

# Physical activity and low-back pain in schoolchildren

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**Abstract** Design of the experiment is to study the cross-sectional sample with retrospective information. The objective is to identify the types of physical activity associated with the decreased occurrence of low-back pain (LBP) in schoolchildren. Physical activity may be hypothesized to possess a potential for LBP prevention. The possible connection between LBP and specific sports activities is however sparsely documented. A total of 546, 15- to 16-year-old schoolchildren filled a questionnaire on current physical activities and LBP occurrence and severity. In multiple logistic regressions, the association of LBP with exposure variables was corrected for body height and weight (data from school health service files) and for anthropometric and school furniture parameters. More than half of the children reported pain or discomfort in the low-back region during the preceding 3 months, and 1/4 experienced a decreased functioning or need of care because of LBP. LBP correlated with physical inactivity, e.g. time spent on homework and hours watching TV or video, and with a series of sports activities, e.g. jogging, handball playing and gymnastics. Among sports activities, only swimming and the number of hours per week participating in soccer were associated with a decreased LBP prevalence. With the exception of swimming and soccer, the types of sport reported by this schoolchild population do not offer

themselves for consideration as tools for LBP prevention. Based on the associations found with indicators of physical inactivity, attempts to motivate the children to increase their general physical activity level should be considered for trial.

**Keywords** Adolescents · Low-back pain · Physical activity · Prevention · Health promotion

## Background

Low-back pain (LBP) is frequent among schoolchildren [1–8]. The occurrence increases with age, especially in the early teen-years [1, 2, 9, 10] so that, by age 14–17, 11–71% will have experienced at least one episode of LBP [1–5, 9–11]. Recurrent LBP during childhood seems to occur among 5–19% of all children [4, 5, 9], and LBP in childhood may be a forerunner of LBP in adult life [12]. Findings concerning an association with gender have been ambiguous [1, 2, 5, 7–14].

In the light of the frequency of LBP and its eventual long-term consequences, preventive efforts should have the high priority. Mapping the etiology or at least a few risk indicators will be a prerequisite for the development of effective primary prevention. Moreover, the etiology is largely unknown and few risk factors have been identified, so that the etiology of LBP in childhood is still a matter of debate.

A family history of LBP seems to increase the risk [2, 4, 10, 12, 13, 15, 16], as does an accelerated growth rate [17], physically demanding occupational activity [5, 17], smoking [1, 5, 17, 18], and some psychological traits, e.g. depression and somatization [19, 20]. There are no clear associations with biological parameters such as body length [17, 21–23]; weight [22–24]; Body Mass Index [5, 14,

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22, 25]; length of the trunk [21, 23–25]; vertebral column mobility [5, 10, 23, 26, 27] and radiological changes of the vertebral column [12, 22, 28–32]. Also the findings concerning the association between LBP and general muscle strength [22, 27, 33, 34] and more specifically, hip flexor muscle flexibility [17, 26, 35] have been ambiguous.

Thus there is still room for hypothesizing LBP occurrence to depend on the amount and the intensity of physical activity. This hypothesis is attractive from the point of view of prevention, as physical activity is amenable to behavioral intervention, and physical training programs at school and leisure activities may be adjusted to aim at strengthening the back. Moreover, physical inactivity and intensive sports activity have been found to be associated with LBP in some [1, 5, 22, 34–36], but not all studies [7, 10, 16, 17, 23, 33]. So far, research on possible associations with specific types of sport is however sparse [13, 37]. Accordingly, the aim of the present study was to investigate the relationship between LBP in schoolchildren and measures of physical activity and inactivity.

## Materials and methods

The present study includes schoolchildren in the 9th grade of 14 public schools in the municipality of Aarhus, a Danish provincial town (population, about 300,000). Schools were sampled based on: (1) a 9th grade school quotient of at least 40 children per school, and (2) the availability of data from the school health service on body height and weight. Based on these criteria, 14 out of 26 eligible schools accepted to participate. The schoolchildren were informed in writing about the investigation and about the anonymity of the questionnaire. Participation was voluntary. All schoolchildren present on the day of data collection participated, in total 555. Nine children with a medically verified chronic back disorder were excluded, leaving 546 children for analysis.

