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original article

Prevalence of pain and its association with transportation of school supplies in university students

Prevalência de dor associada ao transporte de material escolar

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Abstract – The aim of this study was to determine the prevalence of pain and its association with the transportation of school supplies among university students. It was a cross-sectional study with 373 university students between February and September 2012 in which sociodemographic and academic data, as well as those regarding the transportation of school supplies and the presence of pain were collected through a semi-structured interview. Further analysis of anthropometric data was conducted and the volumes transported were weighted. Data were analyzed using the SPSS 17.0®software using the model of Hierarchical Binary Logistic Regression, Backward LR method, in which the power of influence of predictor variables was tested in the presence of musculoskeletal pain. Prevalence of pain of 82.8%, with overall average of 5.21 points on the Visual Analogue Scale (VAS) for pain assessment was found. Among women, the influence of the relative weight of volumes on the presence of pain was 45.1% higher than among men (PR = 0.689, CI 95% = 0.503 to 0.942) for each 1% increment. The transport time, in turn, increased by 22.9% the likelihood of occurrence of pain, every 15 minutes (PR = 1.229, CI 95% = 1.090 to 1.386). A high prevalence of pain related to the transportation of school supplies was observed, as well as the influence of predictor variables such as relative weight and transport time, especially in females.

Key words: Low Back Pain; Musculoskeletal Pain; Public Health; Weight-Bearing.

Resumo – *O objetivo do trabalho foi* **v***erificar a prevalência de dor associada ao transporte de material escolar por estudantes universitários. Realizou-se pesquisa transversal, quantitativa, descritiva-analítica, na qual foram avaliados 373 estudantes universitários da Universidade Estadual da Paraíba, entre fevereiro e setembro de 2012. As informações foram coletadas através de questionário sobre dados sociodemográficos, acadêmicos, transporte do material escolar e presença de dor, sendo ainda realizada a medição de dados antropométricos e pesagem de todos os volumes transportados pelo indivíduo. Os dados foram analisados de forma descritiva e inferencial através do software SPSSÒ 17.0. Utilizou-se modelo de Regressão Logística Hierárquica Binária, pelo método Backward LR, no qual o poder de influência das variáveis preditoras – divididas em blocos – foi testado na presença de dor musculoesquelética. Constatou-se uma prevalência de dor de 82,84%, com média geral de 5,21 pontos na Escala Visual Analógica (EVA) para avaliação de dor. Nas mulheres, a influência exercida pela massa relativa dos volumes sobre a presença de dor foi 45,1% maior que entre os homens (OR = 0,689; IC95% = 0,503 – 0,942) para cada 1% de incremento. O tempo de carga, por sua vez, aumentou em 22,9% a probabilidade da presença de dor, a cada 15 minutos decorridos (OR = 1,229; IC95% = 1,090 – 1,386). Verificou-se alta prevalência de dor relacionada ao transporte de material escolar e a influência preditora de variáveis como peso relativo da carga transportada e tempo de transporte desse material, especialmente nos indivíduos do sexo feminino.*

Palavras-chave: *Dor musculoesquelética; Lombalgia; Saúde Pública; Suporte de carga.*

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INTRODUCTION

The scientific literature shows that the occurrence of pain and postural problems is highly prevalent among the adult population[1–3], with a high frequency also in childhood and adolescence[4–6]. The existence of musculoskeletal pain in two or more anatomical areas is very common in young students[7].

Low back pain is the second most frequent cause of visits to doctors, preceded only by issues related to respiratory distress[8]. However, the etiology of the majority of these backaches (85% to 88%) in adults has never been identified[8]. Moreover, much of studies related to idiopathic low back pain are focused on the adult population, which leads to a lack of understanding about the causes and beginning of this condition among adolescents and children[9], although the incidence rates of low back pain in adults are similar to those in adolescents and children[10].

The incidence of low back pain in adolescents tends to increase during high school and may be associated with work or transporting loads[10–12]. According to the U.S. National College Health Assessment, the incidence of low back pain in young adults increased from 44.2% to 47.7% between 2003 and 2007[13]. Furthermore, there was an increased incidence of low back pain among adults who had had back pain during adolescence[14,15].

