Child Labor and Musculoskeletal Disorders: The Pelotas (Brazil) Epidemiological Survey

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SYNOPSIS

Objectives. This article describes the prevalence of musculoskeletal pain in several anatomic sites in children and teens, and investigates, while adjusting for potential confounders, the association between musculoskeletal pain and back pain and the following: age, gender, sports practice, use of computer/video games/television, school attendance, intensity of involvement in household domestic activities, care of other children, care of sick/elderly family members, work activities, and workloads.

Methods. We conducted a cross-sectional study interviewing 3,269 children aged 10–17 years in the low-income areas of Pelotas, Brazil.

Results. The prevalence of pain in the neck, knee, wrist or hands, and upper back exceeded 15%. Workers in manufacturing had a significantly increased risk for musculoskeletal pain (prevalence ratio [PR]=1.31) and for back pain (PR=1.69), while workers in domestic service had 17% more musculoskeletal pain and 23% more back pain than nonworkers. Awkward posture (PR=1.15) and heavy physical work (PR=1.07) were associated with musculoskeletal pain, while monotonous work (PR=1.34), awkward posture (PR=1.31), and noise (PR=1.25) were associated with back pain.

Conclusions. Musculoskeletal pain is common among working children and teens. Knowledge of occupational risk factors can support actions to restructure work conditions to reduce or eliminate childhood exposure to hazardous conditions. Our results suggest that strategies to prevent musculoskeletal disorders in child workers should be developed.

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Child labor exploitation is a worldwide problem with more than 350 million economically active children between the ages of 5 and 17 years old, almost half of whom are engaged in hazardous work.[1] Developing countries account for 95% of the working children, and Brazil has 5.4 million children from age 5–17 in the labor market.[1,2]

Although children and adolescents are commonly employed in activities in which they are exposed to workloads associated with musculoskeletal disorders, little research has been carried out on these occupational age groups.[3] According to Parker et al., sprains and strains are the most frequent types of injury among teens, and low- and mid-back injuries represent 73% of the work-related events that cause adolescents to miss work or school.[4] Several studies reported that more than 30% of the adolescents had low back pain during their lives, confirming its importance as a public health problem.[3,5,6] The risk factors most frequently evaluated for musculoskeletal disorders are age, gender, smoking, sports, and sedentary activities. Occupational factors have not been evaluated in this age group.[5]

Among adults in Western societies, musculoskeletal disorders remain one of the major health problems with a point prevalence of approximately 30% in people aged 25–74 years.[7] The lifetime occurrence of low back pain is estimated at 80%.[6] A Pelotas, Brazil, population-based study found 4.2% of chronic low back pain in people aged >20 years old.[8] Frequently, these problems in adults are related to work, particularly with activities that involve repetition, vibration, lifting, forceful movement, awkward posture, heavy physical work, and static work posture.[7,9–11] Thus, despite controversy about the relative importance of individual and occupational factors to musculoskeletal problems, there is consensus that the magnitude and cost of the morbidity justify serious efforts to better understand its etiology.[9,12]

Children and teen workers should be the focus of even greater concern because they might be more susceptible to musculoskeletal disorders and could experience worse consequences. From age 10–20 years, an individual acquires 15% to 20% of his or her height. About half of that growth occurs during a two-year period that includes the phase of most rapid growth; girls reach this phase at an average age of 12 and boys at an average age of 14.[12] During this period, teens are at particularly high risk of injuries to ligaments and to bone growth plates.[12,13] Ergonomic factors also could contribute to the increased risk of musculoskeletal disorders among children and teens because of mismatches between their size and the dimensions of equipment, tools, or machinery designed for adults.[12,13] Among the consequences, studies have reported that injuries of growth plates in teens could result in various osteochondroses, some of which lead to long-term orthopedic problems, including limbs of unequal length.[12] Furthermore, prior back problems are one of the strongest predictors of new back injuries.[14] Thus, another reason for concern is the long-term consequences of an early musculoskeletal disorder.

