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Original Research

Prevalence of Low Back Pain and Associated Risks in School-Age Children

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ABSTRACT

Background: Low back pain (LBP) is highly prevalent in children and adolescents, while psychosocial, anthropometric, developmental, and lifestyle factors have been associated. However, the evidence is inconsistent from a biological point of view, so identifying predictors of LBP in the 6–12 years children through physical examination should be appropriate.
Aims: To estimate the prevalence of LBP and associated factors in schoolchildren in a Brazilian population.
Design: Cross-sectional study.
Setting: Three schools in Botucatu, Brazil.
Participants/Subjects: 377 students from 6-12 years.
Methods: Data collection consisted of questions regarding personal history, socioeconomic and anthropometric information, kinesiologic evaluation with anthropometry, lumbar biophotogrammetry, and backpack weight and use. Descriptive analyses were performed, and simple and multiple logistic regression models were used for risk factors.
Results: The prevalence of LBP was 27.32% (confidence interval [CI] 95% = 23.07-32.03). The mean age was 8.85 years (± 1.83) in the group with LBP and 8 years (± 1.76) in the group without LBP (p = .006). Variables such as backpack weight (odds ratio [OR] = 1.45, CI 95% = 1.018-2.064) and exceeding 3 hours per day in front of the television (OR = 7.97, CI 95% = 1.957-32.515) increased the chance of LBP in these students.
Conclusion: LBP is prevalent in younger schoolchildren, and the factors associated with this outcome can be effectively addressed through the promotion of health measures. LBP in schoolchildren is a musculoskeletal discomfort that negatively affects the quality of life of these individuals and persists in adulthood.

Low back pain (LBP), which is a musculoskeletal discomfort that includes pain and muscle tension or stiffness between the 12th rib and the gluteal folds, with or without irradiation to one or both legs (Carvalho do Nascimento & Oliveira Pena Costa, 2015; Kjaer et al., 2017; Milanese & Grimmer-Somers, 2010; Sundell et al., 2019; Swain et al., 2014), is a major public health problem (Foster et al., 2018; Hoy et al., 2012; Maher et al., 2017). The prevalence of LBP ranges from 30%-70% in children and adolescents and is higher when children reach an older age (Junge et al., 2019; MacDonald et al., 2017). This broad range is likely justified by various research protocols, LBP definitions, and study designs (Beynon et al., 2019; Macedo et al., 2015; Meziat Filho et al., 2015).

Schoolchildren (and adolescents) suffer many adaptations to body changes that can result in musculoskeletal disorders and biomechanical changes. These changes, in turn, may cause LBP

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(Beynon et al., 2019; Potthoff et al., 2018). In addition to these adaptations, other factors have been associated with LBP in this population, such as psychosocial (stress, depression, and anxiety) (Andreucci et al., 2019), anthropometric (weight and height), developmental (growth spurts) (Beynon et al., 2019), and lifestyle habits (Kamper et al., 2016; Macedo et al., 2015; Michaleff et al., 2014; Noll et al., 2016a; Noll et al., 2019). However, the evidence for many of these variables is inconsistent because the factors mentioned are unclear from a biological point of view, and the different methodologies, in general, are of low quality (Beynon et al., 2019; Kamper et al., 2016; Nicolet et al., 2014). Identifying predictors of LBP in this age group through physical examination is the differential of the present study, because understanding factors that predispose to this discomfort helps prevent its occurrence and thus contribute to public health in addition to responding to gaps in the literature on musculoskeletal discomfort specifically in that population.

In addition to high prevalence and multiple risk factors, another concerning aspect of LBP in students is the increased prevalence over the years (Beynon et al., 2019) and the persistence of discomfort in adulthood (Swain et al., 2014). A cohort study with nearly 10,000 Danish twin children found that reported LBP increase the chance for developing LBP in adulthood by more than three times. In addition, the authors reported a dose-response association and that those who experienced LBP in childhood for more than 30 days were four times more likely to develop LBP in adulthood (Hestbaek et al., 2006).

