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Original Papers

The epidemiology of non-fatal injuries among 11-, 13- and 15-year old youth in 11 countries: findings from the 1998 WHO-HBSC cross national survey

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The primary objective was to present a cross-country comparison of injury rates, contexts and consequences. The research design was the analysis of data from the 1998 cross-national Health Behaviour in School-aged Children survey and 52 955 schoolchildren from 11 countries, aged 11, 13 and 15 years, completed a self-administrated questionnaire. A total of 41.3% of all children were injured and needed medical treatment in the past 12 months. Injury rates among boys were higher than among girls, 13.3% reported activity loss due to injury and 6.9% reported severe injury consequences. Most injuries occurred at home and at a sport facility, mainly during sport activity. Fighting accounted for 4.1% of injuries. This paper presents the first cross-national comparison of injury rates and patterns by external cause and context. Findings present cross-country similarities in injury distribution by setting and activity. These findings emphasize the importance of the development of global prevention programmes designed to address injuries among youth.

Keywords: Injury; School; Health

1. Introduction

The problem of injuries to children and adolescents is not a new one. It is well documented that injury is the leading cause of death among young people (Institute of Medicine Committee on Injury Prevention and Control 1999). Throughout the world, thousands of people die each day of injuries and thousands more survive but remain disabled (Baker *et al.* 1992, O'Donnell and Mickalide 1998, Krug *et al.* 2000). Non-fatal injuries occur at least 1000 times more often than fatal injuries (Lescohier and Scavo 1996) and their impact in terms of disability and the costs of treatment, rehabilitation and lost productivity is substantial (Rivara *et al.* 1987).

Previous studies describing injuries in populations of young people have addressed different issues related to

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injuries, such as associations between risk factors, behaviours, environmental factors and injuries (Pickett *et al.* 2002), or the patterns of different types of injuries such as those associated with violence-related injuries (Hayes and Hemenway 1999, Pickett *et al.* 2005) or sport injuries (Goldberg *et al.* 1988). Other studies were based on consequences of injuries, such as hospital admissions (Spady *et al.* 2004) and visits to clinics (Hambridge *et al.* 2002). Studies of the epidemiology of non-fatal injuries found that most non-fatal injuries result from recreational and sport activities and these occur mainly at school, home and in the neighbourhood (Harel *et al.* 1994, Scheidt *et al.* 1995, King *et al.* 1996a, Harel 1998a,b). Each of these locations provides opportunities for intervention.

Virtually all of the descriptive and epidemiological studies of injuries are based on national or more local data. However, the varied cultures, practices and policies of different countries may offer additional insights into the multifaceted problems of the causality and prevention of injuries in children. There has been little opportunity for cross-national studies that can provide an international comparison of non-fatal injuries. The Health Behavior in School Children (HBSC) Study is a multi-national, school-based survey of European and North American adolescent health behaviours that provides a unique opportunity to compare patterns of injuries and related factors in young adolescents between a number of different countries.

The purpose of this study is to describe the epidemiology of injuries across 11 countries in Europe and North America, using data collected during the 1997–1998 school year as part of the HBSC. The HBSC study uses mandatory measures and sampling procedures and creates a unique opportunity to compare the epidemiology and typology of injuries across the participating countries. This study examines the prevalence of injuries, severity of injuries, settings in which injuries occur and activities during which injuries occur, in the hopes of informing prevention efforts on an international basis.

2. Methods

2.1. *Data source*

The 1998 HBSC was carried out in 29 countries in Europe and North America, among nationally representative samples of 11-, 13- and 15-year old school children (Currie 1998). A similar sampling design was applied in all participating countries. Schools and classes within schools were selected to be representative by age level and regional geography. Recommended sample sizes for each country were 1500 students per age group. Sample sizes assured a 95% CI of +/− 3% for prevalence estimates, with a design effect of no more than 1.44 in any specific country (Currie 1998). All national samples were selected to be self-weighting with the exception of Israel, in which a set of weights was calculated to compensate for oversampling of the Israeli Arab population.

Descriptions of the 1998 HBSC questionnaire and its development appear in the international survey protocol (King *et al.* 1996b, Currie 1998). The mandatory survey collects information regarding student demographics, general health and well-being, family and peer relationships, school environments, exercise and leisure-time activities, diet, substance use and sexual behaviour (Currie 1998). Countries were able to add additional items in optional packages. One such package focused on violence and injuries.