Children and teens should not be engaged in hazardous work. Thus, it is important to identify work activities and workloads that increase the risk for musculoskeletal disorders to define appropriate standards of protection respecting this age group's particularities. Knowledge about occupational risk factors can support actions to restructure work conditions by reducing workload exposure to acceptable standards or to withdraw the children from hazardous work activities. This article describes the prevalence of musculoskeletal pain in several anatomic sites in children and teens, and investigates the association between work activities and workloads with musculoskeletal pain and back pain, adjusting for confounding factors.

METHODS

We conducted a cross-sectional study in the low-income areas of Pelotas, Brazil. *Low-income neighborhoods* are defined by the population census as areas where less than 1.5% of heads of households earn more than $2,000 U.S. monthly (U.S.$100=the Brazilian minimum salary).[15]

According to the Brazilian census, the urban area of Pelotas has 300,000 inhabitants, 70 low-income areas with an average of 3.5 people per household, and 14% of the population aged 10–17 years old.[15] We randomly selected 22 of the 70 low-income tracts and interviewed all children aged 10–17 in each household within those areas.

The field work was conducted from January to June of 1998 by 24 students of medicine and nursing who were specially trained to collect this information. Quality control was addressed by having a supervisor review all questionnaires, identifying missing data, imprecise or inconsistent answers, and recollecting answers to select questions from 5% of the questionnaires to check data reproducibility.

The subjects—mothers (or their substitutes) and children—gave informed consent to participate in the study. The confidentiality of the information was guaranteed, as well as the right to refuse to participate. Mothers or their substitutes were interviewed about general characteristics of their families, while the children answered questions about their own work, health, and education.

Musculoskeletal symptoms were evaluated through the standardized Nordic questionnaire and characterized pain in the year before the interview in the following sites: neck, shoulders, elbows, wrists/hands, upper back, lower back, thighs, knees, and ankles.[16] To be more specific about the site of pain, in addition to verbal questions, subjects were shown a picture in which different sites of the body were presented in different colors. To evaluate pain intensity, those who complained of pain were asked whether it prevented them from carrying out any activity. According to Kuorinka et al., the reliability tests with the test-retest method showed that the number of non-identical answers varied from 0% to 23%, while the validity tests against clinical history showed that the number of non-identical answers varied between 0% and 20%.[16] The simple language of the questionnaire facilitated the translation and its use with children and teens from a different socioeconomic background than that in which the questionnaire was originally tested.

The study investigated the frequency of pain in the different anatomic sites and the association of independent factors with musculoskeletal pain and back pain. *Musculoskeletal pain* was defined as those who answered "yes" for experiencing pain, at any of the studied sites, in the year before the interview. *Back pain* was defined as those who gave positive

answers for experiencing pain in the neck, shoulders, and upper or lower back, in the year before the interview.

The analysis was performed in the software Stata 7.0 using the prevalence ratio (PR) and its 95% confidence interval (CI) as the measure of association.[17] Due to the high prevalence of musculoskeletal pain and back pain, we performed multivariate analysis using Poisson regression with a robust estimate of variance.[18] The multivariate analysis followed a hierarchical model to evaluate the risk factors for musculoskeletal pain and back pain, adjusting for potential confounders.

The model had age and gender in the first level. In the second level, the model included smoking, non-occupational activities such as school attendance, sports activities, use of computer/video games/television, domestic activities, care of other children, and care of sick/elderly family members. Domestic activities were categorized as the following: *none*, for those who reported no domestic activities; *light*, for those who tidy the house, carry small items, or complete errands; *moderate*, for those who help cook, remove dirt, shop, sweep the house, wash dishes, fix small items, or perform at least one of the designated heavy activities (i.e., regularly cook, clean house, wash clothes, or hang clothes to dry); and *heavy*, for those who do all the heavy activities noted above.