Low back pain and postural problems among young people can have many causes, among them the use of heavy backpacks and their asymmetrical transportation[16].Over 92% of children in the United States carry backpacks that represent 10% to 22% of their body weight[17,18]previous studies have suggested that it may be an important and increasing problem in this age-group. The aim of this study was to determine the prevalence and important symptom characteristics of low back pain such as duration, periodicity, intensity, disability and health seeking behaviour at young ages. A population-based cross-sectional study was conducted including 1446 children aged 11-14 years in the North-West of England. A self-complete questionnaire was used to assess low back pain prevalence, symptom characteristics, associated disability and health seeking behaviour. An additional self-complete questionnaire amongst parents sought to validate pain reporting. The 1-month period prevalence of low back pain was 24%. It was higher in girls than boys (29 vs. 19%; 2=14.7, P<0.001. About 37% of children aged 11-14 years reported pain, with most attributing their occurrence to the use of backpack[19]. Another study in children[20,21] with incremental loads of 10%, 20% and 30% of their body weight revealed that these loads generate very high contact pressure under backpack straps and significant back pain.

Understanding that musculoskeletal pain, especially low back pain and its postural abnormalities can be associated with transporting loads, particularly school supplies, this study aimed to determine the prevalence of musculoskeletal pain associated with the transportation of school supplies among university students.

METHODOLOGICAL PROCEDURES

Cross-sectional study conducted with university students duly enrolled in courses at the Center of Biological and Health Sciences at campus I, State University of Paraíba.

From a universe of 2,465 students, 399 individuals comprised the sample, which were randomly selected by stratified sampling with proportional size to each stratum, adopting confidence level of 95% (Z = 1.96); margin of error of 5% and pain prevalence of 50.0%. Sample size calculation was performed using the Epi Info software 7.1.2 and individuals were randomly selected in each stratum. Twenty-six students were excluded from the study for refusing to participate or were not located after three attempts or because they would bear any kind of disability.

Semi-structured interviews to collect sociodemographic data and those on the transportation of school supplies and presence of pain, measured by the Visual Analogue Scale (VAS) for pain measurement, were applied[22]. Anthropometric data (height and weight) were collected and all volumes transported by the individual were weighted using WISO stadiometer (Sports Technology®, Criciúma, SC, Brazil) and Tanita digital scale® HD313 (Corporation of America, Inc., Illinois, USA) with a 150kg capacity and accuracy of 100g.

Data were tabulated and descriptively and inferentially analyzed using SPSS software 17.0®. Descriptive analysis was used to calculate means and standard deviations. A model of Hierarchical Binary Logistic Regression through Backward LR method for inferential analysis was used, in which the power of influence of predictor variables – divided into blocks – was tested according to the occurrence of the response variable: presence of musculoskeletal pain. The significance level was set at 5%.

Predicting aspects related to individuals (sex, age, weight, BMI and presence of diagnosed orthopedic condition) composed block 1. Aspects related to the load (amount of transported volumes, total load mass, relative load mass and carrying time) composed block 2. Interactions between carrier and load (sex x total load mass; sex x relative load mass and sex x carrying time) composed block 3, with the predictive power of each variable expressed by the odds ratio.

This study was registered at the National Information System on Ethics in Research Involving Humans (SISNEP) and approved by the Ethics Committee of the State University of Paraíba (CAAE No. 0402.0.133.000-11).

RESULTS

Overall, 373 individuals were evaluated, 71.6% were female aged 18-24 years (81.2%), and BMI raging from normal weight to overweight (85.8%). Public transport was mostly used to get to the university (66.8%). Only 18.5% of individuals reported some type of orthopedic condition and physical activity was reported by 41.8% of subjects (Table 1).

It was found that 42.6% of individuals transported more than one volume of school supplies, but only 1.6% carried up to three volumes, with a ratio of 1.44 volumes of material per student. The average total load mass per individual was 3.04 kg (± 1.62 kg) corresponding to 4.9% (± 2.9%) of the student's weight. The most frequent carrying time was 30 minutes (20.1%) and the most used type of material was the two-strap backpack (52.2%); however, students carried their backpacks mainly over the right shoulder (26, 4%). Another aspect is the percentage of transportation on the left shoulder (13.8%), totaling 40.2% of unilateral transport carried over one shoulder (Table 1).

Table 1. Data related to the presence of pain during the transportation of school supplies, amount of tender points and if there is an attempt to ease the pain by decreasing the volume or even not transporting it.

