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Factors associated with non-specific low back pain in children aged 10–12 from Bucaramanga, Colombia: A cross-sectional study

Adriana Angarita-Fonseca[a,b,c,*], Milena Boneth-Collante[b], Claudia Lucia Ariza-Garcia[b], Javier Parra-Patiño[d], Julian David Corredor-Vargas[e] and Andrea Paola Villamizar-Niño[e]
[a]*Grupo de investigación Fisioterapia Integral, Facultad de Ciencias de la Salud, Universidad de Santander, Bucaramanga, Colombia*
[b]*Grupo de Investigación en Manejo Clínico – CliniUDES, Facultad de Ciencias de la Salud, Universidad de Santander, Bucaramanga, Colombia*
[c]*Canadian Centre for Security and Health in Agriculture, University of Saskatchewan, Saskatoon, SK, Canada*
[d]*Escuela de Fisioterapia, Universidad Industrial de Santander UIS, Bucaramanga, Colombia*
[e]*Facultad de Ciencias de la Salud, Universidad de Santander, Bucaramanga, Colombia*

Abstract.
BACKGROUND: There are no Colombian studies published that assess non-specific low back pain (NSLBP) risk factors in children.
OBJECTIVE: To determine the factors associated with NSLBP in 73 children (19.2% girls) aged 10–12 years in one military school in Bucaramanga, Colombia.
METHODS: A questionnaire was used to obtain information of risk factors. Subsequently, children's weight and height were measured. The backpack was weighed at the beginning of each day from Monday to Friday. Crude and adjusted prevalence ratios were calculated, with their respective 95% confidence interval (CI).
RESULTS: The one-month prevalence of NSLBP was 39.7% (95% CI 28.4–51.9). In the multivariate analysis, carrying backpacks wearing between 12% and 20% of body weight, having a perception that the backpack is very heavy, and being a passive smoker increase the likelihood of NSLBP, while being 11-year-old compared to 10-year-old decreases the likelihood of having NSLBP, adjusted for gender, body mass index, and history of LBP in parents.
CONCLUSIONS: High prevalence of low back pain was found in children between 10 and 12 years old. The study of the decisive factors of low back pain is important to identify children at risk, as well as to develop efficient primary prevention programs.

Keywords: Backpack, children, low back pain, risk factors

1. Introduction

Several authors [1–4] define non-specific low back pain (NSLBP) as pain or discomfort located between the lower limit of the ribs, around L1-L5 vertebrae, sacroiliac joints, and the lower limit of the gluteus, with intensity that varies depending on the posture and physical activity. Low back pain (LBP) can occur without any explicit cause (for example, compression of a nerve root, trauma, infection, tumour). NSLBP is usually accompanied with painful movement limitation and can be associated to referred or irradiated pain.

NSLBP has been recognized as a common disor-

*Corresponding author: Adriana Angarita-Fonseca, Grupo de investigación Fisioterapia Integral, Facultad de Ciencias de la Salud, Universidad de Santander, Bucaramanga, Colombia. Tel.: +57 651 6500, Ext: 1406; E-mail: adriangarita@udes.edu.co.

der in school children and adolescents, similar to adult counterparts [5,6]. The lifetime prevalence of NSLBP in children between 9 and 12 years old has been reported to be of up to 37% [7–12] and prevalence in the last month in children between 7 and 14 years old has increased to 67% [1,4,13–17]. In addition, the average lifetime prevalence in children and teenagers under 18 years old informed by a review of 30 studies was 39.9% (95% CI 34.2%–45.9%) [6]. These figures are a major concern because low back pain in childhood and adolescence has been shown to be associated with low back pain in adulthood [18].

The associated factors with NSLBP in children have been studied previously. Environmental factors such as backpack weight, the way it is carried, and furniture in the school [19–23], as well as behavioural aspects such as participation in heavy physical activities [11,24,25] or, on the contrary, performing sedentary activities [8, 10,14,26] has shown a relationship with NSLBP in children. Likewise, psychosocial and psychological aspect such as low school performance, school environment dissatisfaction, depression, pain perception, and a family history of low back pain were identified as risk factors associated with NSLBP [4,16,23,26–28]. In addition, some authors suggested a direct association between biological variables such as sex [1,16,21,29], age [1,10,30], high body mass index (BMI) [12,14] and NSLBP.

To the best of our knowledge, there has neither been Colombian studies on NSLBP prevalence nor risk factors associated to NSLBP in Colombian children [6,31], which is noteworthy because once they are established, preventive strategies can be targeted. Therefore, the objective of this study is to determine the factors associated to NSLBP in school children from a military school in the city of Bucaramanga.

