posture adopted when picking something up from the floor). The PRs were calculated using multivariate analysis based on the Poisson regression model with robust variance³³ ($\alpha = 0.05$).

RESULTS

Of the total number of students in 5th to 8th grade in elementary schools within the municipal school network in Teutônia (n = 859), only 3% (n = 26) refused to participate in this study and/or did not attend school on the day of the assessment. Thus, 833 schoolchildren participated in the study. Of these participants, 89.2% (n = 743) gave clear answers regarding whether pain had occurred in the previous three months.

The prevalence of back pain in the previous three months was 54.1% (n = 402). The results differed between male and female students, and the

percentages of pain occurrence were 48.7% (n = 191) for males and 60.1% (n = 211) for females.

Regarding the frequency of pain (a question that was answered only by students who reported feeling pain), the results showed that most of the students reported feeling pain only once in the previous three months or at a frequency of once a

month. The results also showed that 17.4% of the students reported that back pain prevented them from performing activities of daily life, such as playing, studying and participating in sports. Table 1 presents the descriptive data for both genders for the frequency of back pain and impairment in performing activities of daily living.

Table 1: Results of the frequency of back pain in the previous three months and impairment in performing activities of daily living for students of both genders from elementary schools of the municipal school network in Teutônia, RS, Brazil (2011)

Variable	Male n (%)	Female n (%)	Total n (%)
Frequency			
Only once	68 (38.2)	62 (31)	130 (34.1)
Once per month	67 (37.6)	91 (45.5)	158 (41.8)
Once per week	17 (9.6)	21 (10.5)	38 (10.1)
2-3 times per week	14 (7.9)	18 (9)	32 (8.5)
4 times or more per week	12 (6.7)	8 (4)	20 (5.3)
Impairment in performing activities of daily living			
Yes	20 (10.5)	50 (23.7)	70 (17.4)
No	165 (86.5)	155 (73.5)	320 (79.6)
Did not know how to answer	6 (3.1)	6 (2.8)	12 (3)

The results from the multivariate analysis referring to postural and behavioral habits showed that back pain is associated with the following

variables: time spent per day watching television, posture adopted for sleeping and being seated while writing (Table 2).

Table 2: Results of the correlation and prevalence ratio between back pain and the postural and behavioral variables of elementary school students in the municipal school network of the city of Teutônia, RS, Brazil (2011)

Variables	Nº (%)	Back pain Nº (%)	χ^2^a	Prevalence Ratio (95%CI)
Behavioral Habits				
Time spent watching television per day (n = 629)				
0-1 hour per day	96 (15.3)	47 (49.0)	0.046 ^b	1
2-3 hours per day	246 (39.1)	123 (50.0)		1 (0.93 to 1.09)
4-5 hours per day	149 (23.7)	85 (57.0)		1.05 (0.97 to 1.15)
6 or more hours per day	138 (21.9)	87 (63)		1.09 (1.01 to 1.19)
Time using the computer per day (n = 571)				
0-1 hour per day	213 (28.7)	118 (55.4)	0.582	1
2-3 hours per day	211 (28.4)	124 (58.8)		1.02 (0.96 to 1.08)
4-5 hours per day	95 (12.8)	54 (56.8)		1.01 (0.93 to 1.09)
6 or more hours per day	52 (7)	25 (48.1)		0.95 (0.86 to 1.05)
Sleep time per night (n = 631)				
0-7 hours per day	204 (32.2)	119 (58.3)	0.273	1
8-9 hours per day	324 (51.3)	178 (54.9)		0.98 (0.93 to 1.03)
10 or more hours per day	103 (16.3)	50 (48.5)		0.94 (0.87 to 1.01)

