

Preventing back pain in schools: a dual epidemiological and ergonomic approach

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Abstract

There is no consensus on the risk factors for juvenile low back pain, and the results vary among studies. Risk factors, whether mechanical or psychosocial, cannot be considered in isolation. Therefore, a systemic approach of analysis is essential, focusing on the child as an individual undergoing constant physiological, cognitive and emotional change. This approach would make it possible to investigate real-case scenarios experienced by children and to consider all the constraints of their living environment. Therefore, this paper presents an ongoing study which looks at low back pain in children and the risk factors associated with the school environment. Consequently, a physiotherapist (GA) proposes to combine an epidemiological study in Lebanon, an approach commonly used to address this type of issues but not carried out to our knowledge in Lebanon, with an ergonomic study, an approach not investigated a lot to answer the question of low back pain in children in the school environment.

CCS Concepts

• **General and reference** → Document types; Surveys and overviews.

Keywords

Student health, Back pain, Ergonomics, Work organization

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1 INTRODUCTION

1.1 Early prevention of back pain & risk factors linked to the school environment

The prevention of non-specific back pain is a major public health issue. Back pain can appear during children's period of growth, reaching a prevalence rate of up to 74% [1, 8, 9, 15, 16, 19, 20], with a predominance in children aged 11 to 16 [1, 8]. Growing pains are well known and correspond to short-lived, spontaneous pains that have no disease value and affect up to a third of children. But sometimes the pains are linked to risk factors that are now well-known, including mechanical, psychosocial and lifestyle-related factors. The etiology of non-specific low back pain, i.e. with no identifiable pathology, remains uncertain today [21]. Several studies blame various factors such as posture, physical inactivity, obesity, time spent in front of screens, sleep, furniture not adapted to the child's morphology, the weight of the schoolbag or the way it is carried. Carrying a school bag has been extensively studied by other researchers. Some focused on the weight of the bag [17], whereas others focused on the adjustment of shoulder straps, which have a greater or lesser impact depending on the pressure exerted on the shoulders [12], or on the way the bag is worn on one or both shoulders [13]. According to the French order of physiotherapists, posture, time spent in front of screens or sleep are not responsible for low back pain. The weight of the schoolbag itself and the way it is carried (by hand, on one shoulder, two shoulders) do not appear to be risk factors either. However, a schoolbag that the child finds difficult to carry or that he or she feels is too heavy does seem to be a risk factor for back pain.

Other studies have focused on psychosocial risk factors. They suggest that psychosocial factors are more directly linked to low back pain in children than mechanical factors [21]. Psychosocial factors, often referred to in terms of "heightened emotionality", "conduct problems" or "stress", are therefore increasingly the focus of attention [5, 14, 18]. Once again, however, the results of these studies are relatively non-consensual. An analysis of the studies highlights the fact that the definition of the factors studied can vary greatly from one study to another, as can the used assessment tools.

1.2 School ergonomic approach

Risk factors, whether mechanical or psychosocial, obviously cannot be considered in isolation. There are many contributing factors in low back pain. A systemic approach of analysis is essential, focusing on the child as an individual undergoing constant physiological, cognitive and emotional change. This approach would make it possible to investigate the realities experienced by children and to consider all the constraints of their living environment [4]. One entry point for analysis may be the students in the school environment through all the diverse and variable situations they experience, considering the diversity of contexts of work situations [3, 11]. This would make it possible to consider all the factors, whether physical, cognitive, social, organizational, environmental or other. Preventing back pain in children by working on the risk factors linked to the school work situations supposes to look at physical activity (or physical inactivity) and question it at school in terms of how the day and the activities are organized (time spent in front of screens, physical and sports activities, frequency of movement between lessons from one room to another, classroom activities), but also at home in terms of family and extracurricular activities (time spent in front of screens, physical and sports activities). Talking about poor posture needs to look not only at the furniture and equipment available at school, but also at the way children settle in at home and the equipment and materials available at home (e.g. availability of a desk), according to family rules.