As a result of limitations regarding the biological understanding of the risk factors for LBP, the lack of studies including physical examinations of schoolchildren, and the negative impact of LBP on the quality of life, the objective of this study was to estimate the prevalence of LBP and associated factors in schoolchildren in a Brazilian population.

Methods

This cross-sectional study included schoolchildren between the ages of 6 and 12 years (Fig. 1). The participants were recruited from three schools (two private and one public) selected by simple random sampling in Botucatu, a city located in the central west of São Paulo State, Brazil.

Botucatu is a medium-sized city with approximately 140,000 inhabitants and has nearly 18,000 school-age individuals, a number that determined a minimum sample size estimate of 318 participants (Dean et al., 2013), assuming a prevalence of 30% and type I and II errors of 5% and 20%, respectively. A total of 377 schoolchildren agreed to participate in the study and had obtained their parents/guardians' authorization. The children who refused to participate in the evaluations or presented missing data in the data collection instruments were excluded.

The data were collected during the 2017 school period with the principals' authorization. Meetings were held with parents/guardians to present the research objectives and procedures and provide the informed consent form and the questionnaire on background personal and socioeconomic aspects. The students who were authorized by their parents/guardians to participate in the study were also informed of the research objectives and procedures and were evaluated after the assent form was signed. This medical research involving human subjects was conducted according to the World Medical Association Declaration of Helsinki and approved by the Research Ethics Committee of the School of Medicine of Botucatu (Protocol 1.782.512).

The instruments for data collection included demographic and socioeconomic information and lifestyle habits (participation in physical activity, time spent using the cell phone, computer, tablets, and/or television) and were obtained through questions designed specifically for the research.

To identify the prevalence of LBP, the students who reported pain in the lumbar region (below the ribs down to the gluteal folds) in the last month (Carvalho do Nascimento & Oliveira Pena Costa, 2015) and identified it on a body map (adapted from the Nordic Musculoskeletal Questionnaire) were considered to have LBP (Amaral et al., 2002).

The anthropometric and kinesiologic evaluation consisted of the evaluation of the support base length, lumbar angle, waist-to-hip ratio (WHR), lumbar spine mobility, body weight, and height of participants. The length of the support base was measured using a measuring tape (centimeters [cm]), with the participants positioned in an orthostatic position and barefoot. The lumbar angle was analyzed with biophotogrammetry (SAPO, Software for Postural Evaluation, version 0.69. Laboratory of Biomechanics and Motor Control UFABC - Bloco Ômega, Sao Paulo, SP, Brazil) (Macedo Ribeiro et al., 2017) when the spinous processes of the 12th thoracic vertebrae, the fourth lumbar vertebrae, and the posterior superior iliac spines (PSIS), were selected as anatomical references using 20-mm Styrofoam markers.

The images were captured using a digital camera (Samsung ES90, 14.2 MP, 27- to 135-mm lens. Samsung, Seoul, South Korea), attached to a tripod, without zoom, positioned at 1.3-m focal length and 1.1-m height from the ground (suitable distances for capturing images without positional and optical distortions), with participants in an orthostatic position, in a left side view, and oriented to keep a horizontal look at a fixed point on the wall. SAPO software was also used for data analysis (Macedo Ribeiro et al., 2017).

Lumbar spine mobility was assessed using the Schober test, along with a measuring tape. With the participants in an orthostatic position, a horizontal line was drawn between the PSIS. A mark was made 15 cm above the horizontal line when trunk flexion was requested, and a new measurement was marked between the lower and upper marks. The difference between the initial distance (between the two marks in the neutral position) and the new measurement, in the flexed position, indicated the mobility of the lumbar spine in centimeters (Jensen et al., 1986).

The WHR was calculated by dividing the waist circumference (cm) by the hip circumference (cm). Body and backpack weight were measured using a digital scale (G Tech Glass 10, four sensors. Accumed Hospital Medical Products, Vila São Luis, Duque de Caxias, RJ, Brazil), and height was measured with a measuring tape. Participants were asked to present their backpacks for weighing with all the material used on the day of the evaluation. Moreover, the way in which the backpack was used was also investigated.