The main independent variables, work activities and workloads, were in the third level. We categorized the work activities into non-domestic services, domestic services, retail, construction, manufacturing, and other. Children not currently working were considered the unexposed group. The evaluated workloads were awkward posture, monotonous work, repetition, noise, and heavy physical work. The interviewed subject referred the presence or absence of the workload.

We adjusted each independent variable for every other variable in the same level, and for the variables in the previous levels. However, when evaluating the effect of a particular workload, we did not adjust the workload effect for work activities. A trend test was used to evaluate associations where the outcome was continuous. When the exposure was categorical, a Wald chi-square test was used. When the *p*-value was lower than 0.2, the exposure variable was left in the model as a potential confounder.

The workloads also were evaluated as intermediate variables in the association between type of work and musculoskeletal pain. We examined distal determinants as main exposure categories and then identified the mechanisms of determination. In fact, the distal determinants are synthetic indicators of exposure because they reflect a combination of exposures.[19]

Specifically, in our study, the distal determinants are the types of work children do that result in a combination of workloads intense or frequent enough to cause musculoskeletal pain or back pain. While analyzing workloads as mediators, the study presents their role in the determination mechanism of the studied association. The workloads mediator effect is expressed by the decrease in the prevalence ratio (PR) adjusted for confounding factors and workloads, when compared with the PR adjusted exclusively for confounding factors.[20]

RESULTS

The population studied was 3,269 children aged 10–17. This sample conferred at least 80% of statistical power to evaluate with 95% confidence the associations between the independent variables and musculoskeletal pain and back pain, adjusting for potential confounders, when the relative risk is higher than 80%. The studied subjects had an average age of 13 years (standard deviation=2.25), half were males, 76% were white, 93% were attending school, and 50% were from families with a household income of four minimum salaries (U.S.$400) or less per month. In the population studied, 13.9% were currently working, and 15.7% were not, but had worked previously. The estimate of eligible children missed by the study was 7.6%.

Among the 451 children who were currently working, 32.2% were in retail, 24.1% in domestic services, 22.5% in non-domestic services, 13.6% in construction, 4.1% in manufacturing, and 3.7% in other activities. Their salaries averaged 75% of the Brazilian minimum wage (U.S. $74); 85% were not registered workers (informal sector), and 39.3% worked 40 hours or more per week. Among child workers, 87.1% combined work and school, and 33.5% of child workers/students aged 14–17 attended school at night. Among the non-workers of the same age range, the frequency of attendance to school was 94.8%, and 14.6% of these students were attending school at night.

Pain in the neck, knee, wrists or hands, and upper back was reported by more than 15% of the sample. Workers in manufacturing had the greatest contrast with non-working children and the highest prevalence of pain in the neck (42.9%), shoulder (19.0%), wrists or hands (42.9%), upper back (23.8%), and thigh (19.0%). Construction workers had the highest prevalence of pain in the elbow (6.9%) and lower back (17.2%). Workers in domestic service had the highest prevalence of leg pain (18.9%) and knee pain (25.6%), and those in non-domestic services had the highest prevalence of pain in the ankles and feet (13.6%) (Table 1).

Evaluating workloads that could be related to musculoskeletal pain, we observed that workers in manufacturing reported the highest prevalence of awkward posture (33.3%), monotonous work (38.1%), repetition (66.7%), and noise (23.8%). Workers in construction had the highest prevalence of heavy physical work (32.0%) and the second highest prevalence of awkward posture and repetition (Table 2).

Approximately two-thirds of the children had musculoskeletal pain, and for 41.5% of them, the pain impaired some activity. Age and intensity of involvement in household domestic activities were directly associated with musculoskeletal pain. Sports practice, use of computer/video games/television, school attendance, and care of sick/elderly family member presented a significant association with musculoskeletal pain, with risks between 1.05 and 1.15 (Table 3).

