ABSTRACT

Objectives: 1) To describe patterns of injury among Canadian youth, and 2) to explore whether injured youth can be characterized by adverse lifestyle factors.

Design: Secondary analysis of the Canadian 1993-94 Health Behaviour in School-Aged Children Survey (youth enrolled in grades 6, 8 and 10).

Primary Outcome: Physical injuries that occurred in the twelve months prior to survey.

Results: Each year, 36% of these Canadian youth experience at least one injury. Risks vary by grade, gender and cause of injury. When extrapolated to the Canadian population, more than 600,000 injuries are experienced by youth annually. Sports injuries and accidental falls were leading contexts of injury. There was only limited evidence to suggest that high-risk youth can be characterized by adverse lifestyle behaviours.

Conclusions: Injuries to youth are a major public health problem. Ongoing surveillance is required in Canada. Future editions of this survey will, in part, address this need.

ABRÉGÉ

Objectifs : 1) décrire les schémas dans les blessures subies par les jeunes Canadiens, et 2) voir si des facteurs préjudiciables dans leurs façons de vivre caractérisent les jeunes blessés.

Conception : analyse secondaire de l'Enquête canadienne sur les comportements sanitaires des enfants d'âge scolaire, 1993-1994 (enfants inscrits en 6^e, 8^e et 10^e années.)

Principale mesure : blessures physiques subies dans les douze mois avant l'enquête.

Résultats : chaque année, 36 % des jeunes Canadiens souffrent d'une blessure au moins. Les risques varient selon l'année scolaire, le genre et la cause de la blessure. Si on extrapole à la population canadienne, cela signifie qu'il y a chaque année plus de 600 000 blessures chez les jeunes. Les blessures occasionnées par le sport et les chutes accidentelles sont apparues comme les principales situations à l'origine de blessures. On n'a trouvé que peu de données montrant que des styles de vie préjudiciables caractérisent les jeunes à risque élevé.

Conclusions : les blessures dont sont victimes les jeunes constituent un grave problème de santé publique. Une surveillance constante doit être mise en place au Canada. Les prochaines mises à jour de cette enquête permettront en partie de répondre à ce besoin.

Injury in Canadian Youth: A Secondary Analysis of the 1993-94 Health Behaviour in School-Aged Children Survey

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For many years, injuries have been regarded as a leading cause of death, illness and disability among youth in developed countries. Canadian studies that quantify the magnitude of the injury problem in defined populations are rare. Existing population-based studies of injury are typically limited to analyses of deaths and/or traumatic injuries.¹⁻³ Where surveillance systems exist, it is also rare that denominator data are available so that risks can be expressed as rates as opposed to simple counts of injury events.^{4,5}

This paper provides an analysis of Canadian injury data from the 1993-94 Health Behaviour in School-Aged Children Survey (HBSC). This is a collaborative cross-national research study sponsored by the World Health Organization and is designed to increase understanding of the health-related attitudes and behaviours of young people and the context in which they develop.⁶ Survey findings from a sample of Canadian youth enrolled in Grades 6, 8 and 10 are the basis for our analysis.

These analyses are useful for several reasons. First, the Canadian component of this survey was designed to represent the experiences of all youth in Canada between the ages of 11 and 15. Information was

collected from a large and representative sample of this population. The data include reports of all injury events that presented for medical care. Information was simultaneously collected on lifestyle factors that were potentially associated with injury.

Two specific objectives were addressed: 1) to describe the magnitude and patterns of injury among Canadian youth; and, 2) to characterize Canadian youth at high risk for injury by several potential risk factors, including specific health behaviours and characteristics of their lifestyle.

The lack of descriptive information on the full spectrum of injuries to youth has been an important concern in Canada. The information presented here is new and population-based and should provide an objective basis for injury prevention initiatives.

