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Epidemiology of School-Related Injuries in Belgium. A Better Knowledge for a Better Prevention

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Abstract

The landmark Convention on the Rights of the Child states that children around the World have right to safe environment. In Belgium, as in many countries, children spend, on average, 4.5 weekdays at school, during nearly 8 hours per day. Studies have shown that, the risk of school-related injury exceeds the risk during leisure time. Literature reports that school accidents account for 10 to 30% of all accidents among pupils. Despite that, few papers treat of the school-related injuries. Consequently, based on 1540 accidents forms from an insurance company, injury places, mechanisms involved, body parts injured and nature of injuries were described. Head injuries, upper and lower limbs injuries were investigated in more details. Pearson's chi-square test was used to assess the relationships between the variables and multivariate logistic regression models were used to study the three specific types of injuries cited above. Gender ratio (M/F) was equal to 1.6 with 25.9% of children under 6 years, 29.4% of 6 - 9 years, 26.9% of 10 - 12 years and 17.8% from 13 years or more. The major places of injuries were the playground (56.9%) and the physical education (19.7%). Falls were observed in 52.1% of cases and contacts were reported in 24.3%. The head injuries account for 40.6%, the upper limbs for 32.0% and the lower limbs injuries for 20.2%. The bruises and the scratches were observed in 23.8% and the wounds in 21.5%. Fractures were reported in 16.1%. In conclusion, having a routine access to the data from the insurance companies could be an important source of information for an injury surveillance system in which the school injuries will be included. Taking into account this data will require an awareness of all the concerned persons about the relevance of such a system and a harmonization of the accidental forms.

Keywords

School-Related Injuries, Injury Determinants, Cross-Sectional Survey, Epidemiology

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1. Introduction

The landmark Convention on the Rights of the Child states that children around the World have a right to a safe environment and to protection from injury and violence [1]-[3].

Despite that, injury and violence is a major killer of children throughout the world, responsible for about 950,000 deaths in children and young people under the age of 18 years each year. In addition to the deaths, tens of millions of children require hospital care for non-fatal injuries. Many are left with some form of disability, often with lifelong consequences; therefore the injury is often graphically represented as a pyramid, with, at the top, the smallest group corresponding to the fatal injury group, with, in the middle, the hospitalized injuries and with, at the base, the largest group corresponding to the non-hospitalized injuries [2] [4].

The literature on injuries is frequently focused on childhood injuries or school-aged injuries in general, but also on some specific types as the road traffic injuries or the sport related injuries and; in comparison with this literature, few papers treat of the school-related injuries and some of these existing papers are really old [5]-[8]. Yet, time dedicated to school years is important in child life. In Belgium, as observed in others countries, "*compulsory education covers all children of compulsory school age, domiciled or resident in Belgium, without distinction of status* (*cf. Act of* 29 *June* 1983 *on compulsory education). The minor is subject to compulsory education for a period of twelve years beginning in the school year which starts in the year he reaches the age of six years ending at the end of the school year in the year in which he reaches the age of eighteen years.*" [9]. Therefore, children will spend a substantial part of their time at school. In Belgium, on average, children stay 4.5 days of their week at school, during nearly 8 hours per day. Some studies have shown that, the risk of injury at school, calculated per hour, exceeds the risk during leisure time [10]. Thus, safety at school is an important factor for public health.

Schelp [8] and colleagues have reported, two decades ago, that school accidents account for 10 to 30% of all accidents among school pupils. In 2003, in China, Li [11] and colleagues have found that injuries at school account for nearly a quarter of the places of injuries. In their paper, published in 2006, about the epidemiology of non-fatal injuries among the 11-, 13- and 15-year-old youth based on the data from 11 countries on 43 which participate to the "Health Behaviour in School-aged Children Study" (HBSC), Molcho [12] and colleagues have reported that 21.8% of the observed injuries occurred in the school context. For Belgium, Piette [13] and colleagues have reported, based on the data from the 2002 HBSC Study, that one third of young people interviewed had suffered from an injury during the twelve months before the study and that the school environment was involved in 24% for the girls and 20% for the boys. This means that school injuries are always a public health problem in the world, and also in Belgium.

At the best of our knowledge, in Belgium, there is not really information regarding the problem of school injuries. There is a little bit of information in terms of prevalence through the HBSC Study but there is no information on the associated factors, on the mechanisms involved or on the consequences (in terms of body parts injured and about the nature of the injuries). However, any school-related injury must be declared to an insurance company. Each insurance company has its standard accident form, but there is some similitude between the several forms.

As part of an Injury Prevention Community Plan [14], existing in the French speaking part of Belgium, a reflection is conducted on the potentially available data sources for injury surveillance, because surveillance provides important information for better understanding of the injury patterns and for better designing and evaluating injury interventions [15]. Therefore, having a routine access to the data contained in these forms could be an important source of information for an injury surveillance system in which the school injuries will be included. For having an idea of the potential of the available data, a well-established insurance company (it covers a large part of schools in the territory) has given to us access to old accident forms (it was closed cases).