When examining work activities, jobs in manufacturing and domestic services stood out. Musculoskeletal pain affected 90.5% of the workers in manufacturing and 78.9% of workers in domestic services. After adjustment for confounding factors, child workers in manufacturing presented 31% more risk of musculoskeletal pain than children who were

Table 1. Prevalence of pain in anatomic sites by work activity (*N*=3,269), Pelotas, Brazil, 1998

	Percent							
Body sites	*Not currently working (n=2,816)*	*Non-domestic services (n=110)*	*Domestic services (n=90)*	*Retail (n=152)*	*Construction (n=58)*	*Manufacturing (n=21)*	*Others (n=17)*	*Total (n=3,264)*[a]
Neck	21.8	26.4	27.8	18.4	20.7	42.9	23.5	22.1
Shoulder	9.7	17.3	10.0	11.2	8.6	19.0	5.9	10.1
Elbow	3.6	4.5	4.4	2.0	6.9	—	—	3.6
Wrists/hands	16.2	20.0	16.7	17.8	15.5	42.9	11.8	16.6
Upper back	15.2	13.6	18.9	19.7	19.0	23.8	11.8	15.5
Low back	13.3	12.7	11.1	10.5	17.2	9.5	—	13.1
Thigh	9.7	14.5	10.0	11.8	10.3	19.0	—	10.0
Leg	14.5	13.8	18.9	12.5	15.5	14.3	—	14.5
Knee	17.5	22.7	25.6	11.2	12.1	19.0	11.8	17.5
Ankles/feet	9.8	13.6	12.2	7.9	8.6	9.5	17.6	9.9

[a]Missing data are excluded.

not currently working, while those in domestic services had a risk of 1.17. The risks for musculoskeletal pain of child workers in manufacturing and domestic services were also significantly high when compared with workers in retail. Children exposed to awkward posture at work had 15% more risk of musculoskeletal pain than those who were not exposed to this hazard (Table 3).

Back pain was reported by 41.8% of the studied children, and for 32.8% of them, pain limited activity. Age and intensity of involvement in household domestic activities presented a direct linear trend with back pain. Females and smokers had an increased prevalence ratio (PR) of pain (PR=1.17; 95% CI 1.00, 1.30). Manufacturing (71.4%) and domestic services (54.4%) had the higher prevalence of back pain. After adjustment for confounding factors, child workers in manufacturing had 70% more back pain than children not currently working, while those in domestic services had 23% more risk of back pain (95% CI 1.04, 1.45). Child workers in manufacturing and domestic services also presented a significant increase in prevalence when compared with workers in retail. Exposure to monotonous work, awkward posture, and noise were significantly associated with back pain with respective risks of 1.34, 1.31, and 1.25 (Table 4).

The analysis in Table 4 explores the workloads mediator effect. Comparing the prevalence ratios for work activities after adjustment for confounding factors (Tables 3 and 4) with those adjusted for workloads (Table 5), we observed an important decrease in all prevalence ratios and the loss of statistical significance for the studied association. Hence, an important part of the work activity effects on musculoskeletal pain and back pain occurs via the studied workloads.

DISCUSSION

The Pelotas epidemiologic survey assessed the prevalence of musculoskeletal disorders in several anatomic sites in children aged 10–17. The study found an increased risk of musculoskeletal pain and back pain among children working in manufacturing and domestic services when compared with nonworkers and workers in retail. The exposure to awkward posture and heavy physical work increased the risk of musculoskeletal pain and were important intermediate variables in the association between work activity and this outcome. Awkward posture, monotonous work, and noise increased the risk of back pain and were important mediators in the association between work activity and back pain.

Table 2. Prevalence of workloads by type of work (*n*=451), Pelotas, Brazil, 1998

		Percent				
Work activities	n	*Noise*	*Awkward posture*	*Monotonous work*	*Repetition*	*Heavy physical work*
Non-domestic services	105	10.5	24.8	15.2	45.7	21.0
Domestic services	71	7.0	16.9	14.1	22.5	15.5
Retail	142	9.9	21.8	19.7	36.6	18.3
Construction	50	4.1	28.0	12.0	54.0	32.0
Manufacturing	21	23.8	33.3	38.1	66.7	23.8
Others	15	13.3	13.3	6.7	40.0	6.7
Total	404	9.7	22.8	17.1	40.3	20.0

NOTE: 47 cases were missing.