Participants completed a questionnaire on LBP occurrence during the previous 3 months (period prevalence) including the intensity and duration of LBP and pain coping behavior, e.g. reduced daily activity and care seeking. LBP was defined as pain or discomfort in the low-back region, from the lower rib curvature to the lower part of the seat region, as visualized by a drawing shown in the questionnaire. Menstrual pain was specifically excluded from attention. The questionnaire asked about the overall physical activity during school and leisure hours and about specific sports activities; the weekly number of hours spent on specific sports activities; membership of sports clubs; participation in competition sport; watching TV or video; working at the computer or doing homework; transport of the school bag; vocational activity; smoking; school

furniture and furniture at home. Questionnaires were completed class-wise during school lessons, in the presence of one of the authors (B.S.), during 11 January 2002–30 April 2002. Data on body height and weight were collected from the school health service files. The questionnaire was tested in a pilot study including 17 schoolchildren in 9th grade.

In the statistical analyses, medians were computed for continuous variables [38]. To identify factors with impact on LBP prevalence, multiple logistic regression was applied, yielding odds ratios (OR) estimating the relative risk associated with a risk factor for either LBP or function-limiting LBP. For example, the relative risk of LBP for jogging would be  $p(\text{LBP}_{\text{jogging}})/p(\text{LBP}_{\text{not jogging}})$ . A value  $>1.0$  would indicate that jogging makes LBP more probable than not jogging. The OR of a single factor was derived from contingency table analyses that used Pearson's  $\chi^2$  to test the significance. Regression models were reduced by the use of backward elimination of variables with the  $\chi^2$  distributed  $-2\ln$  (likelihood ratio) as significance test for variable inclusion. Regression model fit was estimated by use of the Hosmer and Lemeshow statistic. Statistical significance required that the  $p$ -value be less than 0.05. Results were reported for the whole group and for gender-specific analyses. To reduce the risk of multi-collinearity, multiple regressions were performed separately for dichotomized and continuous predictors indicating the presence/absence, and amount of sports activity and physical inactivity. In the present context, data on furniture are exclusively used for confounder correction. The project complies with the Helsinki II declaration, and the database was approved by the National Data Inspectorate.

## Results

### Participation

Seventy-eight children (12.3%) did not participate because of absence from school on the day of questionnaire completion. Non-participants differed from participants concerning the body weight (mean 63.8 kg in non-participants versus 60.5 kg in participants) and Body Mass Index (mean 21.8 vs 20.6 kg/m<sup>2</sup>). In one of the schools, absenteeism and, consequently, project non-participation was more outspoken than in other schools (25.7 vs 11.7%). The age span was 14–17 years in the 546 respondents; 97.8% were 15 or 16 years of age and 53.3% were boys.

### Physical activity profile

During the preceding 3 months, 85.7% of respondents engaged in leisure time sports activities (median, 5 h/week

in children engaging in sports). Some children participated in more than one type of sports activity. The most prevalent types of sports were soccer (32.8%), jogging (28.8%) and biking (20.1%) (Table 1). Children playing soccer, handball or basketball, or who engaged in fighting, riding, playing golf or sailing, spent at least 3 h/week (median) on these. Only 1–6 children participated in squash, volleyball, athletics, sailing and rowing.

The day before questionnaire completion, 41.6% walked to school, 33.0% biked, 14.3% took the bus, and 10.3% were transported by car and 2.6% by motorbike. On the same day, only 15.2% made sports, preferably ball-play, during school breaks.

During the 2 days preceding questionnaire completion, the children spent a median of 2 h/day watching TV or video, 1 h at the computer and 1 h of homework. During the preceding weekend, a total of 4 h (median) were spent watching TV or video, 1 h at the computer, and 1 h doing homework.

#### LBP and LBP coping behavior

As much as 64.8% had ever experienced one or more episodes of LBP, and 60.3 and 51.3% reported LBP during the preceding 12 and 3 months, respectively. Nearly 1/4 (24.2%) reported LBP during the preceding 3 months, which had limited their daily activities or resulted in

**Table 1** Types of sport performed during leisure time (preceding 3 months) in 546 schoolchildren

Type of sport	Children		No. of hours per week	
	No.	(%)	Median <sup>a</sup>	Range
Soccer	179	32.8	3.0	0–15
Jogging	157	28.8	1.0	0–25
Biking	110	20.1	2.0	1–12
Dance	64	11.7	2.0	1–20
Handball	61	11.2	3.0	1–9
Badminton	47	8.6	2.0	0–10
Swimming	42	7.7	2.0	0–10
Fighting	41	7.5	3.0	1–14
Basketball	36	6.6	3.0	1–13
Gymnastics	35	6.4	2.0	1–13
Riding	24	4.4	3.5	1–22
Scouting	19	3.5	2.0	1–15
Golf	17	3.1	4.0	1–30
Tennis	15	2.7	2.0	1–7
Table tennis	13	2.4	1.0	0–15
Shooting	10	1.8	2.5	1–7
Other	104	19.0	3.0	0–30