Consequently, the first objective of this study was to describe the injury places, the mechanisms involved, the body parts injured and the nature of injuries; and, because head injuries are the single most common—and potentially most severe—type of injury sustained by children, the second objective was to study the factors associated to the head injuries [2] [7] [16] [17]. Linked with this second objective, we have also study the factors associated with the upper and lower limbs injuries because these type of injuries are not rare but also, and especially, because it is recognized that the musculoskeletal system of the child is particularly fragile, so an injury of this system can have adverse consequences and sometimes irreversible [7] [18].

2. Materials and Methods

2.1. Sampling

In this insurance company, the yearly number of school accident return forms was nearly equal to 35,000. Based on the forms from the year 2005, we have drawn a random sample of 1540 forms. The sample size was based on a precision of 1% around a proportion of 5%, corresponding to the lowest hypothesized proportion to estimate, and a confidence interval of 95%.

2.2. Variables

Regarding the children we have information related to the gender and to the age. The age was calculated as the difference between the injury date and the birth date. Four age groups were made based on the age limits usually reported for some schooling levels in Belgium. The first group gathers together the children under the age of 6 years, corresponding to the age for the kindergarten. Within the 6 - 12 years, corresponding to the age for the elementary school, two groups were done to show the difference between the younger, which could (may be) keep the kindergarten behaviors (it is the second group with the children between 6 and 9 years) and the older (it is the third group with the children between 10 and 12 years). Finally, the fourth group gathers together the children from 13 years or more, corresponding to the age for the secondary school. This link with the school levels were done because it is usually reported, in addition to the development change of the children across time, that the environmental characteristics, the framing norms, and the proposed activities were different and specific across these school levels [7].

Regarding the accident we have information related to the injury places, the mechanisms involved, the body parts injured and the nature of injuries. Except for the several categories of the injury places which were already originally present in the accident return form, the other variables categories were created according to the recommendations made by the World Health Organization [19] in its Injury Surveillance Guidelines.

Therefore, the seven mutually exclusive categories were in the playground, during physical education, in classes during theoretical lessons, in classes during practical lessons, on the way of school, outside school (but during the school time) and in another place that those listed before. Due to the low prevalence of some categories, we have made the choice of gathering some of them; therefore, in the end, we have 4 levels: 1) in the playground; 2) during physical education; 3) in classes (which was the merging of in classes during theoretical lessons and in classes during practical lessons) and 4) in another place (which was the merging of on the way of school, of the outside school and of the another place). Concerning the mechanisms involved, four categories were created based on the free text field available in the accident return form that they have called the "description of the accident". These levels were 1) the falls; 2) the contacts with someone or something; 3) the movement and 4) another mechanism than those cited before. In the accident form, there were also free text fields which must be completed by the physician who has examined the child. It was explained at the top of the field that that "the natures of the injuries and the body parts must be indicated". Based on these texts, the six categories created for the nature of injuries were: 1) the bruises; 2) the scratches and wounds; 3) the traumas of the joints, the muscles and the ligaments; 4) the fractures; 5) the dental traumas and 6) the others natures (e.g. a child who faints). The levels for the body part injured were: 1) the head and the neck; 2) the upper limbs; 3) the chest and the pelvis; 4) the lower limbs and 5) the general affliction or the multiple injuries.

2.3. Missing Values

Because all these variables cited below were not from required fields and because all the injuries did not lead to a consultation, some missing values were reported. In the sample (n = 1540), age and gender were not available for 188 and 208 cases respectively (corresponding to 12.2% and 13.5% of missing values). Regarding the injury places, the mechanisms involved, the body parts injured and the nature of injuries the proportions of unavailable data were 12.2%, 39.9%, 14.9% and 40.8% respectively.

2.4. Statistical Analyses

Proportions were used to describe the injury places, the mechanisms involved, the body parts injured and the nature of injuries. We have also described the proportions of these four variables according to the four age

groups, since it is known that injuries vary with the age. To answer at the second objective, which was to study the factors associated, on one hand, to the head injuries and on the other hand, to the upper and lower limbs injuries, the proportions of these three specific types of injuries were reported according to the gender, to the age groups, the place of injuries and to the mechanisms of the injuries. The Pearson's chi-square test was used to compare proportions and the Bonferroni's correction was applied for the multiple comparisons. When the proportions of injuries increased or decreased according to ordered categories of a factor, the Cochran-Armitage test for trend was used. We also calculated odds ratio (OR) with their 95% confidence intervals (95% CI) to estimate the strengths of the associations. To highlight the "at risk" categories of associated factors (OR > 1), we have chosen the category with the lowest prevalence of injuries as reference (OR = 1).

In a logistic regression model, interactions were tested for ensuring that the age or the gender had not a modifier effect on the association between each specific types of injury and the place or the mechanisms of these injuries. As the likelihood ratio (LR) tests of these interactions were not statistically significant, three models (one for the head injuries and two for both the limbs) containing the gender, the age, the place and the mechanisms were generated for taking into account the potential confounding effects of the associated factors among them. Therefore, adjusted odds ratios (OR_a), derived from these models, were presented with their 95% confidence intervals and the p-value of the Wald's test. To assess the fit of the models, we used the Hosmer and Lemeshow goodness-of-fit. The significance level for all tests was 0.05 and all statistical analyses were performed using Stata/SE 12.0 for Windows (TX: StataCorp LP).