METHODS

Sampling

The Canadian sample was drawn such that overall prevalence estimates were accurate to within 2.5 percentage points, 19 times out of 20. Approximately 2,000 students were selected for study in each grade. A cluster sample design was used with the school class being the basic cluster. The sample was designed so that the proportions of the three samples contributed by each province were approximately equal to true proportions. Within provinces, proportional representation was assured by community type, geographical location, language of instruction, and religious affiliation. The sample design made weighting for proportional representation unnecessary. The sample was drawn from 95% of eligible students. Excluded were those in private and

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special needs schools. Within each grade, 85% of the respondents fell within one-half year of the mean age (Table I).

Survey design and instrument

Topics included in the HBSC surveys are determined and piloted by the researchers representing each participating country. In order to capture a developmental perspective, a simulated longitudinal design was employed. The three age groups were studied to examine the change in health behaviours and attitudes that occur from the onset of puberty to the middle of adolescence. The design is built around the notion of certain factors (independent variables) influencing health outcomes. For this particular analysis, health outcomes include various categories of injury. Independent variables include a variety of other health behaviours.

The survey was administered between November and January in the 1993-94 school year. Classroom teachers administered the survey under specific directions provided by the research team. Anonymity was assured.

Definition of an injury

Youth were considered to have experienced an injury if they answered yes to the question: "During the past 12 months, were you hurt or injured and had to be treated by a doctor or a nurse?" Supplemental questions were asked about the frequency of injury, and the "most serious" injury that occurred. The latter also included questions about the need for medical treatment; time off from school or other usual activities; and the location, context and nature of the physical injuries sustained.

Descriptive analysis of injury patterns

Counts of injured youth were calculated by age group and sex. Descriptive statistics (medians and inter-quartile ranges) were used to depict the average length of time away from school due to injury.

Overall and stratum-specific rates of youth injury were calculated with their associated 95% confidence limits.⁸ Additional rates of injury were calculated by: their context (e.g., sports, falls), location of injury occurrence (e.g., home,

TABLE I
Sample Size Available for Study and Mean Age, by Grade and Gender

	Grade 6 Mean Age		Grade 8 Mean Age		Grade 10 Mean Age	
	n		n		n	
Males	1096	11.5	1055	13.5	059	15.5
Females	1193	11.4	1195	13.4	1160	15.5
Total	2289	11.5	2250	13.5	2219	15.5

TABLE II
Annual Rates (95% Confidence Intervals) of Injured People per 1,000 among Canadian Youth, by Grade and Sex

Grade	Total		Males		Females	
	Number Injured	Rate (95% CI)	Number Injured	Rate (95% CI)	Number Injured	Rate (95% CI)
Grade 6	740	329.5 (310.2, 348.8)	376	351.4 (323.1, 379.7)	364	309.5 (283.3, 335.7)
Grade 8	834	381.7 (361.6, 401.8)	441	428.6 (398.7, 458.5)	393	340.0 (313.1, 366.9)
Grade 10	829	379.8 (359.6, 400.0)	464	447.4 (417.5, 477.3)	365	318.5 (291.7, 345.3)
All grades (6, 8, 10)	2403	363.3 (351.8, 374.8)	1281	408.5 (391.5, 425.5)	1122	322.6 (307.2, 338.0)

TABLE III
Annual Rates per 1,000 for the Most Frequent Contexts and Locations of Injury Among Canadian Youth, by Grade and Sex

Context or Location	Rates of Injury per 1,000 Youth per Year					
	Grade 6		Grade 8		Grade 10	
	Males	Females	Males	Females	Males	Females
(N)	1056	1166	1014	1150	1025	1144
Context						
Sports	90.0	49.7	157.8	111.3	202.0	118.0
All falls:	62.5	84.9	57.2	62.6	39.0	60.3
tripped or fell down	33.1	57.5	35.5	39.1	22.4	42.8
fell off something	29.4	27.4	21.7	23.5	16.6	17.5
Playing/school playground	31.3	26.6	18.7	9.6	4.9	2.6
Riding a bike	31.3	22.3	30.6	12.2	16.6	9.6
Roller skating	9.5	7.7	11.8	11.3	6.8	0.9
Got struck or cut	40.7	28.3	36.5	26.1	33.2	28.8
Fight	8.5	6.0	18.7	6.1	26.3	14.9
Riding car or hit by car	14.2	14.6	11.8	12.2	20.5	21.9
Other	54.0	63.5	76.9	85.2	91.7	60.3
Location of Injury						
Home	105.0	90.9	103.2	88.5	77.1	74.3
School	74.7	75.5	61.0	71.2	59.5	61.2
Sport Facility	60.5	35.2	118.0	57.3	149.3	69.1
Street	37.8	31.7	40.3	26.0	41.0	34.1
Park	22.7	20.6	20.6	18.2	30.2	17.5
Farm	4.7	0.9	8.8	5.2	9.8	7.9
Other	37.8	48.9	68.8	71.2	74.1	53.3