In a school ergonomics approach [11], the starting point for the analysis is the student. This child or adolescent is considered to be a worker, but a worker in constant physiological, cognitive and affective development and maturation, having to carry out certain tasks prescribed by the teacher in a complex and changing work environment, in rigid time frames but with varied time units (hour, week, fortnight, term), and with unevenly distributed workloads [4].

1.3 Proposed dual ergonomic and epidemiological approach

This study presents an ongoing study which looks at low back pain in children and the risk factors associated with the school environment. A physiotherapist (GA) proposes to combine an epidemiological study in Lebanon, an approach commonly used to tackle the issue but not carried out to our knowledge in Lebanon, with an ergonomic study, an approach not investigated a lot to answer the question of low back pain in children in the school environment. The study focuses on students aged between 11 and 16 years old, the period when low back pain is most prevalent among children. We present here a sub-section of a more global work to illustrate the approach and its contributions. The students are considered as workers. We propose a first analysis of their work conditions. Psychosocial risk factors are deliberately not included in this initial analysis.

2 METHODS

2.1 Epidemiological study

In Lebanon there are public schools, public schools that are not free of charge, free public schools and United Nations Refugee Agency

(UNRWA) schools. We excluded free public schools and UNRWA schools from our study because of the difficulties encountered in obtaining the necessary authorizations to carry out the analyses. Five schools were randomly selected from the public and private non-fee-paying schools in Beirut province: two public schools and three private non-fee-paying schools. When a school refused to participate in our survey, another random selection was made. It should be noted that two schools refused to participate in our survey.

Two versions of the questionnaire were employed: an online version and a paper version. School headmasters were given the opportunity to choose the form that corresponded to the specific regulations of their schools. In some cases, the schools did not have access to the Internet, which led the headmasters to opt for the paper-based questionnaire. Data collection involved all primary school students in the selected schools, with informed consent obtained from parents and headmaster beforehand.

The questionnaire consisted of 38 questions organized around 3 sections: (i) students' demographic data (age, gender, height), (ii) low back pain (Nordic questionnaire [10] and Functional capacity evaluation questionnaire which is the French version of the Oswestry Disability Index [6], and (iii) school and extra-curricular activities (extra-curricular activities, time spent in front of screens, carrying a school bag, school furniture, ...).

2.2 Ergonomic study

The method used for the ergonomic study is mainly qualitative. We conducted semi-structured interviews with teachers to understand the different environments in which students work at school. We questioned the students' working environment (physical and material), the students' activities in class, the institutional and social environment (school calendar and its organization, curricula, student numbers, timetable) and the relational environment (relationship with teachers, other students). Data was supplemented by a number of observations which provided additional information on classroom arrangements, the organization of school time over the day (breaks, canteen, class, etc.) according to the number of persons, etc.

3 RESULTS

3.1 Epidemiological study

Parents agreement was unanimous in the concerned classes with 746 students who completed the questionnaire (182 paper-based, 564 online). A large majority of students said they suffered from low back pain (62.9% of boys and 83.2% of girls; Chi-square: 40.485) (Table 1) There were no significant differences according to age (Chi-square: 18.118; $p=0.358$). There did not appear to be any effect of extracurricular activities (Chi-square: 1.730; $p=0.394$). The amount of time spent in front of the screens seems to play a role (Chi-square: 38.919; $p=0.002$): the more time students spend in front of the screens, the more low back pain they experience (respectively 67.5%, 74.9%, 82.6% for sometimes, often and always). When the bag was perceived as too heavy (37.1%), more than three quarters of the students reported low back pain (Chi-square: 26.253; $p=0.000$). When the furniture was perceived as uncomfortable (46.9%), more

Table 1: Distribution of selected factors according to perceived frequency of low back pain among 746 Lebanese young adolescents