3. Results

The gender ratio is equal to 1.6; with 61.3% of boys and 38.7% of girls. The four age groups were distributed with 25.9% of children under 6 years, 29.4% of children between 6 years to 9 years, 26.9% of children from 10 years to 12 years and 17.8% of children from 13 years or more; with an age range varying between 2 years and 20 years (data not shown).

3.1. Places of Injuries

Figure 1 shows that, the two major places of injuries were the playground (56.9%) and the physical education (19.7%). We can also observe that 2.7% injuries occurred on the way of school.

The proportions of the several injuries places varied statistically significantly (p < 0.001) according to the age groups. On one hand, the proportion of physical education injuries linearly increased with the increase of age (p < 0.001); and, on the other hand, the proportion of playground injuries decreased when the age increased (p < 0.001); with the nuance that this decrease exists only from the 6 to 9 years group to the oldest groups. For the youngest, the proportion is lower than the one observed for the 6 to 9 years group (**Table 1**).

3.2. Mechanisms of Injuries

Falls were observed in a little more than half case (52.1%) of injuries; and the proportions of these falls decreased linearly and statistically significantly (p < 0.001) with the increase of the age. Contacts with someone or something were reported in a little less than a quarter (24.3%) of the cases; and these contacts don't varied statistically significantly (p = 1.000) in the several age groups. Finally, the movements, which were reported generally in a little more than one situation on ten (13.9%), increased linearly and statistically significantly (p < 0.001) with the increase of the age (**Figure 2**) (**Table 2**).

3.3. Body Parts Injured and Nature of Injuries

Figure 3 shows that limbs were injured in one situation on two, with a little higher proportion for the upper limbs in comparison with the lower limbs (32.0% vs. 20.2% respectively). This figure also shows that for 40.6% of the situations, it was the head and the neck which were injured. Regarding the variations of the body parts injured between the age groups, the proportions of the head and neck injuries on one hand, and, of the lower limbs injuries on the other hand, varied linearly and statistically significantly with the age (p < 0.001 for both of them): the proportions of head and neck injuries decreased with the increase of age; while the proportions of lower limbs injuries increased when the age increased (**Table 3**).

Regarding the nature of the injuries, the bruises, on one hand, and the scratches and the wounds, on the other
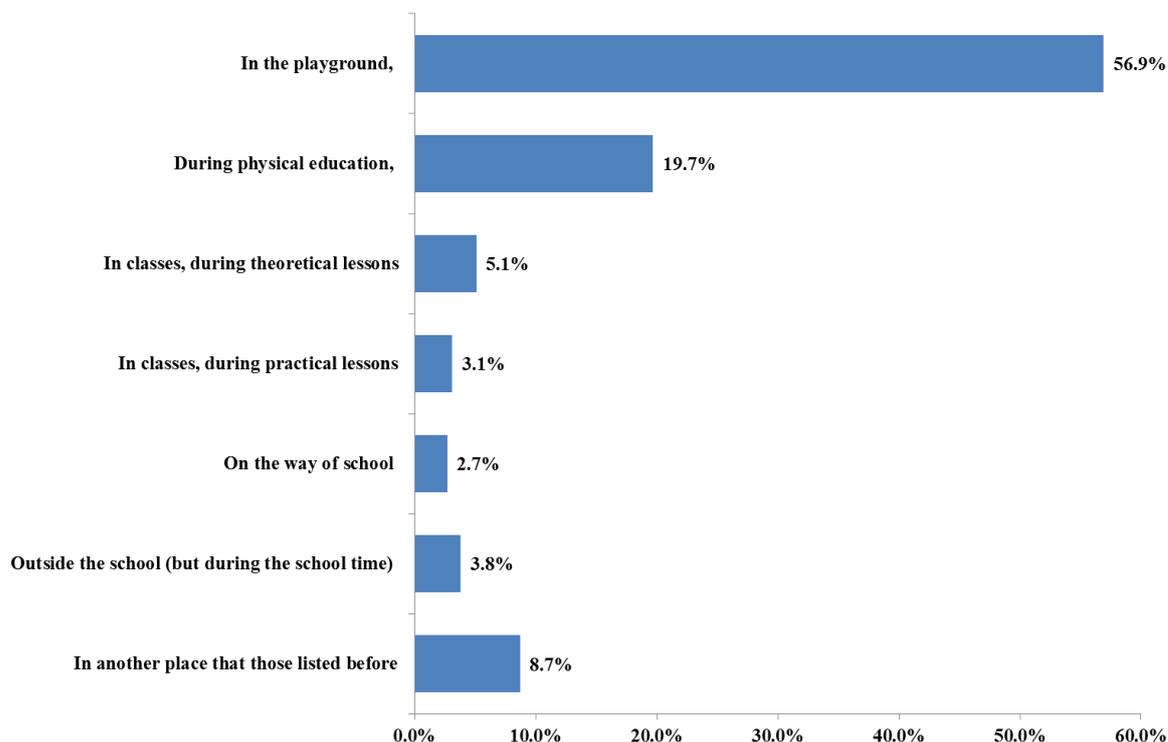
Figure 1. Place of injuries (proportions of each level reported, n = 1352).