Variables	Nº (%)	Back pain Nº (%)	χ^2 ^a	Prevalence Ratio (95%CI)
Read and/or study in bed (n = 743)				
No	148 (19.9)	75 (50.7)	0.621	1
Sometimes	369 (49.7)	201 (54.5)		1.02 (0.96 to 1.09)
Yes	226 (30.4)	126 (55.8)		1.03 (0.97 to 1.11)
Postural Habits				
Sleeping posture (n = 693)				
Supine decubitus	62 (8.9)	27 (43.5)	0.048 ^b	1
Lateral decubitus	426 (61.5)	223 (52.3)		1.06 (0.97 to 1.16)
Prone decubitus	205 (29.6)	122 (59.5)		1.11 (1.01 to 1.22)
Sitting posture for writing (n = 743)				
Adequate	130 (17.5)	59 (45.4)	0.032 ^b	1
Inadequate	613 (82.5)	342 (56)		1.07 (1.01 to 1.14)
Sitting posture on a bench (n = 743)				
Adequate	106 (14.3)	51 (48.1)	0.191	1
Inadequate	637 (85.7)	351 (55.1)		1.04 (0.98 to 1.12)
Sitting posture for computer use (n = 743)				
Adequate	166 (22.3)	82 (49.4)	0.173	1
Inadequate	577 (77.7)	320 (55.5)		1.04 (0.98 to 1.11)
Posture to pick object up from the ground (n = 743)				
Adequate	58 (7.8)	36 (62.1)	0.184	1
Inadequate	685 (92.2)	366 (53.4)		0.95 (0.87 to 1.03)
Method of carrying school materials (n = 743)				
School bag with two handles	675 (90.8)	368 (54.5)	0.501	1
School bag with one handle	36 (4.8)	16 (44.4)		0.94 (0.83 to 1.05)
Other carrying means (briefcase, handbag, others)	32 (4.3)	18 (56.3)		1.01 (0.91 to 1.13)
Method of carrying the backpack (n = 672) ^b				
Adequate (symmetrical handles over the shoulders)	607 (90.3)	329 (54.2)	0.672	1
Inadequate (asymmetric)	65 (9.7)	37 (56.9)		1.02 (0.94 to 1.11)

^a Multivariate analysis of each variable in the model. *Wald Chi-Square* test.

^b Statistically significant association of variable in the model (p < 0.05).

^c Only for students to which the variable applies.

DISCUSSION

The results show that the prevalence of back pain in the previous three months (54.1%) was within the 20-70% range reported in the literature⁴⁻⁶. Skoffer⁴, in evaluating the occurrence of pain in 546 students of both genders between 14 and 17 years of age in a town in Denmark, found that 51.3% of the subjects reported having felt pain in the three months prior to the survey; of these subjects, approximately one-quarter (24.2%) reported that this pain resulted in changes in sleeping habits and in seeking specialized medical care. Similar results were found in the present study, in which 17.4% of students reported that back pain prevented them from performing activities of daily living, although there is no knowledge of the outcomes of these situations.

Furthermore, the greater prevalence of pain in females is also in accordance with findings in the literature^{2,3,6,25}. It is speculated that these results are due to the precocity of females and their distinct anatomical and functional features compared to males (shorter height and lower percentage of muscle and bone mass). It has also been reported that women have more social permission to expose

their symptoms and feelings for social and educational reasons^{3,24}.

Regarding the risk factors related to back pain, the results of the multivariate analysis demonstrated an association between back pain and the time spent per day watching television and the posture adopted for sleeping and sitting while writing. It has been documented that students often spend much of their day in sedentary activities, such as sitting for more than 2 hours watching television and using the computer^{6,26}, in addition to the 4-5 hours on average spent seated in the classroom³⁴. From this perspective, it is speculated that over 50% of students remain in a sitting position at least 8 hours per day in a sedentary activity, making it an important risk factor for the occurrence of back pain⁶.