2.2. *Sample*

The optional violence and injuries package was employed in 11 of the 29 countries: Belgium (Flemish sample); Canada; England; Hungary; Israel; Lithuania; Poland; Republic of Ireland; Sweden; Switzerland ;and the USA. Data from 52 955 students comprised the sample used for this injury study. Injury questions were derived from the 1988 Child Health Supplement to the US National Health Interview Survey (Harel *et al.* 1994, Scheidt *et al.* 1995) and the 1994 version of the HBSC questionnaire (Goldberg *et al.* 1988).

3. Measures

3.1. *Injury*

Students were asked: 'during the past 12 months, how many times were you injured, and had to be treated by a doctor or nurse?' with the following response categories: 'I was never injured in the past 12 months', 'once', 'twice', 'three times' and 'four times or more'. Students who reported one or more injuries were defined as being injured. The latter students then described their single most serious injury during the past 12 months in terms of where the injury occurred, the mechanism, the nature of injury, medical treatment and number of days lost from school or other daily activities.

3.2. *Severity*

Two measures of severity were used: 1) injury that resulted with 1 or more days missed from school or usual activities; 2) injury that resulted in two or more of the following treatments: placement of a cast, stitches, use of crutches and surgery or injury that resulted with overnight hospitalization (Overpeck and Kotch 1995). The items used for the severity measures were collected in eight of the 11 countries.

4. Data analysis

The injury data were examined to explore cross-national variations in injury rates as well as patterns of injuries. The

latter included focused analyses of the severity of injuries, the location where injuries occurred and activities associated with these recurrent injury events. Descriptive statistics were employed in all of these analyses and associated 95% CI are presented for each analysis. Confidence limits were computed with robust standard errors and a conservative design effect of 1.44 in order to account for clustering introduced due to sampling by classrooms (Francois *et al.* 1998).

5. Findings

Across the 11 countries reporting injury data, 41.3% (95% CI 40.9 – 47.7) of all students reported at least one medically attended injury during the past 12 months. Table 1 presents annual rates of medically attended injuries and measures of severity by country. Injury rates varied significantly among the 11 countries. In Israel and Republic of Ireland about half of the students reported at least one medically attended injury, while in Poland only one in four children reported such an injury during the same time frame. Boys experienced more injuries than girls in all 11 countries (data not presented). In Israel, the United States, Switzerland and Lithuania, injury rates were lower among older children compared to younger ones, whereas in Canada and Belgium the opposite trend was found, namely, rates were higher for older students than for younger ones. Injury rates in Republic of Ireland remained stable across the three age groups. No clear trends were evident among the remaining four countries (data not presented).

5.1. *Severity*

Two measures of severity were examined: activity loss; and injury significant medical treatment (table 1). In all 11 countries, a larger percentage of students reported activity loss due to an injury compared with the percentage reporting significant medical treatment. Modest yet statistically significant correlations were found between injury rates and significant medical treatment ($r = 0.32$, $p < 0.005$), and between activity loss due to injury and significant medical treatment ($r = 0.21$, $p < 0.005$). The same patterns of associations were identified in all countries when analysing them separately.

5.2. *Setting and activity*

Large proportions of reported injuries occurred at home or yard (26.3%), at sport facilities (23.4%) and at schools or school ground (21.8%). The street, which might include general neighbourhood settings, is another location for injuries (15.8%). Consistent with these locations, sport activity is by far the most common mechanism of injury (33.5%), followed by biking (13.3%), walking or running (not for sport purposes) (13.1%), skating (7.9%) and riding in a car (3.0%). Fighting was responsible for only 4.0% of all injuries. Table 2 presents the cross-tabulation of injuries experienced in all 11 countries by setting and activity. Almost half of all school injuries, for example, were attributable to sport and playground activities. About 16% of school injuries are due to walking or running. Injuries due to fighting were most prominent in home, school and street locations.

Table 3 presents country-specific injury rates for the three main settings and table 4 presents country-specific injury rates by major categories of activity. In the Eastern European countries sampled, injuries in sport facilities were less common than in Western European countries, North America and Israel, suggesting possible variation in

Table 1. Annual rates of medically attended injury and measures of severity per 100 by country.