Table 1. Variation of the injuries places according to the several age groups.

p_g < 0.001	Age groups				
	Under 6 years (n = 350)	6 - 9 years (n = 398)	10 - 12 years (n = 363)	13 years and more (n = 241)	p value
In the playground	61.7%	71.9%	62.5%	17.0%	p < 0.001
During physical education	7.4%	14.6%	22.9%	41.5%	p_t < 0.001
In classes	14.3%	4.5%	2.5%	14.1%	p < 0.001
Other places	16.6%	9.0%	12.1%	27.4%	p < 0.001

p_g is the p-value of the global test, p_t is a p-value from a linear trend test and the other values come from the comparison's tests of the proportions of each categories of injury versus the remainder, according to age.

hand were observed roughly in the same proportions (23.8% and 21.5% respectively). We have also observed that the injuries led to fractures in 16.1% of the situations (**Figure 4**).

The study of the variations of the injuries nature, according to the age groups, shows that the proportions of the scratches and wounds, but also the traumas of the joints, muscles and ligaments and the tooth traumas varied statistically significantly among the several age groups (p < 0.001 for the cited natures of injuries). The proportions of scratches and wounds were more important for the children under 6 years whereas the traumas of the joints, muscles and ligaments were more observed among the older (p < 0.001). Finally, the highest proportions of dental traumas were observed among the children under 10 years: 14.6% among the 6 - 9 years and 9.4% among the children under 6 years (p < 0.001) (**Table 4**).

3.4. Factors Associated with Head Injuries and with Limbs Injuries

As a reminder, without taking into account the age groups, 40.6% of head injuries were reported (**Figure 3**). The univariate analyses show that there were more head injuries among boys than among girls and that the proportions of head injuries decreased when the age increased. We have also observed that these head injuries resulted from falls or contact with someone or something. Finally, regarding the places of injuries, the highest propor-
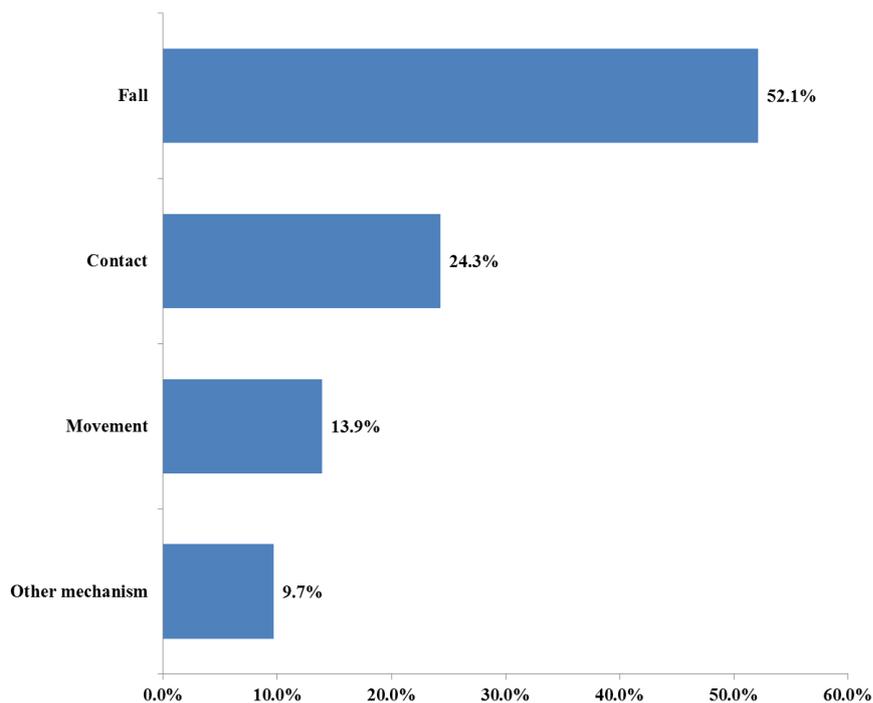
Figure 2. Mechanisms of injuries (proportions of each level reported, n = 926).

Table 2. Variation of the mechanisms of injuries according to the several age groups.

$p_g < 0.001$	Age groups				
	Under 6 years (n = 243)	6 - 9 years (n = 259)	10 - 12 years (n = 250)	13 years and more (n = 174)	p value
Fall	65.8%	52.9%	46.4%	39.7%	$p_t < 0.001$
Contact	21.8%	25.9%	26.8%	21.8%	$p = 1.000$
Movement	4.5%	13.5%	19.2%	20.1%	$p_t < 0.001$
Other mechanism	7.8%	7.7%	7.6%	18.4%	$p < 0.001$

40.6% head and neck

32.0% upper limbs

3.4% chest and pelvis

20.2% lower limbs
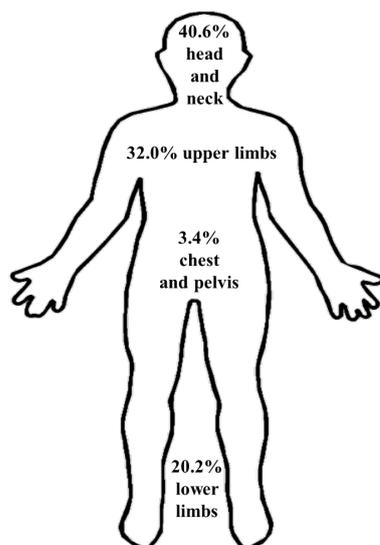
Figure 3. Proportions of the several body parts injured (n = 1310, whose 50 general affections not reported on the figure).