Sleeping position was also significantly associated with the occurrence of back pain among the students of Teutônia. Students who sleep in the prone position have a higher prevalence of back pain. These results are in accordance with the literature³⁵, where it has been reported that it is not advisable to sleep in the prone position, as this position favors increased lumbar lordosis³⁶ and exposes the neck to the limit of its range of motion,

which can cause sprains and cervicalgia³⁶. This position, when adopted as a daily postural habit, can also contribute to an anterior projection of the internal organs and stretching of the abdominal muscles³⁵. Thus, it is recommended that of the three most common sleeping positions (supine, lateral and prone), lateral and supine are the most appropriate positions³⁶.

A significant relationship was found between the occurrence of back pain and inadequate sitting posture for writing. Students who remain seated for long periods throughout the day, much of the time in an inappropriate posture (forward trunk flexion, lack of lumbar support and lack of forearm support), are predisposed to higher levels of general discomfort, such as pain, fatigue and tingling in different parts of the body, and especially degenerative processes, such as disc herniation^{21,22}. Possible explanations for this result may be that the act of sitting generates an increased compressive load on the intervertebral disc and that sitting for a long period may (1) lead to malnutrition of the discs^{5,17} and (2) trigger mechanisms that risk the integrity of the musculoskeletal system, such as an imbalance between the passive, active and neural systems that are responsible for the stability of the lumbopelvic region^{27,28}.

In addition to the high prevalence of back pain, the present study also shows a high prevalence of inadequate postures in performing ADLs, except for the method of carrying school materials. It has been documented that postural education is significantly neglected by most physical education teachers of the 5th to 8th grades of elementary school³⁷, so it is speculated that the negligence in postural education is related to the high prevalence of inadequate postures.

In this context, an interesting option to mitigate the existence of the high prevalence of back pain and inadequate posture in performing ADLs would be a Postural Education Program (PEP)^{38,39} in a school setting as a preventive measure. As evidenced in the literature, the school setting presents various ergonomic problems that adversely affect students' health by causing back pain and postural changes. It has been reported that young PEP participants from different age groups learn to know and identify the spine, its parts and functions, and positively change their posture during ADLs³⁸⁻³⁹. In a systematic review of postural school programs for schoolchildren in Brazil described by Noll, Candotti and Vieira⁴⁰, the studies

showed immediate improvements in the performance of ADLs, demonstrating that students are able to assimilate the content and implement it into their daily lives. Thus, performing a PEP in a school setting may constitute an effective alternative to prevent and correct inadequate postural habits^{1,40}.

A possible limitation of this study is the fact that it is presented as an epidemiological cross-sectional study. Shehab and Jarallah³ suggest that longitudinal epidemiological population studies can better determine the cause and effect of risk factors for back pain. Thus, further studies with a longitudinal design are necessary.

Finally, given that only 3% of the students refused to participate and/or did not attend school on the day of the assessment, it is unlikely that non-participation bias had an effect on the results². Moreover, the results of any study of this nature should not be extrapolated to different contexts because they are influenced by sociocultural, environmental and genetic aspects that are specific to each location, so it is believed that the present study provides scientific evidence at a local level with regard to the prevalence of back pain and the postural habits of students. Because it reveals the local reality, the present study may help to plan public health policies and education for Teutônia, specifically in the context of school health, stimulating actions for the development of PEPs to reverse the trend from a painful childhood to a healthy one.

It may be concluded that in the three months prior to the study, there was a high prevalence of back pain in elementary school students in the municipal school network of Teutônia and that this pain was significantly associated with the time per day spent watching television, the sleeping posture adopted and the posture adopted when sitting to write.

ACKNOWLEDGEMENTS

We would like to thank the Coordination of Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES), the Master's grant and the National Counsel of Technological and Scientific Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq) for granting funds (No: 472544/2011-0; Universal Proclamation 14/2011).