2. Methods

A cross-sectional study was carried out in a population of school children between the ages of 10 and 12 from Colegio Militar General Santander, who were attending school for one month prior to the assessment. Colegio Militar General Santander is the only military school in Bucaramanga city, which is characterized by enrolling students at 2 years old and over, and including three hours per week of physical education in the school curriculum, which is one hour more than in regular schools. Children were excluded if their parents/guardians reported low back pain due to acute trauma and if they had been diagnosed with a musculoskeletal, neuromuscular, cardio-pulmonary, or metabolic pathology. Data collection was carried out between April and May 2012.

2.1. Questionnaires

We used several questionnaires based on other studies [2,18,30,32]. The Non-specific Low Back Pain Questionnaire and the Non-specific Low Back Pain's Characteristics Questionnaire demonstrated acceptable test-retest reliability (Appendix) [33]. The Non-specific Low Back Pain Questionnaire included two questions. The first one inquires whether children have had a pain in the lumbar area lasting for one day or longer in the last month. The second question incorporated a shaded region lumbar on a mannequin diagram, and the child was asked whether he/she experienced pain in the shaded area lasting for one day or longer in the last month. The Non-specific Low Back Pain's Characteristics Questionnaire included five questions. Firstly, pain frequency was asked by the number of days feeling pain. Then, pain intensity was investigated by the Wong-Baker Faces Pain Rating Scale (WBF-PRS) [22], in which the child chose an image of five delimited faces from 0 to 10 as follows: 0 does not hurt, 2 hurts a little, 4 hurts a bit more, 8 hurts a lot more, 10 hurts the most. Additionally, pain duration was investigated using a multiple-choice question with a single answer out of four options: less than 12 hours, from 12 to 24 hours, from one to seven days and more than one week. Also, pain irradiation was asked using a yes/no question. Finally, severity was evaluated by asking whether children consulted a health professional such as a doctor, physiotherapist, nurse, or another professional [33].

There was an additional questionnaire that inquired about socio-demographic aspects such as gender, age, schooling level, type of educational institutions, and socioeconomic strata. Also, sports activities, sedentary lifestyle, parent history of LBP, and backpack characteristics were collected in this questionnaire. Passive smoking was evaluated with the question: Is there someone in your house who smokes? Data information was collected through an interview in which the interviewer was trained so that they do not influence the answer, as well as they follow the order of the questions. Interviews were conducted in an isolated and quiet place. Three final year physical therapy students from Universidad de Santander (UDES) and one medical student from Universidad Industrial de Santander, trained for this study, conducted this questionnaire.

2.2. Measurements

2.2.1. Anthropometry

Anthropometric measurements were performed according to the International Society for Advancement of Kinanthropometry standards [34]. Body weight and height were measured without shoes and the minimum amount of clothes. The data of three measurements was recorded in kilograms, and centimetres and millimetres, respectively. Weight was measured using a digital scale (SECA Clara 803, Hamburg, Germany, precision of 100 g), and height was measured using a wall-stadiometer (SECA 222, Hamburg, Germany). Body mass index (BMI) was determined by dividing the weight of children in kilograms by the square of their height in meters.

2.2.2. Backpack weight

The weight of the backpack was measured during five consecutive weekdays, from Monday to Friday, recording the weight of the backpack with all the contents the student had that day. A digital hanging scale, model OCS-2, Guangdong, China, precision of 10 gr, was used. A collaborator recorded the data given to him/her by the tester in the pertinent format. Backpack weight as a percentage of body weight was computed by dividing the average of backpack weight by the child's weight.

2.3. Statistical analysis

The distributions of the continuous variables were explored through scatterplots and by the Skewness/Kurtosis test. For the univariate analysis, the normally and non-normally distributed continuous variables were expressed as mean and standard deviation, and median and range (minimum and maximum), respectively. Categorical variables were shown in absolute and relative frequencies. The one-month prevalence of NSLBP was calculated dividing the number of participants who responded affirmatively to one or both questions of the Non-specific Low Back Pain Questionnaire by the total participants included in this study, multiplied by 100. In the bivariate analysis, normally distributed continuous variables were analysed with Student's t-test, non-normally distributed continuous variables were analysed with Mann-Whitney U test. Categorical variables were analysed with chi-squared test or Fisher's exact test. Prevalence ratios (PR) were calculated with their respective 95% confidence interval (95% CI). In the multivariate analysis, we used the multiple Poisson regression, following Greenland's recommendations [35]; the linktest was applied to assess the final model's goodness-of-fit, NSLBP being the dependant variable. A significance level of 0.05 was adopted. Program Epidat 3.1 (The EpiData Association, Odense Denmark, 2004) was used for entering data and the statistical analysis was performed in Stata 13.1 (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP).

