Prospective study of school injuries: incidence, types, related factors and initial management

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The rates of school injuries were examined by means of a prospective study of 212 schools during the 1981–82 school year. The results showed an annual incidence rate of 5.4 injury events/100 children, which appears to be an underestimate of the actual rate. Of all the injury events 28.7% resulted in serious injuries. Injuries were significantly more frequent in the elementary as opposed to the secondary schools, and the boys were injured significantly more often than the girls. Most of the injuries occurred during athletic activities. Most of the children with either serious or minor injuries were sent to the school office or returned to the classroom, which indicates that the present level of first-aid training among school personnel is inadequate.

On a étudié la fréquence des blessures subies à l'école dans une étude prospective portant sur 212 écoles au cours de l'année scolaire 1981–82. Les résultats ont révélé une incidence annuelle de 5.4 incidents avec blessures par 100 enfants, ce qui semble être une sous-estimation du taux actuel. De tous les incidents avec blessures 28.7% ont entraîné des blessures sérieuses. Les blessures étaient significativement plus fréquentes à l'école primaire qu'à l'école secondaire, et les garçons étaient blessés significativement plus souvent que les filles. Les activités sportives étaient la cause majeure des blessures. La plupart des enfants souffrant de blessures sérieuses aussi bien que légères ont été dirigés vers les bureaux de l'administration scolaire ou retournés en classe; ceci indique que, au sein du personnel scolaire, le niveau de connaissance en premiers-soins est insuffisant.

Accidents are the leading cause of death among children in industrialized nations.[1] The rate of death from accidents among children aged 1 to 14 years is higher in Canada than in 19 other developed countries;[2] for example, in 1973 the rate in England and Wales was 12.3/100 000, whereas the rate in Canada was 27.7/100 000. A considerable number of childhood injuries are associated with accidents, as reported by police departments and hospitals.[3-7] However, the number may represent merely the "tip of the iceberg", as it does not include injuries that are not reported to these agencies.

Children spend a considerable amount of time in and around and going to and coming from school. Nevertheless, very little is known about how safe schools are or about the incidence of school-related injuries. Although several studies have been conducted in the United States, ours was the first to be conducted in Canada. We report the results of that study, which addressed the following questions: (a) What is the incidence of school-related injuries in the Hamilton–Wentworth region? (b) What types of injuries occur? (c) What are the related factors in such injuries? and (d) What type of care do injured children receive?

Method

The regional municipality of Hamilton–Wentworth has three publicly supported school boards with a combined enrolment of 83 692 children in 212 schools. The municipality is socially and economically heterogeneous and comprises a large urban area, suburban towns and rural areas.

For the 1981–82 school year the three boards of education were asked to use a school accident report form (SARF) developed by our research staff during a 6-month feasibility project. The SARF asked for data legally required by the board, as well as those needed to answer the questions posed in our investigation. It was designed to be easy to complete, in that it was composed of checklists of alternative responses, yet it was concise and accurate.

All 212 schools incorporated the use of the SARF in their routine reporting of accidents to the boards of education during the 1981–82 year. We received a copy of all the forms when they were submitted to the boards. The SARFs were used to report all accidents (one form per child per incident), but only the accidents that resulted in one or more injuries (an "injury event") were included in our study. An injury event could involve one or more injuries to one or more parts of the child's body.

To assess the effects of under- and over-reporting by the schools or boards or both, we also used other data

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sources: random surveys of parents, reports from 50 "target" schools and parental reports. Details on both the SARF and the other data sources are described elsewhere.[8]

The type of injuries could be indicated on the SARF by a check mark in the appropriate category. Serious injuries included fractures, loss of consciousness, dislocations, sprains, torn ligaments or cartilage, chipped or broken teeth and internal injuries. Minor injuries included scrapes, bruises, cuts, swellings or bumps, nosebleeds and "other", which was specified on the form. In the case of an injury event that included more than one type of injury, the event was classified as serious or minor according to the most serious type of injury.

Results

Incidence of injuries

The 212 schools submitted 4298 SARFs in the 1981–82 school year, for an annual incidence rate of 5.4 injury events per 100 schoolchildren. The rate of injuries per enrolled child was higher among the boys than among the girls in both the elementary (7.2 v. 5.2/100) and the secondary (4.6 v. 2.9/100) schools. Overall, the rates were significantly higher among the boys than among the girls (6.3 v. 4.4/100; $\chi^2_1 = 133.6$, $p < 0.001$).