<sup>a</sup> In children performing the specific type of sport

contact with the health care system. Thus, 5.9% had contacted their general practitioners, 0.7% had been treated at an outpatient clinic, 1.1 and 2.7% had visited a medical specialist or a physiotherapist, respectively; and 1.3% saw a chiropractor, 3.7% another type of therapist and 0.4% had been hospital inpatients.

#### Physical activity and LBP

Based on bivariate analysis, LBP was found to be un-associated with age and gender. In general, LBP and sports activities during leisure time were un-associated (OR 1.1,  $p = 0.625$ ), and LBP was furthermore unassociated with hours per week spent on sports activity (OR 1.0 h<sup>-1</sup>,  $p = 0.133$ ). Transport to school by car and some activities during school breaks correlated positively with LBP (Table 2).

Based on bivariate analysis, LBP as well as function-limiting LBP were positively associated with time spent on handball (in both cases, OR was 1.2 h/week;  $p = 0.017$  and  $p = 0.021$ , respectively). Also the time spent on gymnastics was associated with function-limiting LBP (OR 1.4 h<sup>-1</sup>,  $p = 0.030$ ). Concerning indicators of amount of physical inactivity, the number of hours watching TV or video, the preceding weekend or doing homework the day before questionnaire completion correlated positively with LBP (OR 1.1 h<sup>-1</sup> watching TV,  $p = 0.026$ , and OR 1.1 h<sup>-1</sup> doing homework,  $p = 0.018$ ), and the number of hours watching TV or video 2 days before questionnaire

**Table 2** Low-back pain (LBP) during the preceding 3 months, by physical activity (based on bivariate analysis) in 546 schoolchildren

Physical activity	LBP			Function-limiting LBP <sup>a</sup>		
	(%)	OR	$p$ -value	(%)	OR	$p$ -value
Type of sport						
Jogging	58.6	1.5	0.030	31.2	1.7	0.015
Handball	67.2	2.1	0.008	39.3	2.3	0.003
Swimming	40.5	0.6	0.145	7.1	0.2	0.007
Gymnastics	60.0	1.5	0.286	40.0	2.2	0.024
Riding	75.0	3.0	0.017	20.8	0.8	0.696
Scouting	36.8	0.5	0.200	0.0	0.8	0.012
Transport to school						
By car <sup>b</sup>	66.1	2.0	0.019	37.5	2.0	0.014
Activities during school breaks						
Sitting talking <sup>b</sup>	54.0	1.5	0.047	25.3	1.2	0.329
Standing talking <sup>b</sup>	58.1	2.0	0.000	28.1	1.8	0.007

Only activities significantly associated with LBP are presented

<sup>a</sup> LBP resulting in disturbed sleep at night, school absence, prohibition of normal leisure activities, or care seeking

<sup>b</sup> The preceding day

completion was positively associated with function-limiting LBP (OR 1.2 h<sup>-1</sup>,  $p = 0.013$ ).

In multiple logistic regressions, LBP was found to be positively associated with jogging, handball, gymnastics and riding, and negatively with swimming and hours spent playing soccer (Tables 3, 4). Handball was associated with LBP as well as function-limiting LBP, both as indicated by the mere activity and by the number of hours per week. Also jogging and gymnastics were associated with function-limiting LBP, whether indicated by binary variables or by the number of hours. Negative associations were found between swimming and function-limiting LBP (Table 3) and between the number of hours per week playing soccer and function-limiting LBP (Table 4). The number of hours per week swimming was borderline significantly negatively associated with LBP (OR 0.63,  $p = 0.065$ ). LBP was furthermore positively associated with a series of indicators of inactivity such as transport to school by car, standing talking during school breaks (Table 3), and time spent watching TV or video or doing homework (Table 4, Fig. 1). Analyses conducted separately for girls and boys did not reveal any gender difference.

