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ORIGINAL ARTICLE

Low back pain at school: unique risk deriving from unsatisfactory grade in maths and school-type recommendation

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Abstract Psychosocial stress and pain may relate to educational selection. At the end of primary school (International Standard Classification of Education: ISCED level 1) children are recommended for one of three performance-based lower secondary level types of school (ISCED level 2). The study examines the association of educational selection and other risk factors with pain in the upper back (UBP), lower back pain (LBP), peripheral (limb) pain (PP), and abdominal pain (AP). Teacher reports of unsatisfactory grades in mathematics, and official school-type recommendation are included as objective psychosocial risk factors. One hundred and ninety-two schoolchildren, aged between 10 and 13 from 11 classes of 7 schools in Switzerland participated in the cross-sectional study. In logistic regression analysis, predictor variables included age, sex, BMI, participation in sport, physical mobility, weight of satchel, hours of daily TV, video, and computer use, pupils' back pain reported by the mother and father, psychosocial strain, unsatisfactory grade in mathematics, and school-type recommendation. Analysis of pain drawings was highly reliable and revealed high prevalence rates of musculoskeletal pain in the last 4 weeks (UBP 15.3%, LBP 13:8%, PP 33.9%, AP 20.1%). Psychosocial risk factors were uniquely significant predictors of UBP (psychosocial strain), LBP (psychosocial strain, unsatisfactory grade in mathematics, school-type recommendation), and AP (school-type recommendation). In conclusion, selection in terms of educational school system was uniquely associated with LBP in schoolchildren. Stress caused by educational selection should be addressed in primary prevention of musculoskeletal pain in schoolchildren.

Keywords Low back pain · Schoolchildren · Stress · Educational selection

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Introduction

For a long time low back pain (LBP) in schoolchildren was thought to be uncommon. Since the 1990s, however, the accepted view changed [2, 10, 15, 17]. Epidemiology showed prevalence rates of LBP in schoolchildren and adolescents that were comparable with numbers in adult populations [7]. As in adult unspecific LBP, i.e. LBP without an identified pathomorphological source of pain, various factors are associated with or predispose schoolchildren to LBP, including genetic, behavioural, ergonomic, and psychosocial factors. Moreover, there is increasing evidence that LBP in schoolchildren predicts LBP in later years [1]. Therefore, primary prevention efforts should address risk factors of unspecific LBP in children and adolescents [5].

Prevention of unspecific LBP in schoolchildren

Whereas ergonomic risk factors like weight of satchel [27] and chairs [25] can be addressed easily, interventions that address psychosocial factors are rarer and their prospects of success have been estimated to be low [4], because psychosocial factors are very heterogeneous and often seem to be out of reach in terms of prevention efforts (family problems) or unchangeable (socio-economic background). Moreover, the impact of psychosocial factors may be overstated, because associations between both

questionnaire measures could be boosted by common response bias [23]. Bias arises because the assessment of psychosocial factors often relies on self-report questionnaire data that are collected together with self-reports of back pain. Thus, the association may also reflect children's hypotheses about LBP and psychosocial factors; for instance, by attributing experienced symptoms to stress because this reflects plausible social stereotypes [20]. Hence, to be more responsive to primary prevention efforts assessment of psychosocial factors should include specific objective assessments of psychosocial risk factors within school.

Objective psychosocial risk factors

In this study, teacher reports of school grades in mathematics and school-type recommendation are considered as objective psychosocial risk factors. In many countries, school systems include educational tracks that define normative transition processes. In Switzerland, at the end of primary school (at the age of 13), students are evaluated by teachers according to grades and achievement tests and then recommended for a basic or expanded lower-secondary school track. In summary, in prediction of LBP we expect a unique contribution of psychosocial stressors assessed by questionnaire and by teacher reports operating beyond the known risk factors of LBP in schoolchildren.