All evaluated factors associated with LBP were listed after a bibliographic survey (Balagué et al., 2003; Macedo et al., 2015; Meziat Filho et al., 2015; Noll et al., 2016a; Wirth et al., 2013), and only factors that could be evaluated with biologically plausible associations in the time and structure available, that were relevant to the study, were maintained. Despite the fact that the plantar arch is identified in the literature as a risk factor for the development of LBP (Forriol & Pascual, 1990), it was not included as an independent variable, because the plantar arch may develop later (Müller et al., 2012).

The IBM/SPSS Statistics v.26.0 statistical package (IBM, Armonk, NY, USA) was used for the statistical analysis. Exploratory data analysis was performed and presented as means and standard deviations for continuous variables (normal distribution) and simple frequencies for categorical variables, in addition to estimating the LBP prevalence and confidence interval (95%) for the sample. The potential factors associated with LBP occurrence were analyzed using simple logistic regression models with LBP occurrence as the

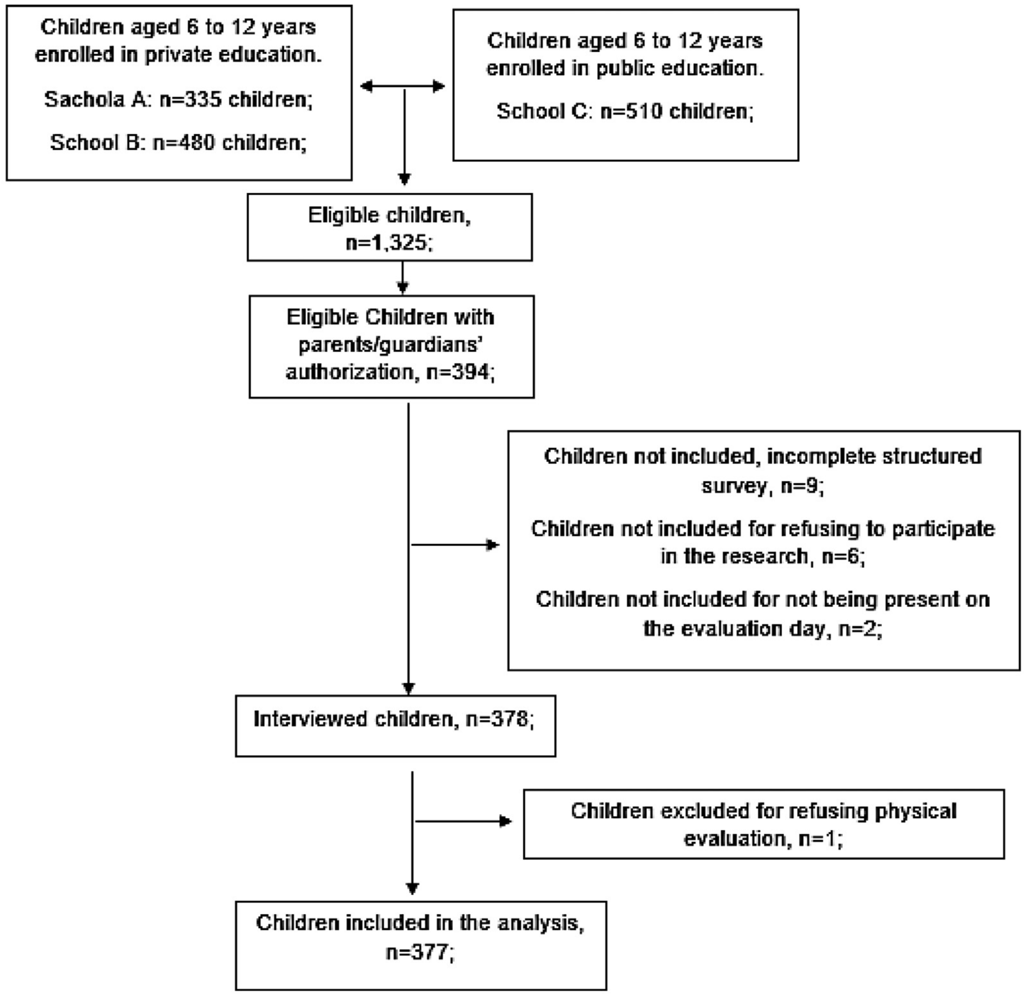

Figure 1. Flow diagram of the study participants.

response variable and each of the independent variables described below as predictor variables. The predictive variables that had a *p* value < .25 in the simple logistic regression models were taken to the multiple logistic regression model and remained in the final adjustment when presenting a *p* value < .05.