REFERENCES

1. Cardon, G; Clercq, D; Bourdeaudhuij, I. Effects of back care education in elementary schoolchildren. *Acta Paediat (Oslo, Noruega)* v. 89, n. 8, p. 1010-1017, 2000 DOI 10.1111/j.1651-2227.2000.tb00426.x
2. Watson, KD; Papageorgiou, AC; Jones, GT; Taylor, S; Symmons, DPM; Silman, AJ et al. Low back pain in schoolchildren: occurrence and characteristics. *Pain (Seattle, USA)* v. 97, n. 1, p. 87-92, 2002. DOI 10.1016/S0304-3959(02)00008-8
3. Shehab, DK; Jarallah, KF. Nonspecific low-back pain in Kuwaiti children and adolescents: associated factors. *J adolescent Health (Philadelphia, USA)* v. 36, n. 1, p. 32-35, 2005 DOI 10.1016/j.jadohealth.2003.12.011
4. Skoffer, B. Low Back Pain in 15 to 16 year old children in relation to school furniture and carrying of the school bag. *Spine (Philadelphia, USA)* v. 32, n. 24, p. 713-717, 2007 DOI 10.1097/BRS.0b013e31815a5a44
5. Paananen, MV; Taimela, SP; Auvinen, JP; Tammelin, TH; Kantomaa, MT; Ebeling, HE; et al. Risk factors for persistence of multiple musculoskeletal pains in adolescence: A 2-year follow-up study. *Eur J Pain (Londres, Inglaterra)* v. 14, n. 10, p. 1026-1032, 2010 DOI 10.1016/j.ejpain.2010.03.011
6. Martínez-Crespo, G; Rodríguez-Piñero, MD; López-Salguero, AI; Zarco-Periñan, MJ; Ibáñez-Campos, T; Echevarría-Ruiz de Vargas, C. Dolor de espalda en adolescentes: prevalencia y factores asociados. *Rehabilitación (Madrid, Espanha)* v. 43, n. 2, p.72-80, 2009 DOI 10.1016/S0048-7120(09)70773-X
7. Gurgueira, GP; Alexandre, NMC; Corrêa Filho, HR. Prevalência de sintomas músculo-esqueléticos em trabalhadoras de enfermagem. *Rev Lat Am Enfermagem (São Paulo, Brasil)*. v. 11, n. 5, p. 608-613, 2003 DOI 10.1590/S0104-11692003000500007
8. Ferreira, GD; Silva, MC; Rombaldi, AJ; Wrege, ED; Siqueira, FV; Hallal, PC. Prevalência de dor nas costas e fatores associados em adultos do sul do Brasil: estudo de base populacional. *Rev Bras Fisioter (São Carlos, Brasil)* v. 15, n. 1, p. 31-36, 2011 DOI 10.1590/S1413-3552011005000001
9. Balagué, F; Troussier, B; Salminen, JJ. Non-specific low back pain in children and adolescents: risk factors. *Eur Spine J (West Sussex, Reino Unido)* v. 8, p. 429-438, 1999.
10. Ayanniyi, O; Mbada, CE; Muolokwu, CA. Prevalence and profile of back pain in nigerian adolescents. *Med Princ Pract (Kuwait)* v.20, p. 368-373, 2011 DOI 10.1159/000323766
11. Taimela, S; Kujala, UM; Salminen, JJ; Viljanen, T. The prevalence of low back pain among children and adolescents: a nationwide, cohort-based, questionnairesurvey in Finland. *Spine (Philadelphia, USA)* v. 22, n. 10, p. 1132-1136, 1997.