Materials and methods

Sample

All schoolchildren were in the 5th year of school in the Aargau canton, Switzerland (mean age 11.4 years). At the end of the first semester of year 5 the decision is made in which upper school level a children will continue his/her school career. Before year 5 no selection has taken place. For the recruitment of the pupils 15 primary schools were contacted by email. The mailing went to head teachers, who were asked to transmit it to the teaching staff of classes of year 5. Seven schools agreed to participate, three refused and from five schools no feedback was received. All in all, 11 classes took part.

All 214 pupils of these classes were asked to participate in the survey through a letter sent to their parents. The parents had to confirm with a signature that their child could be tested and that the teacher could report school grades and school-type recommendations anonymously to the researchers. In 213 returned and signed forms, the parents of 192 pupils gave permission for them to participate and allowed the teacher to report grades and recommendations (90%). On the day of the survey 191 pupils (99.5%) filled in the questionnaire and the same pupils took part in the survey and were measured as described below. One of the registered children was ill on the day of the survey. For the statistical calculations 189 questionnaires (98.4%) were entered. Two completed questionnaires were omitted, one because the child suffered from medically diagnosed rheumatism and the other because a partially deaf child was integrated in a class. This child was 2 years older than the rest of the pupils, however.

The final sample consisted of 85 male pupils (45%) and 104 female pupils (55%). With regard to residential region 85 children were resident in a rural region and 104 children in an urban region. Table 1 shows sample characteristics.

Procedure

The cross-sectional study took place in January 2008. Data were collected at school during one or—in some large classes—two school lessons. The female data collector entered the classroom and explained that she wanted to ask the children about their life in school including questions about their well-being and health. She told the children that there were no right or wrong answers to the questions and explained that it was important to respond to all the questions in the questionnaire. The children were informed that there would be no grading of the questionnaire responses and that their questionnaire would not even be shown to their teachers. Then, the data collector demonstrated how to respond to a response option by making a mark. The schoolchildren were requested not to copy answers from their neighbours and not to write their name on the questionnaire. The data collector then asked the children to scroll through the questionnaire to the pain-drawing figure on page 3. All instructions regarding the questionnaire items were read aloud by one child. While the children responded to the questionnaire (25 min), the teacher left the room and the data collector was present and ready to answer children's questions. After all children had finished the questionnaire the teacher entered the room and started the lecture. As regards the children's seating arrangement in the classroom, three or four adjacent children left the classroom with their finished questionnaire for measurement of body weight and height, weight of satchel, and body flexibility. After these measurements had been taken, the children gave the questionnaire and their name to the data collector, who coded the questionnaire and checked whether all questions had been answered. After all measurements had been taken, the data collector entered the classroom again and thanked the children and teacher for their participation in the study.

Table 1 Socio-demographic characteristics of the study sample ($N = 189$)