## Discussion

The only type of sport found to correlate with a reduced LBP occurrence in the present period prevalence study

was swimming, whereas other types of sports, jogging, handball, gymnastics and riding, were associated with an increased period prevalence risk. The amount of physical activity, however, were ambiguous, as the LBP risk decreased by the number of hours playing soccer, whereas it increased by the number of hours jogging, playing handball and doing gymnastics. In addition, several indicators of physical inactivity took a negative role, e.g. being passively transported to school, not being physically active during school breaks, and the daily number of physically passive hours spent watching TV or video. The number of hours doing homework the day before the investigation was associated with LBP but inversely associated with the number of hours doing homework during the preceding weekend. A possible explanation to this apparent paradox could be that some schoolchildren may plan to do their homework during the weekend and therefore achieved a reduced stress level on weekdays.

As the observation of LBP incidence is time-consuming and probably can be performed only with modest validity, the present study, like most other studies on LBP etiology, is based on the observation of LBP period prevalence. Considering this being the best choice from a pragmatic point of view and with the object of reducing imprecision caused by memory failure, we chose a parallel 3-month perspective for indicators of physical activity and LBP

**Table 3** Significant ( $p < 0.05$ ) physical activity risk estimates (OR odds ratio, with 95% confidence limits by multiple logistic regression) of low-back pain (LBP) during the preceding 3 months in 546 schoolchildren

Dependent variable	Significant predictors	OR <sup>a</sup>	<i>p</i> -value	95% CL
LBP	Sports activity indicators			
	Handball playing <sup>b</sup>	2.35	0.005	1.29–4.28
	Riding <sup>b</sup>	3.46	0.015	1.28–9.35
	Physical inactivity indicators			
	Transport to school by car <sup>c</sup>	2.14	0.019	1.13–4.04
	Standing talking during school break <sup>c</sup>	1.87	0.001	1.28–2.73
Function-limiting LBP <sup>d</sup>	Sports activity indicators			
	Swimming <sup>b</sup>	0.19	0.009	0.06–0.67
	Jogging <sup>b</sup>	1.59	0.046	1.01–2.49
	Handball playing <sup>b</sup>	2.17	0.010	1.20–3.94
	Gymnastics <sup>b</sup>	2.23	0.043	1.03–4.84
	Physical inactivity indicators			
	Transport to school by car <sup>c</sup>	1.94	0.037	1.04–3.60
	Standing talking during school break <sup>c</sup>	1.61	0.039	1.03–2.53
	Doing homework during school break <sup>c</sup>	1.87	0.038	1.03–3.37

<sup>a</sup> OR adjusted for age and gender, Body Mass Index, physical activity and inactivity indicators, weight and transport of schoolbag, school, smoking, school furniture, furniture at home and the other predictors of the table. Model fits, both  $p > 0.6$

<sup>b</sup> The preceding 3 months

<sup>c</sup> The preceding day

<sup>d</sup> LBP resulting in disturbed sleep at night, absence from school, prohibition of normal leisure activities, or care seeking

**Table 4** Significant ( $p < 0.05$ ) physical activity per hour risk estimates (OR odds ratio, with 95% confidence limits by multiple logistic regression) of low-back pain (LBP) during the preceding 3 months in 546 schoolchildren

Dependent variable	Significant predictors	Per hour		
		OR <sup>a</sup>	<i>p</i> -value	95% CL
LBP	Sports activity indicators			
	Handball playing <sup>b</sup>	1.21	0.007	1.06–1.39
	Physical inactivity indicators			
	Watching TV or video <sup>c</sup>	1.07	0.014	1.01–1.14
	Doing homework/reading other things			
	The preceding day	1.27	0.001	1.11–1.45
	The preceding weekend	0.94	0.034	0.89–1.00
Function-limiting LBP <sup>e</sup>	Sports activity indicators			
	Playing soccer <sup>b</sup>	0.90	0.042	0.81–1.00
	Jogging <sup>b</sup>	1.19	0.005	1.05–1.34
	Handball playing <sup>b</sup>	1.16	0.029	1.02–1.32
	Gymnastics <sup>b</sup>	1.51	0.030	1.04–2.18
	Physical inactivity indicators			
	Watching TV or video <sup>d</sup>	1.18	0.007	1.05–1.34
	Doing homework/reading other things			
	2 days before investigation	1.17	0.047	1.00–1.35
	The preceding weekend	0.89	0.020	0.81–0.98