Types of injuries

Because an injury event could include more than one injury (e.g., a fall could cause a sprain, a cut and a bruise), the number of injuries (5334) is greater than the number of injury events (4298). Of the 4133 injury events for which we had all the data, 1183 (28.6%) were classified as serious and 2950 (71.4%) as minor (Table I). Minor injuries were more common in the elementary schools (4.4/100) than in the secondary schools (2.4/100). A surprising finding was the relatively small but statistically significant difference ($\chi^2_1 = 15.1$, $p < 0.001$) between the rates of serious injuries in the elementary (1.6/100) and the secondary (1.3/100) schools. Indeed, overall, injury events were far more common in the elementary (6.0/100) than in the secondary (3.6/100) schools.

Although the boys suffered significantly more injury events than the girls, the rates of serious injuries were similar in the two groups (1.6 and 1.4/100 respectively; $\chi^2_1 = 6.4$, $0.01 < p < 0.05$). However, the rates of minor injuries differed greatly between the boys and the girls (4.5 v. 2.9/100).

Table II shows the incidence of injuries according to level and grade — junior kindergarten to grade 13. Both serious and minor injuries were most common in the children in grades 6 to 8. The rate of minor injuries dropped in the secondary schools, and the rate of serious injuries was lowest in the children in junior kindergarten to grade 2.

Despite reports suggesting that a small number of children repeatedly suffer injury events and that a large proportion of injuries occur in accident-prone children,[9-11] the data from our study do not support this theory. Only 0.5% of the 83 692 children suffered more than one injury event and only 0.08% suffered more than two injury events during the 1981–82 school year. Comparisons with a Poisson distribution showed that the number of children who suffered more than one injury event per year was greater than one might expect by chance (e.g., the observed rate for two injuries was 0.4/100, whereas the expected rate was 0.1/100). The total numbers of injury events and of children who suffered more than one injury event were not large enough to greatly influence the overall incidence rate.

Related factors

Day and time: The injury events were distributed evenly throughout the school week, with no one day accounting for more than 22% or less than 17% of all the injury events. As expected, the number of events peaked during lunch hours and recesses; only 17% of the events occurred between 10 and 11 am, whereas 31% occurred between noon and 2 pm.

Location and activity: Of the serious injuries 38.7% occurred in the gymnasium, 32.6% at the playground and 7.1% on the athletic field; of the minor injuries 37.1% occurred at the playground, 20.9% in the gymnasium and 13.4% in the classroom or workshop.

Athletic activities were thus the major cause of both serious and minor injuries; next most frequent were falls and body contact during playing or fighting (Table III). The pattern did not vary greatly between the boys and

Table I—Distribution of 5302 injuries* among Canadian schoolchildren

Type of injury	No. (and %) of children
Swelling or bump	1439 (27.1)
Cut	917 (17.3)
Bruise	740 (14.0)
Sprain	588 (11.1)
Scrape/scratch	382 (7.2)
Fracture	298 (5.6)
Chipped or broken teeth	180 (3.4)
Torn cartilage/ligament	83 (1.6)
Dislocation	65 (1.2)
Nosebleed	60 (1.1)
Loss of consciousness	22 (0.4)
Internal injury	13 (0.2)
Other	515 (9.7)

*Type of injury was not specified in 32 instances.

Table II—Annual incidence of injuries according to level of school and grade

Level of school and grade	No. (and %) of injuries per 100 children	
	Total	Serious
Elementary		
Junior kindergarten to grade 2	4.1	0.5 (13)
Grades 3 to 5	6.2	1.6 (25)
Grades 6 to 8	7.2	2.7 (38)
Secondary		
Grades 9 to 13	3.5	1.2 (35)

the girls or between the school levels. Half of all the serious injuries occurred during supervised athletic activities. Gymnastics, miscellaneous activities (e.g., "Nerf ball" and "prison ball"), basketball and football were the sports most commonly cited as causing school injuries (Table IV). However, the proportions of serious injuries suffered during these activities varied greatly, ranging from 66.0% in basketball, 58.0% in volleyball, 52.6% in gymnastics and 50.5% in football to 33.3% and 31.1% respectively in hockey and miscellaneous activities. Since the number of children participating in each activity was not determined, the true incidence rates could not be calculated.