Table 3. Variation of the body parts injured according to the several age groups.

$p_g < 0.001$	Age groups				p value
	Under 6 years (n = 341)	6 - 9 years (n = 385)	10 - 12 years (n = 351)	13 years and more (n = 233)	
Head and neck	70.4%	48.6%	20.8%	13.7%	$p_t < 0.001$
Upper limbs	17.6%	27.8%	45.9%	39.1%	$p < 0.001$
Chest and pelvis	2.1%	3.1%	3.7%	5.6%	$p = 0.725$
Lower limbs	7.0%	17.7%	25.9%	34.8%	$p_t < 0.001$
General affection	2.9%	2.9%	3.7%	6.9%	$p = 0.550$
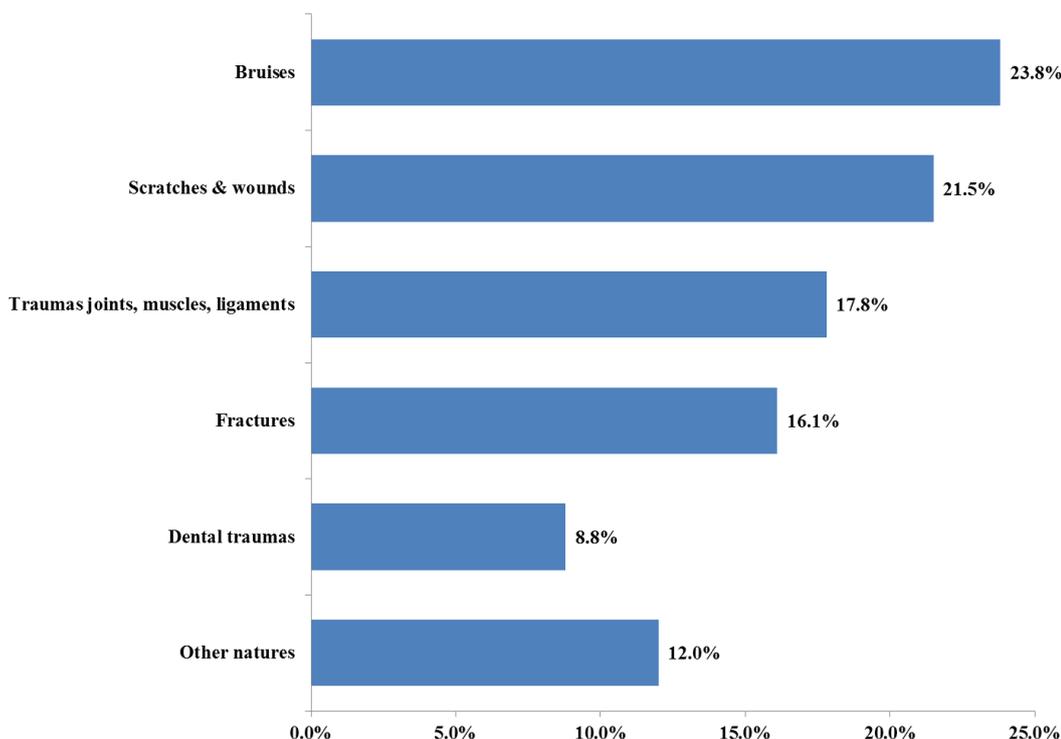
Figure 4. The nature of injuries (proportions of each level reported, n = 912).

Table 4. Variation of the natures of injuries according to age groups.

$p_g < 0.001$	Age groups				p value
	Under 6 years (n = 224)	6 - 9 years (n = 275)	10 - 12 years (n = 252)	13 years and more (n = 161)	
Bruises	21.4%	21.7%	27.8%	24.2%	$p = 1.000$
Scratches & wounds	40.6%	21.8%	8.7%	14.3%	$p < 0.001$
Traumas of JML	3.2%	13.1%	29.0%	28.6%	$p < 0.001$
Fractures	12.5%	18.2%	19.1%	13.0%	$p = 0.744$
Dental traumas	9.4%	14.6%	5.9%	2.5%	$p < 0.001$
Other natures	12.9%	10.6%	9.5%	17.4%	$p = 0.516$

tions of head injuries were observed when the injuries have taken place in the playground or in the classes. After adjustment by all the analyzed variables, the situation at risk for having a head injury was to be a boy, to be young, to have an injury in classes or in the playground (rather than during physical education) and to have a contact with someone or something or to fall (rather than to be in movement) (**Table 5**).

Table 5. Associations between head injuries and gender, age groups, places and mechanisms of injuries.