	Biology	Physical Education	Nursing	Pharmacy	Physical Therapy	Odontology	Psycology	TOTAL
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Sample stratified by course	92 (24.7)	59 (15.8)	55 (14.7)	42 (11.3)	44 (11.8)	38 (10.2)	43 (11.5)	373 (100.0)
Presence of pain related to the transportation of school supplies								
Yes	77 (83.7)	44 (74.6)	49 (89.1)	34 (81.0)	36 (81.8)	28 (73.7)	41 (95.3)	309 (82.8)
No	15 (16.3)	15 (25.4)	6 (10.9)	8 (19.0)	8 (18.2)	10 (26.3)	2 (4.7)	64 (17.2)
Average number of tender points (± SD)	3.23 (± 2.5)	2.14 (± 1.8)	3.02 (± 2.1)	3.12 (± 2.7)	2.55 (± 2.3)	3.16 (± 3.6)	3.77 (± 2.6)	3.00 (± 0.5)
Maximum number of tender points	13	7	9	9	11	18	11	
Decrease in material weight due to pain								
Yes	50 (27.3)	19 (10.4)	27 (14.7)	24 (13.1)	20 (10.9)	12 (6.6)	31 (16.9)	183 (49.0)
No	27 (21.4)	25 (19.8)	22 (17.5)	10 (7.9)	16 (12.7)	16 (12.7)	10 (7.9)	126 (33.8)
No material transport due to pain								
Yes	20 (20.8)	10 (10.4)	15 (15.6)	15 (15.6)	12 (12.5)	14 (14.6)	10 (10.4)	96 (25.7)
No	57 (26.8)	34 (16.0)	34 (16.0)	19 (8.9)	24 (11.3)	14 (6.6)	31 (14.5)	213 (57.1)

SD - Standard Deviation

Regarding the presence of pain, 82.8% of individuals reported pain at some point during the transportation of school supplies. The most frequently reported painful points were right (37.5%) and left shoulder (33.5%) and lower back (29.7%). In addition, 49% of individuals reported that they had tried to reduce the weight of their school supplies due to pain with the intention to minimize it, and 25.7% decided not to carry the school supplies for the same reason (Tables 1 and 2).

By Visual Analogue Scale (VAS) overall pain, on average, was 5.21 points on a 0-10 point scale, showing pain in lumbar (5.73); sacral (6:02) and cervical regions (5.20) (Table 3).

When testing the predictive power of variables on the occurrence of pain, it was observed that individuals on block 1 had χ^2value =16.337; p<0.001, indicating that the set of input variables had a predictive power on the response variable, which was significantly greater than mere chance.

In block 1 of variables, only sex was a significant predictor of pain (p<0.001), indicating that females are 3.17 times more likely to present pain. OR = 0.315 ($CI_{95\%}$ = 0.181 – 0.549).

Table 2. Sample distribution according to the location of tender points and to the course.

	Biology	Physical Education	Nursing	Pharmacy	Physical Therapy	Odontology	Psycology	TOTAL
Most mentioned painful points	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Shoulder region - right side	33 (23.6)	15 (10.7)	22 (15.7)	18 (12.9)	13 (9.3)	18 (12.9)	21 (15.0)	140(37.5)
Shoulder region - left side	29 (23.2)	17 (13.6)	23 (18.4)	14 (11.2)	14 (11.2)	14 (11.2)	14 (11.2)	125(33.5)
Lumbar region	32 (28.8)	17 (15.3)	15 (13.5)	13 (11.7)	11 (9.9)	11 (9.9)	12 (10.8)	111(29.8)
Right scapular region	28 (26.4)	13 (12.3)	13 (12.3)	14 (13.2)	13 (12.3)	11 (10.4)	14 (13.2)	106(28.4)
Cervical region	26 (26.8)	10 (10.3)	12 (12.4)	9 (9.3)	14 (14.4)	8 (8.2)	18 (18.6)	97 (26.0)
Left scapular region	21 (25.3)	11 (13.2)	14 (16.9)	9 (10.8)	11 (13.2)	8 (9.6)	9 (10.8)	83(22.2)
Thoracic region	21 (26.6)	6 (7.6)	16 (20.2)	10 (12.7)	7 (8.9)	7 (8.9)	12 (15.2)	79(21.2)
Sacral region	19 (24.7)	11 (14.3)	9 (11.7)	9 (11.7)	8 (10.3)	7 (9.1)	14 (18.2)	77 (20.6)
Right wrist region	9 (25.7)	5 (14.3)	4 (11.4)	3 (8.6)	4 (11.4)	2 (5.7)	8 (22.9)	35(9.4)
Right elbow region	5 (14.7)	0 (0.0)	10 (29.4)	8 (23.5)	2 (5.9)	5 (14.7)	4 (11.8)	34(9.1)

Table 3. Average pain measured by the Visual Analogue Scale (VAS) for painful points according to university course.