The proportions of fractures among serious injuries were highest for the high-contact sports of football (17.2%) and hockey (16.7%). However, surprisingly, the proportions were also high for track-and-field activities (15.0%), volleyball (11.4%), basketball (10.9%) and miscellaneous activities (e.g., "Nerf ball" and "prison ball") (9.6%).

Parts of body injured: The hand, including the fingers, was the part of the body most commonly injured, accounting for 17.8% of the minor and 26.6% of the serious injuries. It also accounted for 34.2% of all the fractures, whereas the wrist accounted for 18.8% and the arm for 12.4%. Cuts were on the hand in 28.0% of cases and on the head in 23.4%. Of 2922 minor injuries 28.7% involved the head, 11.6% the face, the neck or both, and 7.6% the eyes (in 28 cases the part of the body injured was not specified).

Initial management of injuries

The schools could not give much information on the subsequent treatment and recovery of an injured student, but they were asked to record the immediate destination of the child after an injury event and whether the child had received first aid at the school. If more than one destination (e.g., the school office and then hospital) was recorded, we included the one that was the most time-consuming or expensive.

The children most often went to the school office or returned to the classroom (Table V). More of the children who had serious injuries than of those who had minor injuries were reported to have been sent to a hospital, a doctor or a dentist.

In most cases the schools reported that the children had been supervised at the time their injury events occurred. First aid was given in 61.6% of the cases, but significantly more often ($p < 0.001$) for minor injuries than for serious injuries (66.7% v. 49.0%).

The personnel who gave the first aid were identified on 2438 of the SARFs. They included teachers (in 38.9% of cases), secretaries (in 28.3%), principals (in 17.0%), school nurses (in 7.0%), coaches or trainers (3.0%) and other individuals (e.g., parent volunteers) (in 5.8%).

The principals reported that only a small number of their full-time teaching and support staff had had first-aid training. The schools reported that there were 409 full-time staff members with first-aid training; thus, overall there was 1 trained member per 205 children.

The principals were also asked to report how frequently — "sometimes", "frequently", "most of the time" or "always" — an adult with first-aid training had been present during various athletic activities (i.e., physical education classes, intramural and interscholastic sports, and swimming instruction). Except during swimming instruction, trained adults were seldom "al-

Table IV—Proportions of serious injuries and fractures according to type of athletic activity

Activity	Total no. of injury events*	No. (and %) of serious injuries	
		Total	Fractures
Gymnastics	173	91 (52.6)	15 (8.7)
Miscellaneous†	167	52 (31.1)	16 (9.6)
Basketball	147	97 (66.0)	16 (10.9)
Football	99	50 (50.5)	17 (17.2)
Soccer	98	45 (45.9)	12 (12.2)
Volleyball	88	51 (58.0)	10 (11.4)
Track and field	40	17 (42.5)	6 (15.0)
Hockey	24	8 (33.3)	4 (16.7)
Other	347	124 (35.7)	31 (8.9)
Total	1183	535 (45.2)	127 (10.7)

*The type of activity was not recorded for another 260 injury events.
†Includes "Nerf ball", "prison ball" etc.

Table III—Severity of injury events according to cause*

Cause	No. (and %) of injury events		
	Total	Serious	Minor
Athletic activity (supervised)	1143 (35.3)	628 (53.7)	815 (28.0)
Falls (excluding athletics)	954 (23.4)	271 (23.2)	683 (23.4)
Playing or fighting	642 (15.7)	147 (12.6)	495 (17.0)
Classroom or workshop activity	327 (6.0)	14 (1.2)	313 (10.7)
Flying, thrown or falling object	170 (4.2)	13 (1.1)	157 (5.4)
Bumps into walls, doors etc.	163 (4.1)	28 (2.4)	140 (4.8)
Playground equipment	84 (2.1)	25 (2.1)	59 (2.0)
Other (e.g., bicycle riding, insect bite)	295 (7.2)	44 (3.8)	251 (8.6)
Total	4083 (100.0)	1170 (28.7)	2913 (71.3)

*The cause was not recorded for 50 injury events.

ways" present (Table VI). In addition, again except during swimming instruction, trained adults were more often "always" present during athletic activities in the secondary schools than in the elementary schools.

Discussion

The extent to which our findings on the incidence, types, related factors and initial management of school-related injuries can be extrapolated to other regions can best be determined by local educational and medical authorities. However, because of the diversity and large sample size of our study, we believe that our results can be generalized to other populations with a fair degree of confidence.