As for the analysis of factors associated with LBP, the following predictor variables were included in the simple logistic regression models: age (continuous variable: years); height (continuous variable: cm); body and backpack weight (continuous variables: kilograms [kg]); body mass index (continuous variable: kg/m^2); WHR, length of the support base, lumbar angle, and lumbar spine mobility (continuous variables: cm); type of school (categorical variable: public and private); income (categorical variable: does not know, up to three, and more than three minimum salaries); skin color (categorical variable: white and not white); physical activity (dichotomous variable); type of backpack (categorical variable: strap and wheel); pain in the feet (dichotomous variable); pain intensity in the feet (categorical variable: visual analogue scale 0-2 mild, 3-7 moderate, and 8-10 severe) (Jensen et al., 1986); difficulty sleeping (dichotomous variable); number of people living in the household (categorical variable: up to two and more than two); history of musculoskeletal injury, pain occurring in another anatomical region, history of LBP in the family, presence of smokers at home (dichotomous variables); form of backpack use (categorical variable: one strap, two straps, and on the side); time in front of screens (cell phone, computer, tablet, and/or television) per day (categorical variable: > 3 hours and <3 hours); and posture in front of screens (categorical variable: sitting, half-sitting, and lying).

Results

Of the 377 students, 103 reported at least one episode of LBP in the previous month, resulting in a prevalence of 27.32% (95% CI 23.07-32.03). Table 1 shows socioeconomic, anthropometric, and physical activity information stratified by the presence of pain. The anthropometric variables of the groups were homogeneous, as well as age, whose average was 8.85 years (±1.83) in the pain group and 8 years (±1.76) in the no pain group. The type of school variable (public or private), however, had a different frequency distribution between the groups because of the larger sample fraction of public school students.

As for the type of backpack, most participants in both groups used a backpack with straps (~69%); the results indicated that the majority of these students, in both the pain group (73.2%) and the no pain group (87.7%), used a backpack with two straps, which was not associated with LBP. Although it was not statistically different between groups, the percentage of children not participating in any type of regular physical activity (65% and 70% for the groups pain and no pain, respectively) is worth mentioning. Table 2 shows the predictor variables related to sociodemographic

Table 1
Socioeconomic, Anthropometric, and Physical Activity Profiles of the Studied Population Stratified by Groups Pain and No Pain

		Pain (n = 103)		No Pain (n = 274)		*p*
		Mean	SD[a]	Mean	SD	
Height		1.39	0.12	1.37	0.13	.223
Age		8.85	1.83	8	1.76	.062
Body mass index		17.31	4.86	17.13	4.17	.942
		n	%	n	%	
Income (in minimal salaries)	≤ 3	19	47.5	58	54.2	.225
	> 3	20	50.0	46	43.0	
	Do not know	1	2.5	3	2.8	
Sex	Female	54	52.4	138	50.4	.721
	Male	49	47.6	136	49.6	
Skin color	White	93	90.3	256	93.4	.679
	Not white	10	9.7	18	6.6	
Practices physical exercise	Yes	36	35.0	81	29.7	.324
	No	67	65.0	193	70.3	
Type of school	Private	56	54.4	110	40.4	.015
	Public	47	45.6	164	59.6	
Backpack type	Shoulder strap	71	68.9	189	69.0	.682
	Wheels	32	31.1	83	30.3	
	Transversal	0	0	2	7	
Use of the backpack	One strap	17	23.9	23	12.3	.011
	Two straps	52	73.2	164	87.7	
	Transversal	2	2.8	0	0	

[a] Standard deviation. Chi-squared test.