		Head injuries		
	n	% Head injuries (p-value)	OR$_c$ (CI95%)	OR$_a$ (CI95%) (n = 884 with 341 HI) (p$_{H\&L}$ = 0.983)
Gender		**p < 0.001**		
Boys	786	45.7%	1.67 (1.33 - 2.11)	1.90 (1.35 - 2.69)
Girls	505	33.5%	1	1
Age groups		**p$_t$ < 0.001**		
Under 6 years	341	70.4%	14.93 (9.62 - 23.16)	17.78 (9.52 - 33.18)
6 - 9 years	385	48.6%	5.93 (3.88 - 9.06)	6.07 (3.28 - 11.22)
10 - 12 years	351	20.8%	1.65 (1.05 - 2.60)	1.54 (0.82 - 2.91)
13 years and more	233	13.7%	1	1
Place of injuries		**p < 0.001**		
In the playground	750	46.0%	3.49 (2.49 - 4.89)	1.98 (1.17 - 3.34)
During physical education	260	19.6%	1	1
In classes	106	59.4%	6.00 (3.66 - 9.84)	5.47 (2.48 - 12.05)
Other places	194	37.6%	2.47 (1.62 - 3.77)	2.47 (1.30 - 4.70)
Mechanisms of injuries		**p < 0.001**		
Fall	462	40.5%	4.1 (2.42 - 7.01)	2.28 (1.25 - 4.18)
Contact	219	58.0%	8.36 (4.74 - 14.73)	7.46 (3.92 - 14.20)
Movement	128	14.2%	1	1
Other mechanism	85	12.8%	0.89 (0.40 - 1.99)	0.54 (0.22 - 1.31)

A. ORc are crude odds ratios, p$_t$ is a p-value from a linear trend test, ORa are odds ratios adjusted for all the variables reported in the table, HI is the abbreviation for head injuries, p$_{H\&L}$ is the p-value of the goodness-of-fit test of Hosmer and Lemeshow.

As a reminder, without taking into account the age groups, 52.2% of limbs injuries were reported, with 32.0% of upper limbs injuries and 20.2% of lower limbs injuries (**Figure 3**).

There were more limbs injuries among girls, but the difference for the lower limbs injuries was not statistically significant. Both for the upper and the lower limbs injuries, the proportions were higher among the older. Regarding the place of injuries, there was no statistically significant difference among the proportions of upper limbs injuries, but for the lower limbs injuries, the lowest proportion was observed when the injuries occurred in the classes and the highest proportion was observed when the injuries occurred during physical education. Movements and falls were the major mechanisms involved both for the upper and the lower limbs injuries. After adjustment by all the analyzed variables, the situation at risk for having an upper limb injury was to be a girl, to be older and to have a fall or a movement rather that a contact as the mechanism of injury. For the lower limbs injury, the situation at risk was also to be older, and was to have an injury in the playground or during the physical education (rather than in classes) and to be in movement (rather than to have a contact with someone or something) (**Table 6**).

4. Discussion

To the best of our knowledge, this study is the first in Belgium which gives as much information about the school-related injuries in terms of injury places, mechanisms involved, body parts injured and nature of injuries.

The gender ratio boys/girls in this study is equal to 1.6, indicating that boys are more likely to suffer from school-related injuries than girls. From a general point of view, this excess of risk among the boys is a constant in nearly all the studies related to injuries whether based on school-related injuries or not. Hypotheses are that, in comparison with girls, the boys are more unruly, more mobile, impulsive and short-tempered whereas girls are slower, but maybe clumsier. Also, boys are more engaged in risky and sporting activities [4] [11] [17] [20]-[26].

Table 6. Associations between (upper/lower) limbs injuries and gender, age groups, places and mechanisms of injuries.

	n	Upper limbs			Lower limbs		
		% (p-value)	OR_c (CI95%)	OR_a (CI95%) (n = 884 with 299 ULI) ($p_{H\&L}$ = 0.353)	% (p-value)	OR_c (CI95%)	OR_a (CI95%) (n = 884 with 178 LLI) ($p_{H\&L}$ = 0.876)
Gender		**p < 0.001**			**p = 0.196**		
Boys	786	27.9%	1	1	19.2%	1	1
Girls	505	37.2%	1.54 (1.21 - 1.95)	1.54 (1.13 - 2.09)	22.2%	1.20 (0.91 - 1.58)	1.03 (0.72 - 1.48)
Age groups		**p < 0.001**			**p_t < 0.001**		
Under 6 years	341	17.6%	1	1	7.0%	1	1
6 - 9 years	385	27.8%	1.80 (1.26 - 2.58)	2.37 (1.49 - 3.77)	17.7%	2.83 (1.73 - 4.63)	2.67 (1.44 - 4.92)
10 - 12 years	351	45.9%	3.97 (2.80 - 5.63)	6.09 (3.85 - 9.62)	25.9%	4.62 (2.86 - 7.46)	3.60 (1.97 - 6.57)
13 years and more	233	39.1%	3.00 (2.05 - 4.40)	3.50 (2.06 - 5.19)	34.8%	7.04 (4.29 - 11.54)	6.30 (3.29 - 12.06)
Place of injuries		**p = 0.301**			**p < 0.001**		
In the playground	750	30.8%	0.98 (0.63 - 1.53)	0.89 (0.49 - 1.63)	16.7%	2.83 (1.28 - 6.23)	3.72 (1.26 - 11.05)
During physical education	260	36.9%	1.29 (0.80 - 2.10)	0.89 (0.46 - 1.72)	33.9%	7.24 (3.22 - 16.24)	5.47 (1.81 - 16.54)
In classes	106	31.1%	1	1	6.6%	1	1
Other places	194	30.4%	0.98 (0.58 - 1.61)	0.69 (0.35 - 1.36)	22.7%	4.15 (1.80 - 9.58)	4.62 (1.52 - 14.09)
Mechanisms of injuries		**p < 0.001**			**p < 0.001**		
Fall	462	37.8%	1.92 (1.31 - 2.80)	2.19 (1.32 - 3.64)	19.1%	1.24 (0.80 - 1.90)	1.40 (0.89 - 2.19)
Contact	219	21.0%	1	1	16.0%	1	1
Movement	128	40.9%	2.61 (1.61 - 4.22)	2.19 (1.32 - 3.64)	35.4%	2.89 (1.73 - 4.82)	2.20 (1.28 - 3.76)
Other mechanism	85	58.1%	5.22 (3.05 - 8.94)	6.26 (3.49 - 11.22)	12.8%	0.77 (0.37 - 1.60)	0.85 (0.40 - 1.83)