	All medically treated injuries			Injuries resulting in 1+ days of activity loss*			Injuries resulting in serious consequences†		
Country	n	%	95% CI	n	%	95% CI	n	%	95% CI
Israel	4824	50.4	49.0 – 51.8	2334	20.0	17.9 – 22.1	2660	6.8	6.0 – 7.6
Republic of Ireland	4278	50.3	48.7 – 51.9	1911	30.6	28.5 – 32.7	1911	12.9	10.2 – 12.2
USA	5118	47.4	46.1 – 48.7	–	–	–	2428	9.4	8.6 – 10.2
Hungary	3609	47.4	45.8 – 49.0	1710	15.3	13.0 – 17.6	1710	8.0	7.1 – 8.9
Switzerland‡	5231	45.5	44.2 – 46.8	1062	18.7	15.3 – 22.1	778	8.7	8.2 – 9.2
England	5948	42.2	41.0 – 43.4	–	–	–	2526	5.6	5.2 – 6.4
Lithuania	4308	39.0	37.7 – 40.3	1078	23.9	22.6 – 25.2	1679	10.3	9.4 – 11.2
Canada	6523	37.8	36.6 – 39.0	2379	18.1	16.0 – 20.2	2465	8.0	7.3 – 8.7
Sweden†	3647	35.7	34.1 – 37.3	1611	14.6	11.3 – 17.9	–	–	–
Belgium (Flemish)	4608	29.9	28.6 – 31.2	1616	12.2	9.8 – 14.6	1379	5.8	5.8 – 7.2
Poland*	4861	24.1	22.9 – 25.3	580	12.4	8.6 – 16.2	751	6.0	2.8 – 9.2
All countries	**52 955**	**41.3**	**40.9 – 41.7**	**19 094**	**13.3**	**12.3 – 14.3**	**19 418**	**6.9**	**6.3 – 7.5**

*Not including 15 years from Poland.
†Not including 11 years from Sweden.
‡Includes only 15 years from Switzerland.

exposure and access to sport facilities. In most countries, home injuries were less frequent among boys and in older age groups. School-related injuries were more common among girls but were relatively stable across the three age groups. Boys and older students were more involved in injuries that occurred at sport facilities. Sport activity and biking injury distributions vary among the different countries. Fighting injuries represented about 3–6% of reported injuries in most countries.

Table 5 presents injury distributions by activity and measures of severity. Findings suggest that sport activity was responsible for the majority of injuries that resulted in loss of activity and in significant medical treatment. Fighting was found to be responsible for only about 4% of severe injuries for both measures.

Table 2. Medically attended injury: cross-tabulation of injuries, by setting and activity context for all 11 countries combined.*

	Home (or yard)	School	Sport facility/ Field	Street	Other	Total
Biking	27.6	8.2	7.7	46.7	9.7	100.0
	14.0	5.0	4.4	39.3	10.2	13.3
Skating	20.4	10.0	37.1	24.4	8.1	100.0
	6.2	3.6	12.6	12.2	5.1	7.9
Sport activity	12.9	31.2	47.9	2.6	5.3	100.0
	16.5	47.9	68.5	5.5	14.1	33.5
Riding in a car	16.1	11.0	10.3	46.4	16.1	100.0
	1.9	1.5	1.3	8.9	3.9	3.0
Walking/ Running	34.2	26.1	7.3	20.2	12.2	100.0
	17.1	15.7	4.1	16.7	12.6	13.1
Fighting	29.8	28.3	9.4	23.3	9.1	100.0
	4.6	5.2	1.6	5.9	2.9	4.0
Other	41.6	18.3	7.0	7.2	25.9	100.0
	39.8	21.0	7.5	11.4	51.3	25.1
Total	3866	3212	3450	2330	1869	14 727
	26.3	21.8	23.4	15.8	12.7	100.0
	100.0	100.0	100.0	100.0	100.0	100.0

*Poland, Sweden, Switzerland and Lithuania were excluded from this analysis due to lack of one or two of the setting or activity variables.

6. Discussion

The findings presented above show country variation in medically attended injury from about 24% in Poland to about 50% in Israel. Yet, despite differences observed between countries, the consistency of findings with regard to the locations of injury and their mechanisms are striking.

Although this survey employed a standard methodology cross-nationally, variations in injury estimates across countries may not always reflect real differences. There are several alternative explanations for these variations that have been discussed in previous publications (Harel *et al.* 1994, Scheidt *et al.* 1995). The definition of an injury to be included in the study was an injury 'that was treated by a doctor or a nurse'. Such a definition makes the reported injuries prone to country and cultural variations in utilization of such care (especially in the school setting). The existence or lack of a school nurse might influence the number of medically attended injuries that are reported. In addition, in some populations the acquisition of medical treatment for relatively minor injuries is culturally or socially encouraged while in other populations 'toughing it out' with self-treatment is the norm. Such variations will lead to obvious variations in injury estimates. Finally, there might be variations across countries in the definition of medical care. For example, in some schools in Israel the

Table 3. Country specific medically attended annual injury estimates by setting per 100 injured persons.