Sample characteristics	Mean	SD	Range	Reliability
Age [mean (SD)] (years)	11.38	0.55	10.5–13	na
BMI mean (SD) (kg/m^2)	18.32	3.08	13.4–30.2	na
Stand and Reach test	1.63	0.67	1 (reach floor)	na
			2 (reach ankle)	
			3 (did not reach ankle)	
Weight satchel [mean (SD)] (kg)	3.39	1.06		na
Sport activity in leisure time [mean (SD)] (h)	2.30	0.67	1 (<1 h/week)	na
			2 (1–3 h/week)	
			3 (> 3 h/week)	
Daily TV, video, and computer use [mean (SD)] (h)	3.12	1.16	1 (not at all)	na
			2 (< 0.5 h)	
			3 (0.5–1 h)	
			4 (1–1.5 h)	
			5 (>1.5 h)	
Back pain mother	0.20	0.40	0 (no), 1 (yes)	na
Back pain father	0.19	0.39	0 (no), 1 (yes)	na
Psychosocial strain [mean (SD)] (Strengths and Difficulties Questionnaire, four subscales, 20 items, Goodman et al. [9])	10.37	5.10	0–40	0.74 (Cronbach Alpha)
			Items:	
			0 (no)	
			1 (to some extent)	
			2 (true)	
	n	%		
Females	104	55	0 (boys), 1 (girls)	na
Deficient math grade	9	4.8	0 (no), 1 (yes)	na
Basic school recommendation	49	25.9	0 (no), 1 (yes)	na
Secondary school recommendation	79	41.8	0 (no), 1 (yes)	na
Tertiary school recommendation	61	32.3	0 (no), 1 (yes)	na
Pain in last 4 weeks (pain drawing)				0.86 (Kappa)
Lower back pain (LBP)	26	13.8	0 (no), 1 (yes)	na
Lower lumbar region	10	5.3	0 (no), 1 (yes)	na
Middle and upper lumbar region	19	10.1	0 (no), 1 (yes)	na
Upper back pain (UBP)	29	15.3	0 (no), 1 (yes)	na
Shoulder	18	9.5	0 (no), 1 (yes)	na
Neck	8	4.2	0 (no), 1 (yes)	na
Upper back	8	4.2	0 (no), 1 (yes)	na
Peripheral (limb) pain (PP)	64	33.9	0 (no), 1 (yes)	na
Ankle	19	10.1	0 (no), 1 (yes)	na
Knee	41	21.7	0 (no), 1 (yes)	na
Elbow	9	4.8	0 (no), 1 (yes)	na
Wrist	10	5.3	0 (no), 1 (yes)	na
Abdominal pain (AP)	38	20.1	0 (no), 1 (yes)	na
Medical consultation in last 4 weeks	35	18.5	0 (no), 1 (yes)	na
…because of back pain	3	1.6	0 (no), 1 (yes)	na
One or more days off from school in last 4 weeks because of pain	35	18.5	0 (no), 1 (yes)	na
…because of back pain	3	1.6	0 (no), 1 (yes)	na

SD standard deviation, *na* not applicable

Measures

Pain assessment

In pain drawing or pain mapping, the children were asked to mark the areas of pain on an outline of a human figure and simply to shade those body areas where they felt pain [11, 22]. One child was asked to read aloud the question above the pain-drawing figure 'Did you feel pain for a day or even longer in the last 4 weeks? If yes, please paint on that body figure those areas where you felt pain for a day or even longer'. The data collector explained that the last 4 weeks meant the time since Christmas. The children then filled out the pain drawing. Good inter-examiner reliability of the pain drawing has often been shown in the literature [6, 21, 26]. In this study, LBP is considered as primary outcome; with respect to the specificity of associations of risk factors we also predicted pain in other regions of the musculoskeletal system (upper back and peripheral limb pain) and abdominal pain.

Psychosocial problem questionnaire

Psychosocial problems were assessed with the Strengths and Difficulties Questionnaire for 11–16-year-olds (SDQ) [9], including 20 items addressing emotional problems, hyperactivity, behavioural problems, and problems with peers. This study included the German version of the SDQ [8], each item having three response options (0 = no, 1 = sometimes, 2 = yes). Eschenbeck et al. [8] report the Cronbach alpha coefficient as indicator of reliability of the German version of the SDQ to be 0.72. A test of the present data confirmed satisfactory reliability (Cronbach alpha = 0.74).

Measurement of body weight, body height, weight of the satchel and body flexibility

The measurements were carried out by the researcher outside the classroom. The body weight of the children was measured with digital weighing scales accurate to a 100 g and their height was measured with a fixed measure scale. The weight of the satchel was measured with digital baby weighing scales accurate to ten grams. The physical body flexibility was assessed with a Stand and Reach test. The participants had to stand with closed but not completely straight legs, and then had to bend the upper part of the body forwards and let the arms hang down. The point where the fingertips reached was measured (1 = ground, 2 = ankle, or 3 = only level of shinbone).

Teacher reports of school-type recommendation and maths grades

If the parents had given their agreement to sampling of grades and school-type recommendations, the teacher filled out a form asking for the grades of the pupils in maths (grade 6 was the best grade, decreasing in stages of 0.5 to grade 1, the worst grade). Anything below grade 4 was an unsatisfactory grade. In the case of two unsatisfactory grades the class has to be repeated. The grade values were rounded to the nearest half and (with the agreement of the parents) were copied into a list at the end of the first semester of the school year 2007/2008. In addition to that teachers gave an appraisal for the next school level. The highly channelled educational tracks of the Swiss school system define normative transition processes. At the end of primary school (Grade 6 in most cantons), students are evaluated by teachers according to grades and achievement tests and then recommended for a basic or expanded *lower*-secondary school track [18]. For the schoolchildren in this study, school-type recommendations were threefold: basic school track (*Realschule*), secondary school track (*Sekundarschule*) with a somewhat expanded education, and tertiary school type (*Bezirksschule*) with expanded education.