Table 1
Socio-demographic variables of the study population

Variable	n	%
Gender		
Girls	14	19.2
Boys	59	80.8
Grade		
6	56	76.7
7	17	23.3
Socioeconomic strata		
1, 2, 3 (low)	50	74.6
4, 5, 6 (high)	17	25.4
Age (years)		
10	8	11.3
11	39	54.9
12	24	33.8

Table 2
Prevalence of non-specific low back pain and NSLBP characteristics in the study population

Variable	Summary measurement
Prevalence of global NSLBP *% (95% CI)*	39.7 (28.4–51.9)
How many times have you felt pain in the last month? *Median (Minimum – Maximum)*	3 (1–14)
Usually, how long does your pain last? (n %)	
$<$ 12 hours	22 (75.9)
12–24 hours	7 (24.1)
How intense is the pain? [WBF-PRS] (*average* $\pm$ *standard deviation*)	4.6 $\pm$ 1.7
Pain radiating to the leg (n %)	
Yes	7 (24.1)
No	22 (75.9)
Last year consultation with a health care provider (n %)	
Doctor	2 (6.9)
Physical therapist	1 (3.5)
Nurse	3 (10.3)
Another professional	2 (6.9)

2.4. Ethical considerations

Ethical considerations adhered to resolution 8430 of 1993 of the Colombian Ministry of Social Protection [36]. This research was classified as "minimum risk" given the data was gathered by way of common procedures in physical or psychological exams. We requested a written informed consent from children's legal representatives and the Ethics Committee of Universidad de Santander approved the study.

Table 3
Backpack weight and anthropometric measurements related to NSLBP in children

Variable	With NSLBP		Without NSLBP			Global	
	Median	Min-max	Median	Min-max	p-value	Median	Min-max
Backpack weight Day 1 (kg)	5.2	2.8–9.4	5.1	3.2–8.1	0.202	5.1	2.8–9.4
Backpack weight Day 2 (kg)	5.6	2.7–8.0	4.9	2.8–6.7	0.013	5.2	2.7–8.0
Backpack weight Day 3 (kg)	5.7	4.0–8.5	5.1	3.1 ± 9.7	0.028	5.2	3.1–9.7
Backpack weight Day 4 (kg)	4.8	3.1–8.4	5.0	2.4–7.0	0.109	4.5	2.4–8.4
Backpack weight Day 5 (kg)	5.2	3.0–8.2	5.1	3.0–8.4	0.608	5.2	3.0–8.4
Average of 5 days (kg)	5.3	3.9–7.9	5.1	3.2–6.9	0.075	5.1	3.2–7.9
Backpack weight/body weight ratio	12.2	7.8–20	11.7	5.2–18.9	0.937	11.8	5.2–20
Height (ms)	1.48	1.29–1.66	1.50	1.34–1.63	0.839	1.49	1.29–1.66
Weight (kg)	45.0	25.8–70.1	40.7	28.0–64.3	0.232	43.3	25.8–70.1
BMI (kg/m^2)	20.5	14.4–29.1	19.2	14.5–27.5	0.112	19.9	14.4–29.1

3. Results

The eligible population included 155 boys and girls from the sixth and seventh grade, of which 47.1% complied with the inclusion criteria. The final study sample was made up of 73 school children, mainly boys (80.8%). Regarding the socio-demographic variables, 76.7% were in sixth grade and most of them lived in socio-economic strata 1, 2 and 3 (74.6%). The predominant age was 11 years, accounting for 54.9% (Table 1).

3.1. Prevalence and characteristics of NSLBP

The one-month prevalence of NSLBP was 39.7% (95% CI 28.4–51.9) for all the boys and girls. Regarding the low back pain characteristics, students with NSLBP mentioned a median of 3 days out of the last month feeling pain (range 1–14 days); however, the majority said the pain lasted less than 12 hours (75.9%). On average, the intensity of the pain was 4.6 $\pm$ 1.7 on a scale of 10; for 24.1% the pain irradiated towards the leg and a minority went to the doctor, physical therapist, nurse or another professional (27.6%) (Table 2).