school), and the nature of the injury (e.g., broken bone, sprain). Where a youth reported more than one injury, only the most serious injury event (by self-report) was used in the calculation of injury rates.

Exploratory etiological analysis

An exploratory analysis was used to examine several potential risk factors for

injury. The latter included health behaviours that potentially put youth at risk (tobacco use, alcohol use, binge drinking, lack of exercise, unhappiness); social isolation (loneliness, family support); indirect measures of socioeconomic status (plans for higher education, performance in school, perceived financial status of family) and participation in sports.

TABLE IV
Consequences of Injury among Canadian Youth, by Grade and Sex

Consequences of Injury (N)	Rates of Injury per 1,000 Youth per Year					
	Grade 6		Grade 8		Grade 10	
	Males	Females	Males	Females	Males	Females
	1060	1165	1015	1152	1026	1143
Consequences						
Broken bone	74.5	68.7	135.0	95.5	121.8	66.5
Sprain	65.1	89.3	92.6	109.4	122.8	112.0
Cuts	83.0	51.5	88.7	43.4	76.0	39.4
Concussion	27.3	15.5	15.8	7.8	32.2	21.0
Bruises	23.6	16.3	19.7	13.0	21.4	21.0
Burn	7.5	6.9	6.9	4.3	4.8	7.0
Poisoning	0.9	3.4	3.0	0.9	0.0	6.1
Other	63.2	48.1	59.1	63.4	62.4	43.7

TABLE V
Days Missed from School or Other Usual Activities Due to the Occurrence of Injuries

Grade	Males	Females
Grade 6:		
total injured	376	364
missed 1+ day due to injury	196 (52.1%)	172 (43.8%)
days missed: median (inter-quartile range)*	2 (1,5)	2 (1,4)
Grade 8:		
total injured	441	393
missed 1+ day due to injury	250 (56.7%)	217 (55.2%)
days missed: median (inter-quartile range)*	2 (1,6)	2 (1,5)
Grade 10:		
total injured	464	365
missed 1+ day due to injury	248 (53.4%)	226 (61.9%)
days missed: median (inter-quartile range) *	3 (1,7)	2 (1,5)

* Calculations based upon those who missed 1+ day from school; inter-quartile range = 25th percentile, 75th percentile.

Statistical models were built around the hypothesis that adverse lifestyle behaviours co-exist among Canadian youth, and that these include risk-taking behaviours that are also associated with the occurrence of injury. We wanted to identify those behaviours that were consistently associated with injury in different grades and the two genders. Our approach to modelling was as follows:

- 1) Multivariate analyses using unconditional logistic regression with forward elimination were employed to develop risk factor models for different population subgroups (one each for males and females in grades 6, 8 and 10). Independent variables were included in these models if they appeared in the list of potential risk factors provided above, and they were statistically associated with the occurrence of injury ($p < 0.05$). It was not necessary to consider design effects in the multivariate models.
- 2) The leading context of injury in all but one age/gender group was sports

injury. Because of this, measures of sports participation were the major risk factors identified in our initial attempts at model selection. This hampered our efforts to explore adverse health/lifestyle behaviours among youth and their association with injury. We developed a second series of risk factor models, where sports injuries were excluded. These analyses were limited to grades 8 and 10 (boys and girls), due to the low prevalence of potential risk factors and the consequent lack of statistical power to study associations among the grade 6's.