	Biology	Physical Education	Nursing	Pharmacy	Physical Therapy	Odontology	Psycology	TOTAL
Painful points	(SD)	(SD)	(SD)	(DP)	(SD)	(SD)	(SD)	(SD)
Occipital region of the head	9.0 (1.4)	† (‡)	10.0 (‡	7.0 (0.0)	† (‡)	† (‡)	3.0 (‡)	7.2 (3.1)
Sacral region	6.0 (2.2)	6.3 (2.0)	5.8 (2.2)	5.7 (2.5)	5.1 (1.4)	7.0 (2.4)	6.3 (2.4)	6.0 (0.6)
Lumbar region	6.2 (2.5)	5.1 (2.0)	5.5 (2.2)	6.0 (2.2)	5.9 (2.6)	6.2 (1.8)	5.2 (1.0)	5.7 (0.5)
Right scapular region	5.7 (2.3)	5.4 (1.9)	6.5 (1.8)	5.6 (2.1)	5.1 (2.6)	5.5 (2.0)	6.2 (2.0)	5.7 (0.5)
Left scapular region	5.8 (2.3)	5.4 (2.4)	6.4 (1.5)	6.0 (1.7)	4.7 (2.4)	5.4 (2.7)	5.7 (2.1)	5.6 (0.5)
Frontal region of the head	7.6 (1.9)	3.5 (0.7)	8.0 (2.0)	4.2 (2.2)	† (‡)	7.0 (‡)	2.5 (0.7)	5.5 (2.3)
Thoracic region	5.8 (2.8)	5.3 (2.7)	5.2 (1.5)	5.5 (2.1)	5.9 (2.0)	3.9 (1.8)	6.0 (2.8)	5.4 (0.7)
Shoulder region - right side	5.4 (2.1)	5.9 (1.5)	5.3 (2.1)	5.9 (2.0)	4.7 (2.2)	4.6 (2.5)	5.0 (2.0)	5.3 (0.5)
Shoulder region - left side	5.4 (2.5)	5.8 (1.6)	5.2 (1.8)	5.3 (2.1)	4.8 (2.2)	4.5 (2.6)	5.6 (2.1)	5.2 (0.4)
Cervical region	6.0 (2.7)	4.5 (1.6)	5.6 (2.3)	5.3 (1.9)	5.1 (1.7)	4.4 (1.6)	5.5 (2.3)	5.2 (0.6)

SD - Standard Deviation, † mean not calculated, ‡ standard deviation not calculated

Regarding variables of block 2, a substantial increase in the predictive ability of the model with χ2 value = 39.069; $p<0.001$ was observed, retaining the relative mass of the volume ($p<0.01$) and the carrying time ($p<0.001$); gender remained a significant predictor in association with the two variables included ($p<0.001$), in which females were 2.84 times more likely to experience pain (OR= 0.352; $CI_{95\%}$=0.198 – 0.626). The 1% increase in the relative mass of volumes increased by 22.6% (OR= 1.226; $CI_{95\%}$=1.055 – 1.424) the probability of having pain. Moreover every 15 minutes of transportation increases the likelihood of having pain by 21.9%. (OR= 1.219; $CI_{95\%}$=1.082 – 1.373).

Block 3 had a χ^2 value =44.735; $p<0.001$, suggesting that the introduction of interactions between variables substantially increases the quality of the prediction model, being retained, as significant predictors, variables carrying time ($p<0.001$) and the interaction between sex and relative load mass ($p<0.05$). The result suggests that, among women, the effect of the relative load mass on the presence of pain is 45.1% higher than among men (OR= 0.689; $CI_{95\%}$=0.503 – 0.942) for each 1% increment. On the other hand, the carrying time increases by 22.9% the probability of having pain each 15 minutes (OR=1.229; $CI_{95\%}$=1.090 – 1.386) (Table 4).