3.2. Factors associated with NSLBP

In the bivariate analysis of the continuous variables, we found that those students with NSLBP used the heaviest backpacks on Tuesday and Wednesday, compared to those without NSLBP ($p < 0.05$). However, neither the mean weight of the backpack over the 5 days nor the backpack weight/body weight percentage was statistically different among groups. Regarding the anthropometric variables, no significant statistical differences were found among the students with NSLBP and those without it (Table 3).

When calculating prevalence ratios (PR), an association with NSLBP was found between BMI and the perception that the backpack was very heavy; hence, the children that felt that their backpack was very heavy had a prevalence of NSLBP in the last month of 3.46 (95% CI 1.63–6.10) times more than those who felt that it was not very heavy (Table 4). Children with a BMI $\geqslant 25$ had a prevalence of NSLBP of 1.96 (95% CI 1.11–3.46) times higher than the children with a BMI < 25.

3.3. Multivariate analysis

Table 5 shows a multiple Poisson regression to identify factors that are associated with NSLBP. Participants who wore between 12% and 20% of their body weight, those who perceived that the backpack is very heavy, and passive smokers were more likely to report having NSLBP. 11-year-old participants compared to 10-year-old counterparts were less likely to report having NSLBP, adjusted for gender, body mass index, and history of LBP in parents. The final model had 71 observations, and it is a good model in terms of model specification, linktest ($p = 0.235$).

4. Discussion

The main findings of this study establish prevalence and the factors associated to NSLBP in a population of school children in Colombia. To the best of our knowledge, no similar study exists in the literature. The one-month prevalence of NSLBP found in our study was high (39.7%) compared to several studies reporting one-month prevalence of NSLBP; 4.0%–4.3% in Denmark [15,37]; 14.4% in Iran [14]; 22.1% in Greece [4]; 23.9% in England [1], and 31.6% in Brazil [4].

4.1. Backpack weight and NSLBP

In our study, multivariate analysis showed a signifi-

Table 4
Determinants of NSLBP in children (bivariate analysis)

Variable	NSLBP		PR	95% CI
	Yes (n %)	No (n %)		
Gender				
Girls	6 (42.9)	8 (57.1)	1	
Boys	23 (39.0)	36 (61.0)	0.90	(0.46–1.80)
Age				
12	13 (54.2)	11 (45.8)	1	
11	12 (30.8)	27 (69.2)	0.57	(0.31–1.03)
10	3 (37.5)	5 (62.5)	0.69	(0.26–1.82)
Grade				
6	21 (37.5)	35 (62.5)	1	
7	8 (47.1)	9 (52.1)	1.25	(0.68–2.30)
Socioeconomic strata				
1, 2, 3 (low)	18 (36.0)	32 (64.0)	1	
4, 5, 6 (high)	8 (47.1)	9 (52.9)	1.30	(0.70–2.44)
History of LBP in parents				
No	6 (23.1)	20 (76.9)	1	
Yes	23 (48.9)	24 (51.1)	2.12	(0.99–4.54)
Passive smoking				
No	9 (30.0)	21 (70.0)	1	
Yes	20 (46.5)	23 (53.5)	1.23	(0.83–1.82)
Type of backpack used to go to school				
Two straps	20 (35.7)	36 (64.3)	1	
One strap	9 (52.9)	8 (47.1)	1.48	(0.84–2.61)
How s/he goes to school				
Walking	6 (50.0)	6 (50.0)	1	
School bus	23 (37.7)	38 (62.3)	0.75	(0.39–1.45)
Feels tired when carrying the backpack				
Never	2 (28.6)	5 (71.4)	1	
Sometimes	20 (39.2)	31 (60.8)	1.37	(0.41–4.65)
Always	7 (46.7)	8 (53.3)	1.63	(0.45–5.93)
Perception that the backpack is very heavy				
No	4 (15.4)	22 (15.4)	1	
Yes	25 (46.8)	22 (53.2)	3.46	(1.35–8.85)
Participates in sports activities in or out of school				
No	0 (0.0)	3 (100)	1	
Yes	29 (41.4)	41 (58.6)	NC	(NC)
Hours of sports activities per day				
$\leqslant$ one hour	6 (31.6)	13 (68.4)	1	
More than one hour	23 (45.1)	28 (54.9)	1.42	(0.68–2.96)
Days of sports activities in a week				
1–3 times/week	24 (42.9)	6 (57.1)	1	
More than three times/week	4 (36.4)	38 (63.6)	0.85	(0.37–1.96)
Weekends	1 (33.3)	2 (66.7)	0.78	(0.15–3.96)
BMI				
< 25	24 (36.4)	42 (63.6)	1	
$\geqslant 25$	5 (71.4)	2 (28.6)	1.96	(1.11–3.46)
Backpack weight				
$\leqslant 5.14$ kg	12 (32.4)	25 (67.6)	1	
> 5.14 kg	17 (47.2)	19 (52.8)	1.45	(0.81–2.60)
Backpack weight/body weight percentage				
5–11.9	13 (34.2)	25 (65.8)	1	
12–20	16 (45.7)	19 (54.3)	1.33	(0.76–2.36)