OR_c are crude odds ratios, p_t is the p value of the linear trend test, OR_a are odds ratios adjusted for all the variables reported in the table, ULI is the abbreviation for upper limbs injuries and LLI is the abbreviation for lower limbs injuries, $p_{H\&L}$ is the p-value of the goodness-of-fit test of Hosmer and Lemeshow.

Our results have shown that a large part of the injured children were from kindergarten (25.9% of children under 6 years) or elementary school (29.4% of children between 6 and 9 years, and 26.9% between 10 and 12 years) with a little less than a fifth (17.8%) of children in age of the secondary school. These observations are in agreement with the literature review paper of Laflamme, Menckel and Aldenberg [25] who reported that all injuries aggregated, injuries were generally found to be more frequent among elementary school children than among secondary school pupils. Based on a school injury-reporting system in British Columbia, in Canada, Sheps and Evans [7] also found the same tendency, but, it is not what it was observed by Maitra [23] in his British study. He had found a higher proportion of middle and secondary schools compared to primary school. Linakis [27] and colleagues, based on a sample of American hospitals, have also found a higher proportion of middle school children compared to a lower proportion of primary or secondary school. Finally, the Fotherrgill and Hashemi [26] results, based on data from an emergency department in England, have given the same tendency: a higher proportion from senior schools, followed by the junior schools and the nursery schools. These differences could be due to the fact that the injuries observed in these two studies were school injuries which required attendance at an emergency department, which suggests that injuries occurring for the oldest children could be more serious. The discussion here above, regarding the variations of injuries according to age, shows that studies were more focused on elementary or secondary school children than on preschool children. As men-

tioned at the beginning of this paragraph, our sample contained a little more than a quarter of children under the age of 6 years. This age group was then non-negligible. The work of Garzon [28], based on the contributing factors to preschool unintentional injury, had reported that children under the age of 5 years were more likely to sustain serious injury and have adverse outcomes than their older school aged peers, due to fact that preschool years are a dynamic period of cognitive, physical and emotional development. This group of children have, in our study, the highest proportion of falls (65.8%), the highest proportion of head injuries (70.4%) and the highest proportion of scratches and wounds (40.6%). Always, according to Garzon [28], preschoolers have better gross than fine motor development, so that children under the age of 5 years cannot combat inertia and right themselves once they begin to fall. Their larger and heavier heads increases also the risk of falls and head injuries.

The two major places of injuries observed were on one hand the playground (56.9%), with a lowest proportion for the older and the highest proportions for the children in age of elementary school; and, on the other hand, the physical education (19.7%) with a linear increase of the proportion according to the increase of age. These observations are in agreement with the literature which reports that the playground and the sport activities have been found to be more hazardous than others, with more playground injuries among the elementary school children and more sports accidents among the secondary school children. These distributions fit in with the normal activities of the children and the pupils. It is well know that the "simple games", in the playground, decrease when the children become older but also that children are less turbulent and have better locomotor skills when they become older. In the secondary school environment, sport activities are more common, especially among the first levels of the secondary. The pupils play more to basketball or to soccer during their breaks but they are also more exposed due to the physical education lessons [6]-[8] [17] [21] [25] [26] [29].

In our study, falls were the most common mechanism of injuries (52.1%). This observation is in agreement with the international literature [7] [11] [17] [22]-[25]. We have observed, on one hand, a linear decrease of the fall proportion with the increase of the age and on the other hand, a linear increase of the movement, as the mechanism of injuries, with the increase of the age. These observations were also made by Sheps and Evans [7] who have found a higher proportion of falls for the elementary school students in comparison with the secondary school students. In their literature review Laflamme, Menckel and Aldenberg [25] reported also that having a contact with someone or something was a frequent cause of injuries. In our study it was the second major mechanism of injuries (24.3%).