12. Balagué, F; Dutoit, G; Waldburger, M. Low back pain in schoolchildren. *Scand J Rehab Med (Estocolmo, Suécia)* v. 20, n. 4, p. 175-179, 1988.
13. Balagué, F; Nordin, M; Skovron, ML; Dutoit, G; Yee, A; Wald-burger, M. Non-specific low back pain among schoolchildren: a field survey with analysis of some associated factors. *J Spinal Disord (New York, USA)* v. 7, p. 374-379, 1994.
14. Lemos; Santos; Gaya, 2012. Lumbar hyperlordosis in children and adolescents at a private school in southern Brazil: occurrence and associated factors. *Cad. Saúde Pública (Rio de Janeiro, Brasil)* v. 28, n. 4, p. 781-788, 2012 DOI 10.1590/S0102-311X2012000400017
15. Shiri, R; Solovieva, S; Husgafvel-Pursiainen, K; Viikari, J; Raitakari, OT; Viikari-Juntura, E. Incidence of nonspecific and radiating low back pain: followup of 24-39-year-old adults of the Young Finns Study. *Arthritis Care Res (Atlanta, USA)* v. 62, n. 4, p. 455-459, 2010 DOI 10.1002/acr.20003
16. Auvinen, JP; Tammelin, TH; Taimela, SP; Zitting, PJ; Jarvelin, M; Taanila, AM; et al. Is insufficient quantity and quality of sleep a risk factor for neck, shoulder and low back pain? A longitudinal study among adolescents. *Eur Spine J (Heidelberg, Alemanha)* v. 19, n. 4, p. 641-649, 2010 DOI 10.1007/s00586-009-1215-2
17. Limon, S; Valinsky, LJ; Shalom, YB. Risk factors for low back pain in the elementary school environment. *Spine (Philadelphia, USA)* v. 29, n. 6, p. 697-702, 2004.
18. Ribeiro, CC; Gómez Conesa, A. Lower back pain: prevalence and preventive programs in childhood and adolescence. *Rev Iberoam Fisioter Kinesiol (Barcelona, Espanha)* v. 11, n. 1, p. 32-38, 2008 DOI 10.1016/S1138-6045(08)71834-3
19. Balagué, F; Skovron, M; Nordin, M; Dutoit, G; Pol, L; Waldburger, M. Low back pain in schoolchildren: a study of familial and psychological factors. *Spine (Philadelphia, USA)* v. 29, n. 6, p. 1265-1270, 1995.
20. Smith, A; O'Sullivan, P; Straker, L. Classification of sagittal thoraco-lombro-pelvic alignment of the adolescent spine in standing and its relationship to low back pain. *Spine*, v.33, n.19, p.2101-2117, 2008.
21. Womersley, L; May, S. Sitting posture of subjects with postural backache. *J Manip Physiol Ther. (New York, USA)* v. 29, n. 3, p. 213-218, 2006 DOI 10.1016/j.jmpt.2006.01.002
22. Vanderthommen, M; Defaweux, M; Tomasella, M; Crielaard, JM. Le comportement gestual du patient lotalgique fréquentant une école du dos: analyse préliminaire dún test d'évaluation. *Annales de Réadaptation et de Médecine*