Table 3. Risk factors for musculoskeletal pain at any anatomic site (*N*=3,269), Pelotas, Brazil, 1998

		Poisson regression			
		Crude		*Adjusted*[b]	
Exposures	*Percent*[a]	*PR*	*95% CI*	*PR*	*95% CI*
1st level					
Age (years)					
10–11	59.1	1.00			
12–13	67.6	1.14	1.06, 1.23		
14–15	71.2	1.20	1.12, 1.29		
16–17	67.6	1.14	1.06, 1.23		
2nd level					
Sports practice					
No	62.6	1.00		1.00	
Yes	67.5	1.08	1.01, 1.14	1.07	1.01, 1.14
Use of computer/video games/television					
No	63.5	1.00		1.00	
Yes	67.7	1.06	1.01, 1.12	1.06	1.01, 1.11
School attendance					
No	60.1	1.00		1.00	
Yes	66.9	1.11	1.01, 1.23	1.15	1.03, 1.28
Household domestic activities[c]					
None	55.1	1.00		1.00	
At least one light	60.3	1.10	0.80, 1.50	1.07	0.79, 1.45
At least one moderate	62.7	1.14	0.87, 1.49	1.10	0.85, 1.43
At least one heavy	67.4	1.22	0.92, 1.63	1.17	0.89, 1.54
All heavy	70.7	1.28	0.97, 1.69	1.21	0.92, 1.59
Care of other children					
No	64.8	1.00		1.00	
Yes	68.4	1.06	1.00, 1.11	1.04	0.99, 1.10
Care of sick/elderly family member					
No	66.0	1.00		1.00	
Yes	73.2	1.11	1.02, 1.20	1.08	1.00, 1.18
3rd level—work activities					
Not currently working	66.2	1.00		1.00	
Non-domestic services	62.7	0.95	0.82, 1.10	0.92	0.80, 1.05
Domestic services	78.9	1.19	1.07, 1.33	1.17	1.05, 1.31
Retail	61.2	0.92	0.81, 1.05	0.90	0.80, 1.02
Construction	74.1	1.12	0.96, 1.31	1.08	0.91, 1.28
Manufacturing	90.5	1.37	1.19, 1.57	1.31	1.12, 1.52
Others	52.9	0.80	0.51, 1.25	0.80	0.61, 1.07
3rd level—workloads					
Awkward posture[d]					
No	66.0	1.00		1.00	
Yes	80.4	1.22	1.09, 1.36	1.15	1.02, 1.30
Heavy physical work[d]					
No	66.2	1.00		1.00	
Yes	78.8	1.18	1.07, 1.29	1.07	0.97, 1.20

[a]Percentages indicate the prevalence of musculoskeletal pain, at any site, in the year before the interview in each stratum.

[b]Values of the variables in the 2nd level and 3rd level—work activities adjusted for the variables in the 1st and 2nd levels; 3rd level—workloads adjusted for the variables in the 1st and 2nd levels and for the other workloads.

[c]Categories for household domestic activities were determined as follows: none=no activity; light=tidy up the house, carry small items, complete small errands; moderate=help cooking, remove dirt, shop, sweep, wash dishes, fix small things; heavy=regularly cook, clean up the house, wash clothes, hang clothes to dry.