The probability of entering a basic or expanded track depends not only on grades and achievement test results but can also be predicted by students' behaviour in classes and their socio-economic status [19]. Therefore, both objective indicators of psychosocial school-related stressors, i.e. maths grades and recommendation of school type, are teacher judgments that are highly relevant for the life of children in Switzerland [18]. The social meaning and potential individual significance of the basic versus expanded lower-secondary school track can be illustrated with respect to the next following transition into *upper*-secondary education track at the age of 16: "While all students can theoretically choose to enter any upper-secondary education track, the entrance examinations that determine admittance to upper-secondary general education, and the selection procedure to enter prestigious apprenticeships, are strongly based on the curricula of expanded lower-secondary school tracks [16], making transition difficult from one track to another. Moreover, the lower-secondary school tracks are an effective signal for teachers, parents, and students who adapt their expectations and strategies in making recommendations and choices for the future." [18, p. 43].

Data analysis

In order to predict pain we conducted multiple logistic regression analysis, using SPSS Version 17 (SPSS Inc.,

Chicago, IL). Predictor variables that entered the regression model were age (years), sex (0 = female, 1 = male), body flexibility as measured in the Stand and Reach test, BMI and weight of satchel assessed by weighing scales, self-reported information on sport activities, daily TV, video, and computer use, child reports of back pain from the mother and the father, the SDQ questionnaire values for psychosocial strain, teacher reports of deficient grades in maths and their secondary school-type recommendation. The potential differences between the 11 classes were controlled by inclusion of ten dummy variables. All P values in logistic regression analysis were two-tailed with α set to 5%.

Results

Prevalence of musculoskeletal pain and abdominal pain in schoolchildren

The coding of pain regions in pain drawings followed the scoring template of Margolis et al. [14]. Agreement in coding was tested in 25 pain drawings that were coded by two independent raters. The agreement was assessed by Cohen's kappa coefficient and was good (kappa = 0.86).The majority of schoolchildren reported to have experienced pain sometime in the last 4 weeks that lasted for 1 day or longer. Only 35 children (18.5%) reported no pain. Among 154 children who reported some pain, 106 reported pain in the upper or lower back, limbs, or abdomen. Table 1 shows prevalence rates of LBP, UBP, PP, and AP. In the last 4 weeks PP was most frequent (33%), followed by reports of AP (20%), UBP (15%), and LBP (14%). Of the 106 children with LBP, UBP, PP, or AP, 40 children reported pain in more than one region at a time (31 children reported pain in two regions, eight reported pains in three regions, and one child reported pain in all four regions). Ten combinations included simultaneous reports of UBP and LBP, i.e. out of 55 children who reported UBP or LBP, 10 reported pain in both regions.

Association between pains in body regions

Children who reported UBP were also more likely to report LBP ($r = 0.26$, $P < 0.001$). There were no other significant correlations between pains in different body regions.

Logistic regression analyses

Table 2 shows results of multiple logistic regression analyses where four regions of pain were regressed on anthropomorphic factors (age, sex, body flexibility, BMI), biomechanical load and activity (weight of satchel, sport activity, daily TV, video, and computer use), family risk factors (back pain mother, back pain father), and psychosocial risk factors (psychosocial strain questionnaire, teacher report of deficient grade in maths, and school-type recommendation).