Perceived frequency of low back pain						
			Never N(%)	Sometimes N(%)	Often N(%)	Always N(%)
Total		N (%)				
		746 (100%)	199 (26.7%)	379 (50.8%)	119 (16%)	49 (6.5%)
Gender						
Age	Boy	364 (48.8%)	135 (37.1%)	164 (45.1%)	47 (12.9%)	18 (4.9%)
	Girl	382 (51.2%)	64 (16.8%)	215 (56.3%)	72 (18.8%)	31 (8.1%)
	p	Chi-square: 40.485	p 0.000			
	11-12 yrs old	125 (16.75%)	31 (24.8%)	68 (54.4%)	16 (12.8%)	10 (8%)
	13-14 yrs old	397 (53.22%)	112 (28.2%)	201 (50.6%)	62 (15.6%)	22 (5.54%)
	15-16 yrs old	224 (30.03%)	56 (25%)	110 (49.1%)	41 (18.3%)	17 (7.58%)
Extracurricular activities	p	Chi-square: 18.118	p 0.358			
	Theater	4 (0.54%)	2 (50%)	1 (25%)	0 (0.00%)	1 (25%)
	Drawing / Painting	6 (0.80%)	2 (33.3%)	4 (66.7%)	0 (0.00%)	0 (0.00%)
	Chess game	4 (0.54%)	0 (0.00%)	4 (100%)	0 (0.00%)	0 (0.00%)
	Robotics/Programming	15 (2.01%)	4 (26.6%)	10 (66.6%)	1(6.66%)	0 (0.00%)
	Dance	70 (9.38%)	10 (14.3%)	45 (64.3%)	12 (17.1%)	3 (4.28%)
	Music	65 (8.71%)	17 (26.15%)	36 (55.38%)	11 (16.9%)	1 (1.53%)
	Scout	105 (14.08%)	29 (27.6%)	54 (51.4%)	19 (18%)	3 (2.85%)
	Sport (basketball, football, etc.)	303 (40.62%)	86 (28.38%)	151 (49.8%)	40 (13.2%)	26 (8.58%)
	p	Chi-square: 1.730	p 0.394			
	Screen time					
0 to 3 hours		307 (41.1%)	100 (32.5%)	157 (51.1%)	34 (11%)	16 (5.21%)
4 to 7 hours		290 (38.9%)	73 (25.1%)	134 (46.2%)	58 (20%)	25 (8.62%)
8 to more than 10 hours		149 (19.9%)	26 (17.4%)	88 (59%)	27 (18.1%)	8 (5.36%)
p		Chi-square: 38.919	p 0.002			
Bag perceived as too heavy						
	Yes	294 (39.41%)	60 (20.4%)	151 (51.4%)	55 (18.7%)	28 (9.52%)
	Moderately	342 (45.84%)	94 (27.5%)	176 (51.5%)	56 (16.3%)	16 (4.67%)
	No	110 (14.75%)	45 (40.9%)	52 (47.3%)	8 (7.27%)	5 (4.55%)
	p	Chi-square: 26.253	p 0.000			
Furniture perceived as comfortable						
	Yes	154 (20.64%)	53 (34.4%)	76 (49.3%)	19 (12.3%)	6 (3.9%)
	Moderately	241 (32.31%)	74 (30.7%)	117 (48.5%)	39 (16.2%)	11 (4.56%)
	No	351 (47.05%)	72 (20.5%)	186 (52.9%)	61 (17.4%)	32 (9.11%)
	p	Chi-square: 8.794	p 0.005			

than three quarters of students reported back pain (Chi-square: 8.794; $p=0.005$).

3.2 Ergonomical study

Interviews were conducted with four experienced teachers in history, English language, mathematics and civics, all with more than 20 years' teaching experience (Mean: 25.3; SD: 3.51) and more than 15 years at the given school (Mean: 18.6; SD: 2.88). A total of three days of observation were carried out.