- Physique, v. 42, n. 8, p. 485-492, 1999 DOI 10.1016/S0168-6054(00)87702-8
23. Andrade, SC; Araújo, AG; Vilar, MJ. Escola de coluna: Revisão Histórica e sua aplicação na lombalgia crônica. Rev Bras Reumat. (São Paulo, Brasil) v. 45, n. 4, p. 224-228, 2005 DOI 10.1590/S0482-50042005000400006
 24. Trevelyan, FC; Legg, SJ. Back pain in school children – Where to from here? Appl Ergon (Oxford, Inglaterra) v. 37, n. 1, p. 45-54, 2006 DOI 10.1016/j.apergo.2004.02.008
 25. Vitta, A; Martinez, MG; Piza, NT; Simeão, SFA; Ferreira, NP. Prevalence of lower back pain and associated factors in students. Cad. Saúde Pública (Rio de Janeiro, Brasil) v. 27, n. 8, p. 1520-1528, 2011 DOI 10.1590/S0102-311X2011000800007
 26. Gunzburg, R; Balagué, F; Nordin, M; Szpalski, M; Duyck, D; Bull, D et al. Low Back pain in a population of school children. Eur Spine J (Heidelberg, Alemanha) v. 8, n. 6, p. 439-443, 1999 DOI 10.1007/s005860050202
 27. Karahan, A; Bayraktar, N. Determination of the usage of body mechanics in clinical settings and the occurrence of low back pain in nurses. Int J Nurs Stud. (Oxford, Inglaterra) v. 41, n. 1, p. 67-75, 2004 DOI 10.1016/S0020-7489(03)00083-X
 28. Steele, EJ; Dawson, AP; Hiller, JE. School-based interventions for spinal pain: a systematic review. Spine (Philadelphia, USA) v. 31, n. 2, p. 226-233, 2006 DOI 10.1097/01.brs.0000195158.00680.0d
 29. Candotti, C; Roth, E; Noll, M. Avaliação do peso e do modo de transporte do material escolar em alunos do ensino fundamental. Rev Paul Pediatr (São Paulo, Brasil) v. 30, n. 1, 2012. DOI 10.1590/S0103-05822012000100015
 30. Siivola, S; Levoska, S; Latvala, K; Hoskio, E; Vanharanta, H; Kiukaanniemi, SK. Predictive Factors for Neck and Shoulder Pain: A longitudinal Study in Young Adults. Spine (Philadelphia, USA) v. 29, n. 15, p. 1662-1669, 2004 DOI 10.1097/01.BRS. 0000133644.29390.43
 31. Noll, M; Candotti, CT; Vieira, A; Loss, J.F. Back Pain and Body Posture Evaluation Instrument (BackPEI): Development, Content Validation and Reproducibility. Int J Public Health (Basel, Suíça), 2012, IN PRESS. DOI 10.1007/s00038-012-0434-1
 32. Noll, M; Candotti, CT; Tiggemann, CL; Schoenell, MCW; Vieira, A. Prevalência de dor nas costas e fatores associados em escolares do ensino fundamental do município de Teutônia, Rio Grande do Sul. Rev Bras de Saúde Matern Infant (Recife, Brasil), v. 12, p. 1-1, 2012A. DOI 10.1590/S1519-38292012000400006
 33. Pestana MH, Gageiro JN. Análise de dados para ciências sociais: a complementaridade do SPSS. Lisboa: Edições Silabo, p.125-130, 2003.
 34. Freire, IA; Teixeira, TG; Sales, CR. Hábitos Posturais: diagnóstico a partir de fotos. Conexões (Campinas, Brasil) v. 6, n. 2, p. 28-41, 2008.
 35. Vickery, S; Moffat, M. Manual de Manutenção e Reeducação Postural. Porto Alegre: Artmed Editora, p.220-1, 2002.
 36. Furtado R, Jones A, Furtado RNV, Jennings F, Natour J. Validation of the Brazilian-Portuguese version of the gesture behavior test for patients with non-specific chronic low back pain. Clinics (São Paulo, Brasil) v. 64, n. 2, p. 83-90, 2009 DOI 10.1590/S1807-59322009000200004
 37. Candotti, C; Rohr, J; Noll, M. A Educação Postural como conteúdo curricular da Educação Física no Ensino Fundamental II nas escolas da Cidade de Montenegro/RS. Movimento (Porto Alegre, Brasil) v. 17, p. 57-77, 2011.
 38. Candotti, C; Nunes, SE; Noll, M; Freitas, K; Macedo, CH. Efeitos de um programa de educação postural para crianças e adolescentes após oito meses do seu término. Rev Paul Pediatr (São Paulo, Brasil) v. 29, n. 4, p. 557-583 DOI 10.1590/S0103-05822011000400017
 39. Candotti, CT; Macedo, CH; Noll, M; Freitas, K. Escola postural: uma metodologia adaptada para crianças. Rev Arq Movimento, v. 5, n. 2, p. 34-49, 2009
 40. Noll, M.; Candotti, CT; Vieira, A. Escola postural: revisão sistemática dos programas desenvolvidos para escolares no Brasil. Movimento (Porto Alegre, Brasil) v. 18, n. 4 p. 265-290, 2012.