Variance explanation in four regions of pain was 29% in UBP, 45% in LBP, 26% in PP, and 31% in AP (Nagelkerke estimate of R^2). The multiple risk factor logistic regression model was successful in correctly indicating those children most likely to report LBP (percentage of children who were predicted to report pain among those children who really did was 47%). Prediction was less satisfactory in UBP (17%). Percentage of correctly predicted pain was good in PP (47%), and somewhat lower in AP (35%). In prediction of LBP seven significant unique risk factors emerged. LBP was less frequent in younger children (OR = 0.16, CI 0.05–0.60). The weight of the satchel was a significant risk factor in multiple logistic regression of LBP (OR = 2.35, CI 1.27–4.34). LBP was less likely in those children who reported longer daily use of TV, video, and computer (OR = 0.48, CI 0.27–0.85). Meanwhile three out of four psychosocial risk factors were significant predictors of LBP (psychosocial strain questionnaire: OR = 1.15, CI 1.01–1.31; unsatisfactory maths grade: OR = 15.08, CI 1.37–165.99; secondary school recommendation: OR = 4.77, CI 1.04–21.86). Only one significant risk factor emerged in prediction of UBP (more reported psychosocial strain), and prediction of PP (less PP in girls). Prediction of AP indicated two significant risk factors (more AP in girls, more frequent AP in children with basic school recommendation, compared with children with most prestigious tertiary school recommendation).

Discussion

In this study, for the first time grades in mathematics and school-type recommendation were considered as objective psychosocial risk factors for LBP in schoolchildren. The study focused on a (pre)transition period as a special opportunity for the study of psychosocial risk factors that were new for all children: for the first time in their educational career children experienced a career transition at the end of primary school (International Standard Classification of Education: ISCED level 1) when children received their recommendation for one of three performance-based lower secondary level types of schools (ISCED level 2). Results confirmed psychosocial stress to be associated with back pain.

Because school-type recommendations and unsatisfactory grades in math were reported by teachers, the association of LBP with objective specific psychosocial

Table 2 Logistic regression analyses predicting upper back pain (UBP), lower back pain (LBP), peripheral (limb) pain (PP), and abdominal pain (AP) in schoolchildren ($N = 189$)

	Low back pain (LBP)			Upper back pain (UBP)		
	OR	*P* value	CI (OR)	OR	*P* value	CI (OR)
Age	0.16	0.01	0.05–0.60	1.31	0.55	0.53–3.21
Sex	0.48	0.26	0.14–1.70	0.99	0.98	0.38–2.53
Stand and Reach test	1.03	0.94	0.44–2.41	1.20	0.59	0.62–2.36
BMI	1.19	0.06	0.99–1.43	1.07	0.44	0.91–1.25
Weight satchel	2.35	0.01	1.27–4.34	0.89	0.63	0.55–1.43
Sport activity	1.74	0.21	0.73–4.16	1.01	0.98	0.51–1.98
Daily TV, video, and computer use	0.48	0.01	0.27–0.85	0.75	0.17	0.50–1.13
Back pain mother	2.39	0.20	0.63–9.02	1.64	0.34	0.59–4.53
Back pain father	1.96	0.36	0.46–8.33	1.88	0.26	0.62–5.65
Psychosocial strain	1.15	0.04	1.01–1.31	1.15	0.01	1.03–1.27
Math problem	15.08	0.03	1.37–165.99	0.52	0.69	0.02–13.60
Basic school recommendation	1.74	0.57	0.26–11.65	0.32	0.13	0.07–1.42
Secondary school recommendation	4.77	0.04	1.04–21.86	0.85	0.76	0.29–2.50
	Peripheral (joint) pain (PP)			Abdominal pain (AP)		
	OR	*P* value	CI (OR)	OR	*P* value	CI (OR)
Age	1.06	0.88	0.51–2.20	1.51	0.33	0.66–3.45
Sex	0.47	0.05	0.22–1.01	4.25	0.01	1.46–12.37
Stand and Reach test	0.69	0.20	0.40–1.21	1.12	0.73	0.58–2.17
BMI	1.00	0.98	0.88–1.14	0.93	0.34	0.81–1.08
Weight satchel	0.97	0.86	0.67–1.40	1.03	0.89	0.66–1.61
Sport activity	1.64	0.10	0.92–2.94	1.02	0.95	0.53–1.99
Daily TV, video, and computer use	0.76	0.12	0.54–1.07	1.42	0.10	0.94–2.17
Back pain mother	0.81	0.66	0.32–2.06	1.42	0.51	0.50–4.04
Back pain father	2.31	0.08	0.90–5.98	1.10	0.87	0.36–3.38
Psychosocial strain	1.07	0.14	0.98–1.16	1.01	0.79	0.91–1.13
Math problem	0.11	0.09	0.01–1.37	0.58	0.62	0.07–4.97
Basic school recommendation	2.25	0.17	0.70–7.20	5.19	0.03	1.18–22.85
Secondary school recommendation	1.43	0.44	0.58–3.52	3.33	0.06	0.95–11.66