Institutional and social environment. The school has 2,500 students in classes of 30 to 35. The school year lasts 10 months, from September to June, and includes 5 days of teaching per week. Classes start at 7.30 a.m. and finish at 2pm, divided into seven

periods of 50 minutes each, with two breaks of 30 minutes each. The school day is divided as follows: three periods of lessons followed by a 30-minute break, then two more periods of lessons with a second 30-minute break, and finally two periods of lessons to finish the day. The classrooms are located in a 3-floor building. All students in the cycle take their break together. Throughout the year, students benefit from two periods of physical activity per week, each lasting 50 minutes. For the other subjects, the periods over the year devoted to the subjects can be different, as can the number of slots devote to each subject per week: one civics lesson per week, three English language lessons, and five for math's. Teachers meet with students once or several times a week, depending on the subject. Throughout the school year, the students in each class have

their own classroom, reducing the need to travel between lessons. However, for specific courses such as IT and Spanish, students are taught in classrooms specifically equipped. Otherwise, during the school day, the only movements are during breaks in the common areas. Teachers adapt their teaching according to educational needs. They can switch from a lecture to a debate or discussion (e.g., for civics and English language lessons), to an interactive session (e.g., for history and geography lessons), or even to a flipped classroom (e.g., for math's). Various interactive teaching tools such as interactive whiteboards, videos and educational software (such as GeoGebra) are used. Group work, including research projects, is sometimes incorporated, providing an opportunity for relaxation and discussion with the students. These interactive approaches often require changes in seating arrangements and encourage students to alternate between sitting, standing and moving around the classroom.

Physical and material environment. Classroom furniture is standardized, with wooden chairs and tables facing the interactive whiteboard. The organization of the classroom can be modified according to the needs and activities. The school has three types of furniture: single station (separate chair and table), single station (chair and table attached) and double station (two chairs and table attached). The teachers made a number of observations about the students. They found it difficult to adopt an appropriate posture on the seats in class. They pointed out the tendency to change position frequently during the lesson or to put their knees on the table. Some students wear back braces because of back pain and require adaptations such as the use of cushions or balloons to improve their sitting position. The most common aches and pains among students are in the neck, back, knees, and feet.

4 DISCUSSION

The epidemiological study enables us to identify trends and risk factors. The results of our study seem to show that students in Beirut suffer from low back pain. A large majority of students reported experiencing low back pain, with a significantly higher prevalence among girls (83.2%) compared to Boys (62.9%). This finding aligns with previous research indicating a higher prevalence of low back pain in adolescent girls [2]. The comments made by the French Order of physiotherapists seem to be confirmed: when the weight of the schoolbag is perceived as too heavy or the furniture is perceived as uncomfortable, then students report more back pain. The ergonomic study makes it possible to refine the analysis and gives a more global view of the conception of work and its environment. Lebanon is not significantly different from other countries. The furniture doesn't always seem to be suitable, and students spend a long time in the same room, except for certain specific courses. They spend long hours sitting, whether it's in front of a computer screen studying or working on assignments. Finally, they don't move around much during the day and remain in constrained positions. They have few liberties: tasks are imposed by teachers, times and durations are non-negotiable, and the activities are fragmented from one subject to another. The risk factors may be linked to the students (their physical and psychological state, their perception of the situation, etc.) and to the context (physical environment, organization of activities over time, etc.). Like work activity, school

(work) activity is determined by all these constraining factors. And ultimately, the results of this activity will have consequences for the student's learning and health (including low back pain). Several international studies have been carried out to improve the working conditions of children in their educational environment [7]. These studies focus on the constraints associated with computer use, the weight of school bags and the design of school furniture. But in the end, these studies do not examine the organizational aspects and their impact on students. "A school situation can be described as ergonomic when it has created a real balance, a real compatibility between the student, obviously a singular being, and the constraints imposed on him" (p. 255, [4]). Ergonomics is not very involved in defining living and working conditions in schools, with studies currently focusing on the weight of school bags, furniture design or the use of new information media. If we draw a parallel with the workplace and consider students as workers [4], they ultimately have little room for manoeuvre, they have to meet a standard, they are constantly being assessed, they are the last link in a hierarchical system. It is necessary to take into account all the working conditions of the students, seeking an overall balance in the learning situations.

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