Table 4. Variables predictive of pain.

	Predictor	Reference	p	Adjusted OR	CI 95%
Block 1	Sex	Male	< 0.001	0.315	0.181 – 0.549
Block 2	Sex	Male	< 0.001	0.352	0.198 – 0.626
	Relative load mass	1%	< 0.01	1.226	1.055 – 1.424
	Carrying Time	15min	< 0.001	1.219	1.082 – 1.373
Block 3	Carrying Time	15min	< 0.001	1.229	1.090 – 1.386
	Sex X Relative load mass	Male/1%	< 0.05	0.689	0.503 – 0.942

DISCUSSION

The aim of this study was to determine the prevalence of pain and its association with the transportation of school supplies among university students. Results indicated that students carried school supplies with average weight of 3.04 kg, corresponding to 4.95% of student's weight. This result puts them in a safe range, according to Brackley and Stevenson[23],who stated that, based on epidemiological, physiological and biomechanical data, there is a tolerance for the transportation of school supplies of 10%-15% of students' body weight.

Previous survey conducted among 238 college students revealed an average weight of 5.2 kg of school supplies[10]. Other authors, more cautiously demonstrated that the load volume should not exceed 10% the subject's weight[24,25]. In this sense, the mean values for university students, in the present study, are within normal limits stipulated by literature. The load weight increases significantly with increasing age, ranging from 5 to 29% the body weight , which exceeds the advisable limit of 10%[26].

Regardless of university course, the most frequent type of material was the two-strap backpack (52.2%). However, the transportation occurred mainly over one shoulder (40.2%), thus becoming a practice that entails adapting modification in all anatomical planes, causing larger musculoskeletal imbalance and greater effort in order to correct deviations arising from asymmetric transportation[27].

In Spain, Aparicio *et al.*[28] showed similar results regarding the material chosen by students. When assessing the mode of transportation of school backpack among 203 school children from the city of Salamanca (Spain), the use of the two-strap backpack was predominant. However, among American students, 81% carried their backpack with both straps on the back, while only 14% carried on only one strap[19].

The most appropriate way to transport school supplies is carrying the backpack at the back line with one strap over each shoulder[24]. Some authors recommend that the backpack should be symmetrically carried over both shoulders, distributing its load evenly, otherwise, it could result in a tilting torque, hurting the spine, which over the years can lead to the development of low back pain and musculoskeletal symptoms[23,27].

About 82.84% of individuals surveyed reported feeling pain somewhere in the body when transporting their school supplies. The prevalence reported in literature varies from 37%[19] to 50%[29],however, when analyzed according to sex, there is a prevalence of 36.5% for males and 38.8% for female university students aged 19-20 years[10].Several authors have suggested that a substantial prevalence of low back pain in adolescents is related to the weight of their school supplies[29].

The average overall pain by visual analog scale found in this study was 21.5 points, confirming literature data, which shows average of 5.2 points[19]. The model proposed to test the predictive power of variables on the occurrence of pain demonstrated that, among women, the effect of the relative load mass on the presence of pain is 45.1% higher than among men. The carrying time also increased the likelihood of having pain by 22.9%, for every 15 minutes, confirming previous findings that showed that females had higher prevalence of pain[10,19].

Some authors reported that there is a positive correlation between increase of the relative load of school supplies and prevalence of musculoskeletal pain[19]. Such findings confirm the results of this study, which identified higher prevalence of pain of 45.1% for each 1% increase in the relative weight of school supplies, as well as a 22.9% increase for every 15 minutes of transporting school supplies.

Some limitations should be highlighted, like the fact that it is a cross-sectional survey, in which only a single measurement of the weight of school supplies was performed. However, it is known that the weight of school supplies may vary with the day of the week[27],thus indicating the need for the development of further studies that follow up a longitudinal measuring of the weight of school supplies, in addition to the association between labor activities and the presence of pain among university students.

It is also necessary to consider the gap in literature on information about the mode of transportation of school supplies in different regions of Brazil, a fact that underlines the importance of data obtained in this study, as the initial step for the development of further studies in different regions of Brazil.

CONCLUSION

This study showed a high prevalence of pain related to the transportation of school supplies and the predictor influence of variables such as relative load mass and carrying time of this material. However, although these results are important to promote greater awareness, they may not be transferred to other groups of students due to many genetic, social, cultural differences among the various states of Brazil.

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