[d]missing cases = 47

PR = prevalence ratio

CI = confidence interval

Table 4. Risk factors for back pain at any anatomic site (*N*=3,269), Pelotas, Brazil, 1998

		Poisson regression			
		Crude		Adjusted[b]	
Exposures	*Percent*[a]	*PR*	*95% CI*	*PR*	*95% CI*
1st level—demographic factors					
Age (years)					
10–11	32.5	1.00		1.00	
12–13	42.2	1.30	1.13, 1.50	1.30	1.13, 1.50
14–15	44.7	1.38	1.19, 1.59	1.38	1.19, 1.59
16–17	48.1	1.47	1.29, 1.68	1.47	1.29, 1.68
Gender					
Male	38.6	1.00		1.00	
Female	45.2	1.17	1.04, 1.31	1.17	1.04, 1.31
2nd level					
Smoking					
No	41.0	1.00		1.00	
Yes	52.6	1.28	1.12, 1.48	1.17	1.00, 1.36
Household domestic activities[c]					
None	29.0	1.00		1.00	
At least one light	32.8	1.13	0.78, 1.64	1.18	0.80, 1.72
At least one moderate	36.1	1.24	0.81, 1.90	1.27	0.84, 1.91
At least one heavy	43.0	1.48	0.94, 2.33	1.43	0.94, 2.18
All heavy	48.8	1.68	1.08, 2.62	1.49	1.00, 2.21
3rd level—work activities					
Not currently working	41.2	1.00		1.00	
Non-domestic services	41.8	1.01	0.81, 1.26	0.98	0.79, 1.21
Domestic services	54.4	1.32	1.11, 1.57	1.23	1.04, 1.45
Retail	41.4	1.00	0.86, 1.17	0.95	0.82, 1.11
Construction	44.8	1.09	0.80, 1.48	1.06	0.78, 1.43
Manufacturing	71.4	1.73	1.42, 2.10	1.69	1.32, 2.17
Others	29.4	0.71	0.40, 1.27	0.67	0.36, 1.24
3rd level—workloads					
Awkward posture[d]					
No	36.0	1.00		1.00	
Yes	62.8	1.50	1.31, 1.72	1.31	1.12, 1.53
Monotonous work[d]					
No	36.1	1.00		1.00	
Yes	66.2	1.59	1.30, 1.93	1.34	1.07, 1.68
Noise[e]					
No	36.3	1.00		1.00	
Yes	65.0	1.54	1.21, 1.96	1.25	1.00, 1.57

[a]Percentages indicate prevalence of musculoskeletal pain at any site in the year before the interview in each stratum.

[b]Values of the variables in the1st level adjusted one for the other; variables in the 2nd level and 3rd level—work activities adjusted for the variables in the 1st and 2nd levels; and 3rd level—workloads adjusted for the variables in the 1st and 2nd levels and for the other workloads.

[c]Categories for household domestic activities were determined as follows: none=no activity; light=tidy up the house, carry small items, complete small errands; moderate=help cooking, remove dirt, shop, sweep, wash dishes, fix small things; heavy=regularly cook, clean up the house, wash clothes, hang clothes to dry.

[d]missing cases=47

[e]missing cases=48

PR = prevalence ratio

CI = 95% confidence interval

Table 5. Evaluation of the workloads as a mediator of the association between work activities and the main outcomes (*N*=3,269), Pelotas, Brazil, 1998

	Poisson regression			
	Musculoskeletal pain[a]		*Back pain*[b]	
Work activities	*PR*	*95% CI*	*PR*	*95% CI*
Not currently working	1.00		1.00	
Non-domestic services	0.86	0.73, 1.00	0.83	0.66, 1.06
Domestic services	1.10	0.96, 1.26	1.08	0.87, 1.35
Retail	0.86	0.75, 0.99	0.83	0.66, 1.04
Construction	0.95	0.79, 1.15	1.03	0.76, 1.39
Manufacturing	1.20	1.00, 1.43	1.29	0.94, 1.77
Others	0.86	0.57, 1.30	0.70	0.33, 1.47

[a]Values adjusted for age, sports practice, use of computer/video games/television, school attendance, household domestic activities, care of other children, care of sick/elderly family member, awkward posture, and heavy physical work.

[b]Values adjusted for age, gender, smoking, household domestic activities, awkward posture, monotonous work, and heavy physical work.