RESULTS

Injury rates by grade and sex

Annual rates of youth reporting one or more injuries are presented by grade and sex in Table II. The rates were consistently higher among males than among females, with an overall sex ratio of 1.3 to 1 when

expressed as a ratio of male:female rates. Rates of injury were higher in grades 8 and 10 than in grade 6.

Injury rates by context, location and consequences

Table III shows the most common contexts of injury among the three subgroups of Canadian youth. Among males, the leading contexts in all age groups were sports injuries and falls. Sports injuries became more prevalent with increasing age, while a reverse trend was apparent for most other contexts. Leading contexts associated with female injuries were sports injuries, falls and being struck or cut by an object. The age-specific patterns of injury observed in the two sexes were generally similar with one notable exception. Rates of injury caused by fighting were low and similar (6/1000/yr) in the two younger female age groups, and higher (15/1000/yr) in the older age group, while the male rates of injury consistently increased with increasing age.

Locations of injury by age and sex are also shown in Table III. In general, the locations likely reflect the contexts in which the injuries occurred and the amounts of exposure that youth have to these environments, and are consequently led by home, school and sports facility locations. Table IV describes the nature of the injuries sustained. The leading types of injuries reported were fractures, sprains/strains and lacerations.

Days lost from school or other usual activities

Table V describes the number of days lost from school or other usual activities due to injury, by grade and sex. Overall, 1,309 (55%) of the 2,403 injured persons lost at least one day from school/usual activities, although there was variation in this figure by age and sex. The median number of days missed from school or other usual activities due to injury was three for grade 10 males and two for each of the other five groups.

Exploratory etiological analysis

Table VI shows the results of our exploratory risk factor analysis. The purpose of this analysis was to identify risk-

taking behaviours that are strongly and consistently associated with the occurrence of injuries (excluding sports injuries) among grade 8 and 10 boys and girls.

This analysis indicated that none of the health behaviours were consistently associated with the occurrence of injury, in all of the four subgroups of youth. The only risk factor that was identified in three of the grade/gender groups was whether a measure of smoking behaviour (answered yes to "have tried smoking"), which was associated with a 1.7-fold increase in risk for injury in grade 8 boys, and grade 8 and 10 girls. Being drunk on more than one occasion was identified as a risk factor in both male groups, and the use of recreational drugs was identified as a risk factor in grade 10 boys. Modest but statistically non-significant increases in risk were observed among grade 8 girls who spent larger numbers of evenings away from home with friends.

DISCUSSION

This paper provides a new analysis of Canadian data on injury and associated risk factors, from a multi-national survey of youth and their health behaviours. It was hoped that these population-based results would help in the ongoing development and targeting of prevention initiatives.

Magnitude of injury as a health problem among Canadian youth

Our analyses suggest that each year in Canada, 36% of youth in grades 6, 8 and 10 experience at least one injury for which treatment is required from a doctor or a nurse. Annual prevalence rates of injury among Canadian boys and girls in this grade range are 409/1000/yr and 323/1000/yr, respectively, and this figure peaks at 447/1000/yr among boys in grade 10. Forty-three percent of the subgroup of youth reporting injuries listed more than one injury event. The reported injuries were not inconsequential health events. The consequences of these injuries were most commonly fractures, sprains and cuts/lacerations. About two days, on average, were missed from school for each injury.

TABLE VI
Potential Factors for Injury Among Canadian Youth, by Grade and Gender, Identified via Logistic Regression Analysis

Variable	Boys				Girls			
	Grade 8 OR	p	Grade 10 OR	p	Grade 8 OR	p	Grade 10 OR	p
Have tried smoking	1.68	0.002			1.70	0.0005	1.72	0.001
Times been drunk								
never	1.0		1.0					
once	2.12	0.002	0.87	0.63				
2-3	1.69	0.08	1.85	0.02				
4-10	1.22	0.65	1.54	0.11				
11+	2.05	0.05	2.09	0.006				
Use drugs to get high/for non-medical purposes			1.63	0.01				
Number of evenings per week spent away from home with friends								
0					1.0			
1					0.50	0.03		
2					0.71	0.25		
3					0.87	0.62		
4					1.02	0.94		
5					1.44	0.23		
6					1.09	0.84		
7					1.65	0.16		