Table 2
Odds Ratio (OR) Estimates With Respective Confidence Intervals (95% CI) in Univariate Logistic Models

	OR	95% CI	*p*
Demography			
Age (in years)	0.900	0.877-0.924	<.001
Salary income: ≤ 3 MS[a]	0.305	0.180-0.517	<.001
Salary income: > 3 MS	0.435	0.257-0.735	.002
Anthropometry			
Height (cm)	0.498	0.423-0.587	<.001
Personal Background			
Musculoskeletal pain in another part of the body	0.145	0.069-0.305	<.001
Foot pain	0.690	0.480-0.993	.046
Suffered any musculoskeletal injury	0.484	0.261-0.896	.021
Lifestyle Habits			
Time in front of the television (h)	0.553	0.471-0.649	<.001
Time using cellphone (hours)	0.599	0.513-0.699	<.001
Backpack weight	0.818	0.770-0.869	<.001

MS = minimum salaries.

Table 3
Odds Ratio (OR) Estimates With Respective Confidence Intervals (95% CI) in the Multiple Logistic Regression Model

	OR	95% CI	*p*
Anthropometry			
Height (cm)	0.042	0.006-0.277	.001
Lifestyle habits			
Backpack weight (kg)	1.450	1.018-2.064	.039
Time in front of the television (hours)	7.978	1.957-32.515	.004

aspects, personal history, and lifestyle habits that were significantly associated with LBP occurrence in the simple logistic models.

The results obtained in the adjustment of the multiple logistic model (Table 3) show that the variable height remained statistically significant as an anthropometric factor that reduces the chance of LBP occurrence in this population (OR = 0.042, 95% CI 0.006-0.277). The other variables that remained statistically significant were related to lifestyle and the type of backpack. The weight of the backpack increased the chance of LBP, with each increased kilogram of weight increasing the chance of LBP by 45% (OR = 1.45, 95% CI 1.018-2.064). The time spent watching television also increased the chance of LBP, and when this time was exceeded by 3 hours, the chance of LBP increased by almost eight times (OR = 7.97, 95% CI 1.957-32.515). The same deleterious effect was not observed with other types of screens.

Discussion

The prevalence of LBP found in the present study (27.3%) was apparently below the values reported in the literature (30%-70%) (Balagué et al., 2003; Houghton, 2010; Junge et al., 2019; MacDonald et al., 2017; Macedo et al., 2015). This difference may be related to choosing a younger age group than the one chosen in other studies because the prevalence of LBP increases as children get older (Kamper et al., 2016). The choice of age group in the present study was due to an interest in investigating the age at which children begin to report LBP complaints.

The prevalence of LBP in younger age groups is concerning because several studies have shown that musculoskeletal discomfort in children and adolescents is responsible for high annual costs as a result of the parents' absence from work and medical expenses and/or treatments (Global Burden of Disease Study 2013 Collaborators, 2015; Kamper et al., 2016). In the United States alone, these costs reached USD19.5 billion annually for the 10- to 17-year age group, according to a longitudinal study published in 2014 (Groenewald et al., 2014). Moreover, in Germany, spinal disorders in people under the age of 25, including LBP, were estimated at around EUR100 million per year (Ochsmann et al., 2010).

As for the associated factors that remained significant in the multiple models, height was a protective factor for the presence of LBP. This protective effect likely occurred as a result of the age group of the studied population, because some individuals may not have yet experienced pubertal growth resulting from hormonal influences that increase height and body weight (Beynon et al., 2019). Although studies have highlighted that taller children have a higher risk for developing LBP (Hughuet et al., 2016), a systematic review reported that this association has not been established (Kamper et al., 2016).

Furthermore, there was an association between backpack weight and LBP in schoolchildren, and the chance of LBP increased by almost 1.5 times for each kilogram increase in the weight of the backpack, data that corroborate the recent literature. A cross-sectional study conducted in Malta with 4,000 students aged 8 to 13 years (Spiteri et al., 2017) also reported an association between LBP and backpack weight. Moreover, Neuschwander et al. (2010) evaluated the effects of backpack weight using magnetic resonance and found that it increases lumbar asymmetry and the occurrence of back pain.