$N = 189$. Results are controlled for being in 11 different school classes (10 dummy variables). *OR* odds ratio, CI (OR): 95% confidence interval of the odds ratio. *P* significance level of logistic regression coefficient; sex (0 = m, 1 = f), Stand and Reach test (1 = reach floor, 2 = reach only ankle, 3 = did not reach ankle), BMI (kg/m^2), weight satchel (kg), sport activity (1 = <1 h/week, 2 = 1–3 h/week, 3 = >3 h/week), daily TV, video, and computer use (1 = not at all, 2 = <0.5 h, 3 = 0.5–1 h, 4 = 1–1.5 h, 5 = >1.5 h), back pain mother (0 = no, 1 = yes), back pain father (0 = no, 1 = yes), psychosocial strain (0–40), math problem (0 = no, 1 = yes), basic school recommendation (0 = no, 1 = yes), secondary school recommendation (0 = no, 1 = yes)

stressors rules out bias from children's hypotheses about LBP and psychosocial factors. Bias may arises when the assessment of psychosocial factors solely relies on self-report questionnaire data that are analysed together with self-reports of back pain. In this study, however, psychosocial stressors included teacher reports and therefore common response bias is ruled out [23]. Thus, results underline the importance of psychosocial factors in children's LBP shown in previous studies [13, 28]. Hence, to be more responsive to primary prevention efforts assessment of psychosocial factors should include specific objective assessments of psychosocial risk factors within school.

A change of school, particularly transfer to the selective secondary school level, seems to be a stressful element for many children [3]. Recommendation of a lower-ranking school type, however, for the first time in the children's life includes a selection related to social status that may evoke social distance as a stressful condition. Future longitudinal studies should explore the reversibility of LBP after transition.

The association of unsatisfactory grades in maths and LBP in children needs in-depth examination. Mutual influence can be assumed: LBP may distract from teaching and lower achievement. Lower achievement during

qualification periods raises pressure. In the end, a vicious cycle may arise, and this cycle should be broken. So far, many researchers are sceptical with respect to primary prevention efforts that really can address concrete psychosocial factors in schoolchildren: '…since the literature shows that back-pain related reports of schoolchildren are mainly associated with psychosocial factors, the scope of the LBP prevention may be limited' [5, p. 663]. The current study shows concrete risks that can be covered. Regarding the school-type recommendation prevention should address procedures of school career transitions, decision-making and the quality of communication between teachers, children, and parents. In addition, the permeability of educational career tracks should be further increased. Regarding children's coping during qualification periods, future investigations should also focus early on the area of stress and strain management at school [12].

Limitations

One limitation of the study is the lack of detailed information on potential specific medical causes of back pain in children. The bias from this limitation, however, is presumably small; only 3 out of 35 children who reported a medical consultation in last 4 weeks were treated for back pain. Furthermore, the data collector asked the children during the measurement of body weight if their pain originated from an accident. Only two children reported an injury. A second important limitation is that the study is only cross-sectional and no causal inferences can be drawn.

Conclusion

Specific psychosocial stressors that are related to the selection tracks in the Swiss educational school system are uniquely associated with LBP in schoolchildren. Primary prevention of LBP in schoolchildren and prevention of LBP in adulthood should address these specific stressors. Clinical diagnostics should address problems in school career transition periods.

Conflict of interest None.

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