A British study, based on school injuries which required attendance at an emergency department, had shown, regarding the nature of injuries, a proportion of a little more than a fifth of sustained fractures or dislocations and a proportion of a little less than a fifth of lacerations or grazes [23]. Our results were almost in the same direction with a proportion of fractures equal to 16.1% and a proportion of scratches and wounds equal to 21.5%. We also have found a proportion of bruises equal to 23.8%, which combined to the proportion of scratches and wounds, confirms the fact, as stated by Haq and Haq [17] in their review of the literature that cuts, abrasions and contusions were the most frequently reported injuries. In the study of Fotherrgill and Hashemi [26], which was based on hospital data, bruises, abrasions and sprains accounted for over half of the total of the nature of injuries observed. In the Laflamme study [25], the authors reported that the type of injuries is difficult to be compared between studies because of differences between classifications used to describe the type of injury and part of the body parts injured but generally speaking, there is a tendency for the type of injury to vary with the school levels. Indeed, we have observed, on one hand, that the proportions of traumas of the joints, the muscles and the ligaments were higher for the two oldest age groups and, on the other hand, that the proportions of dental traumas were higher among the youngest age groups.

Regarding the part of the body injured, this study has shown that the head injuries were the most observed (40.6%) followed by the upper limbs injuries (32.0%) and the lower limbs injuries (20.2%). These observations were also found in others studies dedicated to school-related injuries despite the different geographical localization around the world [6] [10] [21] [22] [30]. Regarding the variation with age, the proportions of head injuries, on one hand, and the injuries of the lower limbs, on the other hand, varied with a linear increase according to age for the head injuries and a linear decrease according to age for the lower limbs. This tendency has been summarized in the literature review from Laflamme [25] and colleagues who reported that head injuries seem to be sustained more frequently in the playground (which concern more the youngest children), while injuries to the lower and upper extremities of the body are most frequently incurred during sports (which concern the older

children). The study of Willer [16] and colleagues, which was focused on the concussion, had reported that the head injury with concussion were higher for boys than girls and higher for younger children than older children; with the falls as common cause of head injury and head injury with concussive symptom, especially among the younger children.

Finally, we discuss the issue of the data availability. In their review, Haq and Haq [17] have proposed that a computerized reporting system must be helpful. Actually, in Belgium, the accident forms are now increasingly recorded through a computerized system, specific for each insurance company, but always based on forms which have kept similarities between companies. Therefore, having access to the databases of these insurance companies (in an anonymous form) could be an important step in the construction of an injury surveillance system. The take into account of the data provided by the schools for the documentation of the school-related injuries was already done, as examples, in the United States, in Canada, in France, in United Kingdom or in Germany [4] [7] [15] [21] [31]-[33]. Routine school reporting could underestimates the incidence of school injuries, but provides the simplest method of gathering information [21]. Thus, such a system, requires qualitative criteria, such as flexibility and acceptability for long term operation. It should also be and stay reliable and inexpensive [10]. A first step, in this case, could be to give a feedback to the insurance company about the relevance of the use of their data in a preventive perspective; because, as say by Stark [21] and colleagues: one of the barriers to action in schools is likely to be a lack of recognition of the importance of school accidents, and of the scope for prevention. Currently, since the text explaining how the accident happened is not compulsory, there is then a lot of missing data for some of the variables. Another step could be, therefore, to concentrate on the automatic and complete description of the injury in terms of place, mechanism but also in terms of body parts injured and nature of injuries. As it was done for the Utah Student Injury Reporting System, a systematic follow-up of discrepancies or missing values, for all reports received by the person in charge, could be done. Finally, a last question could be asked. Despite the fact that, in Belgium, each school-related accident must be declared to an insurance company, we have currently no idea about the practices of each school. In their paper about the staff concerned with the data collection and reporting procedures about accidents in the school environment, Williams, Latif and Cater [34] reported that some schools under-report accidents whereas others over-report in anticipation of complaints and litigation. In his work on preventing school injuries, Garnier [5] insists on the need to know about all accidental events, even those that don't lead to serious injury, since the factors responsible of these "little incidents" could have led to more serious injuries.

5. Conclusions

This study, which is the first in Belgium, gives interesting and rich information on epidemiology of the school-related injuries, according age and gender, in terms of injury places, mechanisms involved, body parts injured and nature of injuries. In summary, our results shown that 1) boys are more likely to suffer from school-related injuries than girls; 2) a large part of the injured children were from kindergarten or elementary school; 3) the major places of injuries were the playground, with a lowest proportion for the older, and the physical education with an increase of the proportion according to the increase of age; 4) falls were the most common mechanism of injuries with a decrease with the increase of the age; 5) bruises, scratches and wounds were observed roughly in the same proportions and fractures count for an non negligible part of the injuries; 6) the head injuries were the most observed followed by the upper limbs injuries and the lower limbs injuries; 7) the situation at risk for having a head injury was to be a boy, to be young, to have an injury in the playground and to fall; and 8) the situation at risk for having an upper limb injury was to be a girl, to be older and to be in movement; and for the lower limbs injury, the situation at risk was also to be older, and was to have an injury in the playground or during the physical education and to be in movement.

Finally, under the idea of "better to know to better prevent", having a routine access to the data from the insurance companies could be an important source of information for an injury surveillance system in which the school injuries will be included. But this taking into account will require an awareness of the field staff about the relevance of such a system and a harmonization of the accidental forms.

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