	Home (or home yard)			School			Sport facility		
Country	n	%	95% CI	n	%	95% CI	n	%	95% CI
Israel	2214	20.1	18.3–21.9	2214	23.3	21.5–25.1	2214	23.9	22.1–25.7
Republic of Ireland	2014	26.6	24.6–28.6	2014	17.6	15.9–19.3	2014	29.7	27.7–31.7
USA	2335	33.4	31.4–35.4	2335	22.0	20.3–23.7	2335	27.0	25.2–28.8
Hungary	1558	29.7	27.4–32.0	1558	22.1	20.0–24.2	1558	13.9	12.1–15.7
Switzerland†	765	15.8	13.2–18.4	765	15.4	12.8–18.0	765	21.8	18.8–24.8
England	2493	26.2	24.4–28.0	2493	21.1	19.5–22.7	2493	23.3	21.7–24.9
Lithuania	1477	36.7	34.2–39.2	1477	23.0	20.8–25.2	1477	12.5	10.8–14.2
Canada	2353	23.5	21.8–25.2	2353	21.2	19.5–22.9	2353	29.3	27.4–31.2
Sweden*	890	17.3	14.8–19.8	890	18.5	15.9–21.1	890	26.9	23.9–29.9
Belgium (Flemish)	1457	25.4	23.1–27.7	1457	23.2	21.0–25.4	1457	22.5	20.3–24.7
Poland	1156	25.3	22.7–27.9	1156	26.1	23.5–28.7	1156	14.0	12.0–16.0
All	**17 949**	**27.1**	**26.4–27.8**	**17 949**	**21.7**	**21.1–22.3**	**17 949**	**22.9**	**22.3–23.5**

*Not including 11 years from Sweden.
†Includes only 15 years from Switzerland.

Table 4. Country specific medically attended annual injury estimates by activity per 100 injured persons.

	Sport activity			Biking			Fighting		
Country	n	%	95% CI	n	%	95% CI	n	%	95% CI
Israel	2107	32.5	30.5–34.5	2107	14.4	12.8–16.0	2107	6.0	5.0–7.0
Republic of Ireland	2076	39.9	37.8–42.0	2076	8.7	7.5–9.9	2076	4.4	3.5–5.3
USA	2342	49.7	47.6–51.8	2342	8.0	6.9–9.1	2342	5.8	4.8–6.8
Hungary	1551	27.5	25.2–29.8	1551	21.6	19.5–23.7	1551	3.7	2.7–4.7
Lithuania†	1460	10.8	9.2–12.4	1460	22.5	20.3–24.7	–	–	–
Canada	2290	36.4	34.4–38.4	2290	8.0	6.9–9.1	2290	2.9	2.2–3.6
Sweden*	856	29.9	26.8–33.0	856	11.8	9.6–14.0	856	5.0	3.5–6.5
Belgium–Flemish	1419	33.3	30.8–35.8	1419	17.9	15.9–19.9	1419	3.9	2.9–4.9
Poland	1156	26.6	24.0–29.2	1156	13.1	11.1–15.1	1156	4.7	3.5–5.9
All countries	**15 257**	**33.3**	**32.5–34.1**	**15 257**	**13.1**	**12.5–13.7**	**15 257**	**4.1**	**3.8–4.4**

*Not including 11 years from Sweden.
†Lithuania did not have categories walking/running and fighting.

Table 5. Cross-tabulation of severe injury rates by activity and type of severity measure for all countries combined*†‡§.

	Activity loss		Consequences	
Type of activity	n	%	n	%
Biking	1913	13.0	1947	14.8
Skating	1131	7.5	1157	9.1
Sport activity	4691	31.6	4798	27.5
Riding in a car	423	2.8	428	4.6
Walking/Running	1771	11.7	1835	12.7
Fighting	548	3.8	109	3.8
Other	3462	29.7	3513	27.6
Total	**13 904**	**100.0**	**14 234**	**100.0**

*Not including 15 years from Poland.
†Not including 11 years from Sweden.
‡Includes only 15 years from Switzerland.
§Lithuania did not have categories walking/running and fighting.

school secretary (or some other administrative function) holds the first-aid cabinet in their room. When a child is injured, this administrative person provides the first-aid treatment. Although the provider of care in this example is not 'a doctor or a nurse', children might report this event as medically attended. Cross-national variations in injury estimates should therefore be treated with caution.