From the biomechanical point of view, this association can be explained by the fact that carrying more weight than the spine can bear changes the center of gravity and increases lumbar lordosis, overloading the joints, ligaments, and muscles that stabilize the spine, causing LBP (Adeyemi et al., 2017; Macedo et al., 2015; Neuschwander et al., 2010).

Certain authors have stated that backpack weight is not associated with back pain (Kamper et al., 2016; Yamato et al., 2018). However, it is important to highlight that these studies analyzed musculoskeletal pain in any spine region, unlike the present study, which investigated the association of this variable specifically with LBP.

In the present study, variable backpack use (asymmetric or not) was not associated with LBP occurrence, with 73.7% of the students who reported pain using the backpack in the way traditionally considered adequate, with both straps used symmetrically. A recent longitudinal study with schoolchildren in Brazil indicated an association between asymmetric backpack use and LBP occurrence (Noll et al., 2019). However, this study did not include the weight of the backpack as an independent variable; therefore, it was not possible to infer if the association between asymmetric backpack use and the occurrence of LBP was affected by backpack weight.

The factors related to lifestyle habits showed that schoolchildren spending more than 3 hours a day in front of the television were almost eight times more likely to have LBP, which was an expressive result but was expected and corroborated by the literature (Noll et al., 2019). This association can be explained by postures that overload the lower back and cause musculoskeletal complaints in children who tend to spend a good part of the day in front of the television (Meziat Filho et al., 2015). The habit of spending more than 3 hours per day in front of the television is also associated with a sedentary lifestyle, which can cause LBP (Noll et al., 2016b). The result of only one of the screens being associated with LBP can be explained by the simultaneous use of different screens. Thus, when sitting to watch television for a period longer than 3 hours, the use of other screens (cell phones, tablets, video games, computers) may be associated with LBP, but because the television is the main screen, it is more noticeable.

The main limitation of this study was the absence of a blind evaluator to investigate the outcome. However, as in another recent study (Bernardes, Gómez-Salgado et al., 2019), all evaluations and examinations were standardized to minimize the risk for bias. Another possible limitation may have been the use of reported LBP complaints, but besides being a study involving children, LBP diagnosis by imaging tests is unnecessary and undesirable at any age (Fagundes et al., 2016).

One of the strengths of this study was the use of a standardized LBP definition to better compare the complaints, as indicated in the literature (Carvalho do Nascimento & Oliveira Pena Costa, 2015). In addition, the choice of a broader age range than usually presented in LBP studies in the literature, and the specific search for an affected lumbar region, were factors that favored the originality of the results.

Implications for Nursing Education, Practice, and Research

Except height, the modifiable factors are related to lifestyle habits. Thus, the need for health education measures to promote and protect the health of school-age children and adolescents is highlighted because it is during a period that they start developing habits and attitudes that will continue into their adult life (Miñana-Signes & Monfort-Pañego, 2016; Miñana-Signes et al., 2019). Therefore, in its practical application to school nursing, teaching healthy habits should be a priority because of its strong association with postural correction and LBP.

Based on the findings of the present study, we highlight the importance of future research on healthy lifestyle promotion, especially related to postural hygiene, recognition of risk factors, and the prevention of back injuries in daily routines and sportive life. In addition, it would be important to address the impact of LBP on the quality of life of students, including physical examinations and analyzing the repercussions.

Conclusion

The results obtained show that LBP is a highly prevalent symptom in children aged 6 to 12 years, although lower than the prevalence reported in the literature. This symptom can appear even in younger children; the need for a quick diagnosis and effective measures to treat and relieve symptoms is pertinent because this pain can remain in adolescence and, consequently, in adulthood, resulting in other negative consequences such as functional limitations and financial losses. Modifiable factors, such as backpack weight and hours per day in front of the television, were shown to be associated with the reported occurrence of LBP in children, stressing the importance of measures to promote and protect the health of this population.

Declaration of Competing Interest

None.

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