PR: Prevalence Ratio, 95% CI: 95% Confidence interval, NC: Not Calculable.

cant statistical association between NSLBP and backpack weight to body weight percentage with a PR of 1.12 (95% CI 1.01–1.26). NSLBP was even more strongly associated with the perception that the backpack is very heavy with a PR = 3.01 (95% CI 1.27–7.09). In other words, we demonstrated a significant effect of backpack weight on the prevalence of NSLBP with subjective and objective measurements. Regarding subjective measurements, it is important to recognize that pain may influence children's perception. Children suffering from LBP could feel a heavier backpack than those not suffering from LBP even though the actual loaded weight percentage is similar for both. This phenomenon has been well studied in occupational health; employees with chronic pain responded more negatively to questions characterizing their work than those without chronic pain [38,39].

Wearing a heavy backpack has physiological,

Table 5
Determinants of NSLBP in children (multivariate analysis)

Variable	PR	95% CI	p
Backpack weight/body weight percentage			
5–11.9	1		
12–20	1.88	(1.04–3.39)	0.037
Age in years			
12	1		
11	0.53	(0.29–0.95)	0.032
10	0.44	(0.18–1.09)	0.078
Gender			
Girls	0.84	(0.41–1.66)	0.609
Boys	1		
Passive smoking			
No	1		
Yes	1.95	(1.08–3.51)	0.025
Perception that the backpack is very heavy			
No	1		
Yes	3.28	(1.43–7.51)	0.005
BMI			
< 25	1		
$\geqslant 25$	1.59	(0.82–3.05)	0.164
History of LBP in parents			
No	1		
Yes	1.65	(0.78–3.47)	0.191

PR: Prevalence Ratio, 95% CI: 95% Confidence interval, NC: Not Calculable.

biomechanical and musculoskeletal implications. In the first place, an increasing trunk flexion to maintain the centre of gravity while walking has been associated to carrying backpacks exceeding 15% of body weight [40,41]. This change of the spine increases use of energy, which is reflected in the changes of the body's saturated oxygen [42]. While wearing a heavy backpack for a long time could increase musculoskeletal stress, it has been reported that paraspinal muscle activity is higher in people with chronic LBP both before and after the carrying activity. Prolonged muscle activity may generate muscle fatigue. Thus, compensatory mechanisms could be activated such as decreasing the contraction of any primary muscle and activating accessory muscles, which ultimately could result in postural and movement alterations [42–44].

Besides backpack weight, some characteristics of the backpack could lead to postural and movement alterations. To illustrate this, Chen and Mu [45] found that carrying a backpack a the T12 level could reduce the trunk flexion and back discomfort, while Pascoe et al. [40] found that an asymmetrical backpack carrying method increased lateral spinal deviation during walking.

Dockrell et al. [46] and recently Yamato et al. [47] found that the results reported in literature assessing the relationship between the backpack weight and NSLBP are contradictory and inconclusive; they also found that the recommended backpack weight limit for school children varies between 5% and 20% of his/her body weight. The cut-off point distinguishing "heavy" and "less heavy" backpacks in this study was 11.9%, at the middle percentage the range cited in literature.

4.2. Passive smoking and NSLBP

Our study showed a significant association between passive smoking and NSLBP. Uei et al. [48] attributed this relationship to changes in the gene expression in intervertebral discs. Several studies have shown the association between active smoking and NSLBP in children and adolescents [18,49–52]. In a meta-analysis, Shiri et al. [53] concluded that current adolescent smokers had a greater incidence of NSLBP than those who had never smoked (OR = 1.82 95% CI 1.42–2.33). In contrast, the only two studies investigating the relationship between passive smoking and NSLBP in childhood did not find an association [4,54]. Therefore, the relationship of passive smoking and NSLBP needs further investigation.