PR = prevalence ratio

CI = confidence interval

In the Pelotas study, musculoskeletal disorder prevalence was high for children and adolescents, frequently resulting in some level of limitation in their daily activities. We did not find publications on the prevalence of musculoskeletal problems in all of the body sites we studied. Most of the available evidence is on adolescent back pain. Balagué et al.[5] found a lifetime (from birth until the interview) back pain prevalence (including cervical, lumbar, and thoracic sites) of 46% in adolescents, slightly higher than the Pelotas back pain prevalence in the year before the interview (Table 1). In the Balagué et al. study, the lumbar location was the most frequent site of back pain followed by thoracic and cervical sites,[5] while in the Pelotas study, the most frequent locations were cervical followed by thoracic and lumbar (Table 1). The variability in the age ranges, time frame, and exposures in the studied populations explains in part the differences in the reported prevalence and main affected sites.

Age was associated with musculoskeletal pain and back pain (Tables 2 and 4). In agreement with our results, other studies in adolescents reported an increase in the prevalence of low back pain with age.[5,6,9]

Gender was significantly associated with back pain but not with musculoskeletal pain (Tables 2 and 3). The association of gender and musculoskeletal disorders is controversial and varies according to site of pain.[9] However, studies on adolescents found a higher prevalence of low back pain among females when compared with males, in accordance with our survey.[3,5] The higher prevalence of musculoskeletal disorders in women is attributed to some physiological factors. One of them is the presence of more type one fibers in the trapezius muscle in women than in men, and others are the sexual dimorphism of the spine and the high incidence of dysmenorrhea, which sometimes is confounded with mechanical low back pain. Moreover, women have a different function in the labor market, frequently entering hand-intensive jobs. Thus, the higher prevalence of this outcome among women also can be related to the type of work and the type of workloads to which they are exposed.[9]

Smoking was significantly associated with back pain but not with other musculoskeletal pain (Tables 3 and 4). Several studies reported a positive association between smoking history and low back pain, sciatica, or intervertebral herniated disc; whereas in others, the relationship is negative.[5,9] One hypothesis for this relationship is that coughing from smoking causes back pain. Other proposed mechanisms include nicotine-induced diminished blood flow to vulnerable tissues and smoking-induced diminished mineral content of bone causing microfractures.[9]

Sports, use of computer/video games/television, and school attendance were significantly associated with musculoskeletal pain, but not with back pain (Tables 3 and 4). There is evidence that sports activities may cause injuries. Conversely, lack of physical activity may increase susceptibility to injury and is not clear vis-à-vis an association with musculoskeletal disorders.[5,9]

School attendance could increase the risk of injury since children play at school, but attendance also involves a large amount of time seated in a static posture and sometimes carrying heavy books. The use of leisure time for the computer, video games, or television suggests the habit of performing sedentary activities. In the Balagué et al. study, the prevalence of low back pain increased with the number of hours spent watching television.[5] The weight of schoolbags and how the children carry them, type of transport used to travel to and from school, time expended seated at school, and the type and intensity of physical activities at school are some of the details that would be useful to better understand these likely determination mechanisms.[5,21]

The increase in the intensity of involvement in household domestic activities was directly associated with musculoskeletal pain and back pain, while care of other children and care of sick or elderly family members were associated exclusively with musculoskeletal pain. We did not find other studies that examined the impact of these activities on musculoskeletal disorders; however, these activities involve exposures to heavy physical work and awkward posture through

the acts of washing and hanging clothes, carrying children, helping sick or elderly family members, and through the repetitive movements in some cooking tasks.