Cross-national variations that are due to access and utilization of care should be most evident for minor injuries. The more severe the injury the less prone that event should be to such a reporting bias (Harel *et al*. 1994). These cross-national variations for more severe injuries were therefore examined based on two types of measures: 1) loss of daily activity; 2) significant medical treatment. When examining these two measures, the ranking of injury rates between countries changed substantially. In all severity categories of injury, Republic of Ireland and the USA had the highest injury rates while Belgium and Poland were at the bottom of the ranking. In these countries it may be assumed that the injury rates, as reflected in the general injury measure, were quite representative of medically attended injuries. A different pattern emerged in other countries. Israel, for example, which was ranked first with the highest injury rate in the original measure, was ranked lower (fifth and seventh) on each of the two more severity measures. This may reflect high accessibility to the national health care system, community first-aid clinics and maybe a cultural tendency to skip school for minor injuries – more than in other countries. In contrast, Lithuania was ranked eighth using the original measure with 39% of the students reporting one medically attended injury or more, but was ranked second with regard to more severe injuries (on both measures). This suggests that the Lithuanian students search for medical assistance for more severe injuries.

Another interesting aspect of international variations lies in the differences with regard to bicycle injuries. Findings presented here correspond with previous findings (Klein *et al*. 2005) showing cross-national differences in bicycle helmet use and the differences in national interest and programmes in bicycle safety, especially bicycle helmets. Klein *et al*. (2005) reported the relative lack of programmes on bicycle safety for Hungary and more programmes for Sweden, Canada and the USA that corresponded with the percentages of school children using bicycle helmets in these countries. Indeed, the current study found high rates of bicycle-related injuries in Hungary (21.6%) and lower rates in Sweden, Canada and the USA (11.8%, 8.0% and 8.0% respectively). This may suggest that informed legislation and other injury prevention programmes can play an important role in decreasing injury rates at the national level.

Despite variations in country-specific estimates, cross-national similarities in the distribution of injuries by setting

and activity context were striking. In all countries the three main settings where adolescent injuries occur are school, home and sport facility environments, a finding that is supported by previous studies (Harel *et al*. 1994, Scheidt *et al*. 1995, King *et al*. 1996a, Harel 1998a,b). The two most frequent activities associated with injuries in all countries are biking and sport activities. This trend holds for severe injuries as well.

One of the most interesting finding surrounds the incidence of intentional injuries. Overall, about 4% of all reported injuries were caused by fighting and this figure was consistent across the 11 countries. Moreover, injuries due to fighting were responsible for only about 4% of all severe injuries, based upon both measures of severity used. This finding is of importance given the focus that intentional injuries receive (Hayes and Hemenway 1999, Pickett *et al*. 2005). Yet, it is important to emphasize that fighting is just one form of violent behaviour (World Health Organization 2002) and that not all fights result in a medically attended injury. Therefore, the rate of intentional injuries presented here should by no means be regarded as an indicator of the prevalence of violent behaviours among youth in these countries.

Findings from this study suggest that injuries are a serious public health issue internationally, by adding information on injuries in the community as opposed to previous studies that reported injury data based on hospital records and death records (Institute of Medicine Committee on Injury Prevention and Control 1999, UNICEF 2001). The study presents, for the first time, an international comparison of injury rates and contexts, using a similar research tool. The high rates of injury among youth, in all 11 countries that collected these data in the WHO HBSC study indicate that this problem universal. The cross-national similarities in causes and locations are compelling. The three leading locations (home, school and sport facilities) should be targeted as a high priority worldwide. Whether by planning safer environments that could be implemented inexpensively in different countries or by developing common programmes aimed at these locations, such efforts should be made.

Several limitations of this study should be noted. The HBSC covers a broad range of topics related to the health of youth. As such, in-depth information on the exact circumstances (such as drowning and poisoning) leading to individual injury events cannot be obtained. In addition, the data were collected during school class period. Thus, youth who were not in attendance at school were not represented. The study also relies upon self-reports and this involves use of individual student's perceptions. These limitations have been discussed previously (Harel *et al*. 1994, Scheidt *et al*. 1995, Harel 1998b).

Findings from this study can contribute to understanding about how injury patterns vary and are similar cross-nationally. Knowledge obtained in comparing the 11 countries could provide prevention efforts with valuable information on the most common locations and activities in which children are injured, together with demographic information on an international basis, information that may help in developing injury prevention strategies. These findings demonstrate that there are cross-national similarities in the external causes of youth injuries and their location of occurrence. The consistency of these findings points to the need for cross-national strategies to address recurrent injury patterns experienced by young people, but could, all the same, assist in advocating for injury prevention at the national level. These should necessarily focus upon the most common locations and activities in which children are injured, namely, school and various sport activities. Findings from this study support the importance of the development and evaluation of prevention programmes designed to address injuries among youth. However, there is a need for more detailed investigation on the causes of injuries, together with information on the regulations and prevention efforts in the different countries and how they pattern with the national injury rates. Such investigation may provide crucial information on the efficiency of prevention strategies and may give a lesson on the cross cultural applicability of such strategies.

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