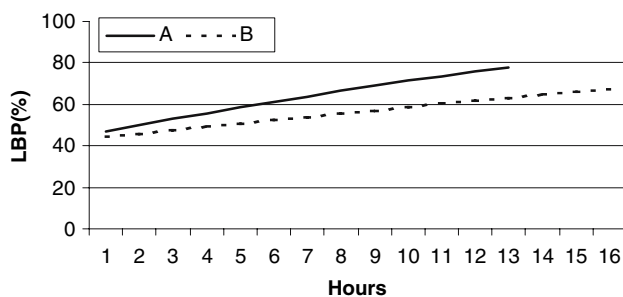
<sup>a</sup> OR adjusted for age and gender, Body Mass Index, physical activity and inactivity indicators, weight and transport of schoolbag, school, smoking, school furniture, furniture at home and the other predictors of the table. Model fits, both  $p > 0.6$

<sup>b</sup> Hours per week within the preceding 3 months

<sup>c</sup> Hours the preceding weekend

<sup>d</sup> Hours two days before the investigation

<sup>e</sup> LBP resulting in disturbed sleep at night, absence from school, prohibition of normal leisure activities, or care seeking



**Fig. 1** Estimated 3-month period prevalence (estimates based on logistic regression; both model fits,  $P > 0.4$ ) of low-back pain (LBP) by **a** hours preparing to school on the preceding day and **b** hours watching TV or video during the preceding weekend, in 546 schoolchildren

occurrence. However, some indicators of physical activity focused on the very near past, e.g. the day or the weekend before questionnaire completion.

Prevalence studies regarding LBP involve some “chicken-or-egg”-questions, i.e. indicators actually may denote consequences rather than causes of LBP, or they may include at least an element of LBP impact. Standing talking during the school breaks thus may denote an

example of physical inactivity associated with an increased LBP as well as a pain coping reaction. This also counts for other inactivity indicators. Being transported inactively to school has previously been demonstrated to be associated with LBP [16], and in another study LBP was observed more frequently in children who did not walk to school [39]. Also other authors have found LBP to be positively associated with time spent on watching TV [1, 37]. It is well documented that physical inactivity has biochemical consequences and may exert heavy impact on the connective tissue of the locomotor system [40]. Therefore, the association between the reported inactivity and LBP seems relevant.

The most prominent finding concerning leisure time sports activity seems to be the lack of an overall association with LBP, whether negative or positive. Consequently, it is not possible to conclude that, e.g. in general more sports activity will result in less LBP. This is in agreement with previous research [7, 10, 16, 17, 23, 33]. In a recent Danish study, no association was found between directly observed physical activity and LBP [41]. This contrasts the association between the amount of leisure time physical activity and the relatively low occurrence of recurrent low-back

pain found in males participating in a 25-year follow-up study [42]. Moreover, inferring about the possible role of specific sports activities may be even more problematic. Children with LBP would not be expected to possess a tendency to choose, e.g. team handball (with sudden and often rather violent movements) or jogging (with repeated pushes of the locomotor system, including the spine), why these associations could hardly be the result of selection bias. Furthermore, these two types of sport have been shown to be associated with pain in other regions, e.g. the knee [43]. Parallel etiologic mechanisms may be active as concerns riding and gymnastics.

In a previous study [13], associations between participation in volleyball and LBP have been found. The present study cannot highlight this question, as few children reported participation in volleyball.

In the present study, swimming was found to correlate with a relatively low-LBP period prevalence. This could, in theory, be a result of healthy children selecting this type of sport. However, swimming activates the muscles of the trunk, e.g. the erector muscles of the spine, so that there is a basis for considering swimming a tool for LBP prevention. The inverse correlation between hours playing soccer and LBP could denote a selection of healthy children playing soccer during many hours. Soccer has been found to be positively associated with chronic LBP [44], whereas other types of physical activities, such as regular walking and bicycling, have been found to be associated with less LBP [37].

In summary, with the exception of the case of swimming, the present research does not provide an observational basis for suggesting more sports activity with the aim of preventing LBP. On the other hand, the associations between inactivity measures and LBP may point to the desirability in avoiding physical inactivity in general and, conversely in promoting activity during and after school hours. Increased physical activity should, of course, not include activities shown to correlate positively with LBP. Before implementation, such low-back health promotion programs should be tested by use of randomized controlled trials conducted in relevant school populations.

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