The few articles on adolescent musculoskeletal disorders do not evaluate the impact of their work.[3,5,6,21] The Pelotas study showed that work in manufacturing and domestic services was associated with musculoskeletal pain and back pain (Tables 3 and 4). The main jobs in manufacturing were carpenters/joiners, laborers (general), silk-screen workers, and bakers and food manufacturing workers. In many studies on adults, manufacturing does not appear as a high risk occupation for musculoskeletal disorders, but manual workers and blue collar workers are generally among the higher risk groups.[7,22] Moreover, there is strong evidence of a causal relationship between the workloads to which the child workers were exposed and pain in several of the studied sites.[9]

Domestic services appear second in terms of prevalence of pain at several sites. The main jobs performed were yard cleaners, nannies, and maids. Domestic service is among the most common urban child work activity in developing countries, and it employs a large number of girls.[14,23] In Brazil, 8% of the child workers aged 10–14 were employed in this type of work.[23] Description of domestic services' working conditions illustrates that some chores seem to be hazardous and that frequently children work for long hours and do not attend school.[24–26] In the Pelotas study, domestic service was not among the occupations that had a higher prevalence of workloads; however, the diversity of chores in this activity could have led to an underestimate of this prevalence. In contrast to other types of work in which the workloads are present during the whole working day, in domestic services the workloads can appear in one task but not in another. For example, a maid could be exposed to heavy physical work and awkward posture while washing and hanging clothes, but not exposed while cooking. In addition, these child workers might not recognize the workloads due to their similarity with the work they perform in their own home. Interestingly, in our study, domestic activities performed in the home also were associated with musculoskeletal pain and back pain.

Work in construction was not significantly associated with musculoskeletal pain and back pain (Tables 3 and 4). However, these workers reported the highest prevalence of heavy physical work and the second highest prevalence of repetition and awkward posture (Table 2). They also presented the highest prevalence of low back pain among all types of studied activities (Table 1). Studies on adults showed that construction is a high-risk activity for back problems. Rossignol et al.[22] found that construction workers had the greatest length of absence from work due to back problems, and Liira[7] found the highest prevalence of long term back problems among the workers in this activity. In the Pelotas survey, the low statistical power due to the small number of workers in construction could account for the lack of a significant association.

There is evidence that repetition, force, posture, and vibration are causally related to neck and shoulder, hands/wrists, and back pain.[9] The causal relationship between psychosocial factors and work-related musculoskeletal disorders is less consistent. However, studies suggest that monotonous work, limited job control, low job clarity, and low social support are associated with various musculoskeletal disorders.[9,12] The Pelotas study is in agreement with some of the previous evidence that awkward posture and heavy physical work were associated with musculoskeletal pain, while awkward posture, monotonous work, and noise were associated with back pain. Moreover, these workloads were mediators in the association between work activity and the studied outcomes (Tables 3–5).

The Pelotas study had a large sample with a low frequency of missing subjects. Moreover, the study included a detailed characterization of exposure and outcomes. Among the limitations of the study, we recognize that the cross-sectional design sometimes results in difficulty establishing the directionality of associations. For example, it is plausible that children not currently working had left work due to a musculoskeletal disorder.[27] Most of the temporal ambiguity problem would bias the associations toward the null hypothesis. Moreover, workers in general are healthier than nonworkers because to be a worker implies some type of selection. This healthy worker effect might have resulted in underestimating the magnitude of associations. Anthropometric factors such as weight, height, body mass index, and obesity are potential risk factors for the studied outcomes and were not evaluated as potential confounders in the association between work activities and musculoskeletal disorders.

We found a high prevalence of musculoskeletal pain in several sites among children and teens. The study confirms the available literature on the association of age, gender, sports activities, and sedentary activities with the morbidity studied. The study also explored the role of activities performed in the children's homes (domestic activities, care of other children, and care of sick/elderly family members), showing their association with musculoskeletal disorders and enlarging the evaluation of etiological factors. The main contribution of this study was the identification of manufacturing and domestic services as high-risk occupations for musculoskeletal pain and back pain detailing the workloads determination mechanism.

The prevalence of musculoskeletal pain and its potential long-term effects justify early prevention of the problem. McCauley[28] tested a preventive program incorporating body mechanics instruction. Young workers who participated in the program performed better in using proper body mechanics at work.[28] More preventive strategies need to be proposed and evaluated through intervention studies.

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Photo: David L. Parker

Children playing in the fountain at the Museum of Anthropology (Mexico 1992)