If these injury data are representative of the experiences of youth in Canada, the magnitude of the illness burden due to injury is large. When extrapolated to the Canadian population of youth aged 11-15, at a minimum more than 600,000 injuries are experienced, and more than 750,000 days are missed from school due to injury.* When the direct and indirect costs of these health events are considered, even at a superficial level it is evident that injuries to youth are a major economic issue as well.

Youth at high risk for injury

Our data indicate that there are strong differences in rates of injury by gender and grade in Canadian youth. This is consistent with the observations of others, in that high rates of injury were observed in males, and among youth in older grades.^{10,11} These differences in part reflect variations in the development of boys and girls at different ages, and in part reflect different exposures to risk as youth enter and then pass through adolescence. Because the injuries were identified by self-report, we acknowl-

edge that systematic differences in the quality of information provided might explain some of the differences observed. Analogous forms of bias have been observed when different periods of recall (one month versus twelve months) have been used.¹² In general, rates based upon 12-month periods of recall under-estimate the true magnitude of the injury problem, and our estimations are therefore likely to be conservative. It is also likely that different practices exist for the referral of injuries to medical care. For example, injuries that occur during organized sports or on school property may be high because of the need for coaches and school officials to err on the side of caution where referral is indicated.

It is also not surprising that both our descriptive and etiologic analyses showed that participation in sports activities was a major risk factor for youth injury. Large numbers of Canadian youth are involved in sports on an ongoing basis and this trend must continue; the recreational and developmental functions are obvious. However, the inherent levels of risk associated with participation in many sports are also clear. Initiatives that improve prevention and care for these injuries are warranted.

Of greater interest to our working group was the possibility that there exists a group of Canadian youth at high risk for injury

* estimated using population figures from the 1991 Canada Census of Population,⁹ the lower 95% confidence limits from our rate calculations, and the assumption that these rates reflect the experiences of the 1993 Canadian population of youth ages 11-15.

that shared several, clustered high-risk health behaviours. We hypothesized that these youth might typically be characterized as being economically deprived; socially isolated from others in the school and home environments; and exhibiting high levels of misuse of tobacco, alcohol and non-medical drugs.

There was some evidence that our ideas were tenable with selected subgroups of the study population. Smoking, excess drinking and non-medical drug use did appear as modestly strong risk factors in certain subgroups of youth. Most of the expected etiological patterns did not consistently emerge in all subgroups, however, suggesting that excess risks for injury cannot be fully explained by adverse health behaviours alone. Further, it appeared that the strength of different risk factors varied considerably between the subgroups, indicating that if clusters of high-risk behaviours exist, they do not operate in the same manner in different age groups and sexes. We were therefore unable to develop a simple list of clustered, high-risk behaviours that consistently appear in association with youth at high risk for injury.

NEXT STEPS

Few population-based data sources exist that allow the surveillance of injuries among Canadian youth at a national level. At the very least, this analysis provides a baseline from which the youth injury problem in Canada can be monitored. Future editions of this survey are planned, and will be compared against this baseline.

Finally, our analysis indicates patterns of youth injury to be given national priority

for intervention and further research. The specific priorities for intervention include: 1) the primary prevention of sports injuries in boys and girls in all three grades, but particularly among those occurring at the high school level, and in organized sports facility locations; and, 2) formal first aid training for the common types of injury sustained by youth (fractures, sprains and cuts/lacerations). Priorities for further research include: 1) further investigation of focused research questions on the etiology and costs of specific types of injury observed among different subgroups of youth; 2) methodological studies that address aspects of the quality of injury data reported by youth in a survey format; and, 3) randomized, controlled trials that assess the effectiveness of interventions aimed at the prevention of any of the priority patterns of injury.

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