4.3. Age and NSLBP

We found a direct association between age and NSLBP, although the age of 10 years old was not statistically significant. A direct association between age and NSLBP has also been reported in the literature. Younger children may be less exposed to physical and environmental risk factors because they are less exposed to high intensity activity in comparison to the older children [10]. Also, older children tend to show greater sensitivity to pain as a result of puberty. Burton et al. [55] found an increase of NSLBP after 12 years of age, which is possibly a reflection of puberty growth and the greater tension of the spine with greater time spend at school.

4.4. Strengths and limitations

A strength of this study is that the backpack weight was assessed using subjective and objective measurements. Also, we studied not only the backpack weight but also the type of backpack. Another strength is that The Non-specific Low Back Pain Questionnaire and the Non-specific Low Back Pain's Characteristics Questionnaire have acceptable reliability in Colombian children.

This study has some limitations. Compared with similar previous studies, the sample is small for an epidemiologic study, unbalanced as regards the gender and composed by children who attend a very special

school. Particularly, for perceived backpack weight, pain may have affected reports; it means that those with chronic pain could identify a heavier backpack. Also, we cannot determine the causality because this was a cross-sectional study. Moreover, it is not possible to determine whether the results are influenced by the amount of physical activity that children perform or not. Additionally, psychosocial characteristics that have previously been demonstrated to influence NSLBP were not assessed. In consequence, the results may not be generalizable.

5. Conclusion

We concluded that the prevalence of low back pain in boys and girls between 10 and 12 years old was high compared with previous studies. The variables associated to NSLBP in the multivariate analysis were: Backpack weight/body weight relationship, perceiving that the backpack is very heavy, passive smoking, and age. Although a causal relationship cannot be confirmed, biological plausibility is high that backpacks contribute to back pain. Therefore, variables associated with methods of carrying a backpack deserve further investigation as well as we recommend further prospective studies that can determine if the associations that we found in this cross-sectional study are cause-and-effect relationships in order to better plan appropriate preventative interventions.

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Conflict of interest

None to report.

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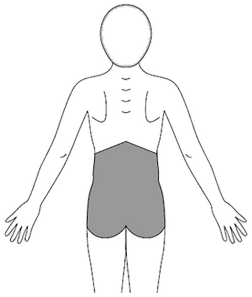
Appendix

Non-specific Low Back Pain Questionnaire[1]

Subject number: ☐☐

1. In the past month have you experienced pain in the lower back (lumbar region) which lasted for one day or longer? ☐
   ☐ Yes (1)
   ☐ No (0)
2. In the past month have you experienced pain in the shaded area which lasted for one day or longer?

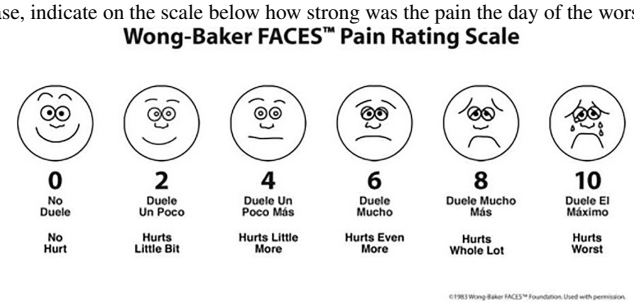


   ☐ Yes (1) ☐
   ☐ No (0)

[1]Watson KD, Papageorgiou AC, Jones GT, Taylor S, Symmons DP, Silman AJ, et al. Low back pain in schoolchildren: occurrence and characteristics. Pain. 2002; 97(1-2): 87-92.

Characteristics of the Non-specific Low Back Pain

1. In the past month, how many days have you experienced pain in the lower back (lumbar region)? ☐
   ☐☐ days
2. Please, indicate on the scale below how strong was the pain the day of the worst pain in the last month[2]. ☐



3. Usually, how long is the pain in the lower back (lumbar region)? ☐
   ☐ < 12 hours (0)
   ☐ 12–24 hours (1)
   ☐ 1–7 days (2)
   ☐ > 1 week (3)
4. Is the lower back pain going down the leg? ☐
   ☐ Yes (1)
   ☐ No (0)
5. Indicate which of the following persons consulted during the last year for your back pain:
   5.1 Physician ☐ Yes (1) ☐ No (0) ☐
   5.2 Physiotherapist ☐ Yes (1) ☐ No (0) ☐
   5.3 Nurse ☐ Yes (1) ☐ No (0) ☐
   5.4 Other ☐ Yes (1) ☐ No (0) ☐

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