The annual incidence rates of school injuries in Sweden and West Germany have been reported to be between 3% and 4%,[9] compared with the 5.4% found in our study. Moreover, on the basis of the comparisons with other data sources, we believe the schools in our study may have under-reported the number of injury events. Our random survey of 1799 parents revealed a rate of 15.3 school-associated injury events per 100 children.[10]

The results of our study confirm the differences in the incidence of school-related injuries between boys and girls noted in previous studies in the United States.[11,12] However, it is interesting that the incidence of minor injuries, rather than that of serious injuries, contributed to the bulk of this difference.

We had expected that the boys would have had many more serious injuries than the girls, but the difference (1.6 v. 1.4/100 students) was relatively small. This finding may reflect the increasing participation of girls in athletic and workshop activities. However, we did not expect the marked difference in the incidence of minor injuries between the boys and the girls. There may be three explanations for this phenomenon: boys do indeed suffer more minor injuries than girls; boys report minor injuries to school staff more readily or more frequently than do girls; or school staff are more likely to report the boys' injuries than the girls' injuries. It is tempting to believe that this phenomenon simply reflects the rougher, more physical type of activity considered typical of boys. However, without sufficient data we can only speculate on the reasons.

The peak in the incidence rate of serious injuries in children in grades 6 to 8 (known as junior high school in some areas) was similar to the trend previously reported among public schools in Seattle.[13] This finding may be related to both the activities (especially athletic) engaged in by this age group and the characteristics of these children. Children in junior high school are usually at the age of puberty (commonly known among parents as the "clumsy age"), which involves rapid increases in body size, muscle mass and strength. These developments may affect the ability and safety of these children at school. Therefore, close supervision is necessary to reduce the number of injuries, especially during play and athletic activities.

The proportion of serious injuries suffered during the various athletic activities was somewhat surprising. It was high for gymnastics, basketball and volleyball, and many of the serious injuries suffered in these sports were sprains. On the other hand, it was relatively low for contact sports such as hockey and football, in which the rate of fractures was high (i.e., a serious injury was more likely to be a fracture in contact sports than in gymnastics). The true incidence rates for injuries suffered during intramural and interscholastic sports could not be determined, as the numbers of children engaged in the various activities were not known. Nevertheless, these data should be of interest to those involved in school athletic programs.

Table VI—Frequency with which adults with first-aid training were "always" present during athletic activities

Activity and level of school	No. (and %) of Schools responding*	No. (and %) of Trained adults always present
Physical education classes		
Elementary	115 (66.1)	24 (20.9)
Secondary	35 (92.1)	17 (48.6)
Intramural sports		
Elementary	112 (64.4)	16 (14.3)
Secondary	31 (81.6)	7 (22.6)
Interscholastic sports		
Elementary	82 (47.1)	16 (19.5)
Secondary	32 (84.2)	9 (28.5)
Swimming instruction		
Elementary	117 (67.2)	100 (85.5)
Secondary	19 (50.0)	12 (63.2)

*Includes 174 elementary schools and 38 secondary schools.

Table V—Destination of child according to the school accident report forms (SARFs)

Destination of child	Total no. (and %) of SARFs*	No. (and %) of SARFs reporting Serious injury	Minor injury
School office	1165 (29.1)	296 (25.6)	869 (30.5)
Back to classroom	1132 (28.3)	297 (25.7)	835 (29.3)
Hospital/emergency room	684 (17.1)	269 (23.2)	415 (14.6)
Home	422 (10.5)	125 (10.8)	297 (10.4)
Nurse's office	297 (7.4)	65 (5.6)	232 (8.1)
Doctor's/dentist's office	208 (5.2)	78 (6.7)	130 (4.6)
Other	97 (2.4)	27 (2.3)	70 (2.5)
Total	4005 (100.0)	1157 (28.9)	2848 (71.1)

*The destination was not recorded on the 293 additional SARFs submitted.

There was a lack of first-aid training among school staff. In particular, trained personnel were seldom present during athletic events. When competition is expected to be greatest (i.e., during interscholastic sports) fewer than one third of the schools reported that an adult trained in first aid was always present. All individuals involved in scholastic athletics should be capable of providing first aid. Better first-aid training of school staff could reduce the rate at which children with serious injuries, including fractures, are sent back to class or otherwise denied immediate medical attention. Clinicians should seriously consider the value of advocating such training among school personnel.

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