

**SELF REPORTED DENTAL AND ORAL INJURIES
IN ONTARIO ADULTS AGED 18 TO 50 YEARS:**

Prevalence and causes

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Executive summary

Few population-based studies have been undertaken of traumatic dental injury in adults. The objective of this study was to assess the prevalence and severity of injuries to the mouth and teeth among adults aged 18 to 50 years living in the Canadian province of Ontario. A telephone survey was undertaken based on random digit dialling and 2001 adults in the target age range interviewed.

- Overall, 15.5% of subjects reported a history of injury to the mouth and teeth. Of these, one-third reported two or more episodes of injury. Two thirds of the injuries reported occurred before the age of 18 years and one third after this age.
- Males were more likely than females to report injury and to have experienced more than one injury. There was no association with age but a U-shaped relationship with education.
- When asked about the nature of the worst injury experienced, 85% with a history of trauma reported damage to the teeth and of these, 38.5% reported one or more teeth were chipped and 26.0% broke one or more teeth. One quarter (25.4%) reported avulsions and 6.5% reported luxations. Other types of injury were reported by 3.5%.
- One-fifth of those with tooth injuries had not been treated by a health professional. This was not associated with the nature of the damage that occurred; rather subjects from the lower educational groups were less likely than those from higher educational groups to have received treatment.
- There was a significant association between injuries to the mouth and teeth and injuries in other body locations. One-third of those reporting two or more episodes of the latter reported having experienced injuries to the mouth and teeth.
- Just over a half of respondents reported playing the kinds of sports commonly associated with oral injuries and they were twice at risk (OR=1.99) of such an injury than those who did not play such sports.
- The most common cause of injury was playing sports, followed by collisions and sports. Violence accounted for 10% of the injuries reported. However, the causes of injury varied according to the age at which they occurred.

The results of this self-report study indicate that dental trauma constitutes a significant health issue among adults and that a minority may be injury prone. Health promotion programs to reduce the incidence of injury, particularly among lower socio-economic groups. These have high rates of injury and the lowest rate of receipt of treatment. Such programs need to vary according to the age of the populations targeted.

INTRODUCTION

Over the last three decades there has been a substantial improvement in the oral health of most child populations, as evidenced by declines in the prevalence and severity of dental decay. While caries remains an important public health issue and a significant source of disparities in oral health (1), this decrease in what was the main childhood dental disorder means that increasing attention is being paid to other oral conditions affecting children (2). One of these is traumatic dental injury. These injuries range from minor fractures of the enamel to more major damage involving the displacement or avulsion of teeth. Such injuries entail significant emotional and social costs to children and their families (3). In addition, the treatment of such injuries involves economic costs in both the short and the long term. Consequently, injuries to the teeth constitute the most serious dental condition experienced by children (4). Since the majority of these are preventable, there is an emerging consensus that they constitute a major public health problem and that oral health promotion programs to prevent such injuries are necessary in communities where they are either frequent or severe (5).

Numerous studies of dental trauma in children have been undertaken (5-20). Estimates of the prevalence of injury to the anterior dentition provided by these studies vary widely. At age 12, they range from 11.7% (Marcenes et al, 1999) to 58.6% (Marcenes et al, 2001). These differences are only partly due to the different ages of the populations studied and differences in diagnostic classifications. Studies by the same investigators or studies using the same diagnostic protocol show variations between countries and variations within countries. These variations point to the role of social and community factors in the aetiology of traumatic dental injury in children. Repeated cross-

sectional studies in the same communities show that at best rates are stable and at worst increasing. Marcenes and Murray (17) found that, in a deprived inner city community, the prevalence at age 14 increased from 23.7% to 43.8% over a three-year period.

Few of the population-based studies of dental trauma involved adults so that little is known about its prevalence and incidence in this section of the population. Kaste et al (21) provided estimates of the prevalence of injuries to the teeth in adults based on the NHANES III, a health survey of a nationally representative sample of the U.S. population. Of those aged 21 to 50 years, 28.1% showed clinical evidence of damage to the anterior dentition, with enamel fracture being the most common injury observed. Consistent with studies of children, rates were higher in males (33.6%) than females (22.8%). The association with age showed a distinct pattern; rates were highest at age 21 to 30 years, with a slight decline by age 41 to 50 years.

Although studies of the prevalence of dental injury in Canadian children have been undertaken (22), no data are available on the prevalence and distribution of such injuries in adults. The Canadian Community Health Survey (CCHS) of 2003, a self-report survey of a random sample of Canadians aged 12 years and above (23), included a substantial section on injuries. However, no questions were asked about injuries to the teeth and mouth. Consequently, the aim of the study reported here was to obtain preliminary estimates of the prevalence and extent of dental trauma in adults aged 18 to 50 years living in the province of Ontario, Canada. Consistent with the CCHS, a self-report approach rather than a clinical examination survey was used to collect data. Since no publicly accessible listing of the adult population living in Ontario exists, a telephone interview survey using a multistage sampling design was used.

METHODS

Data were collected by means of computer assisted telephone interviews based on random digit dialling. Telephone numbers were randomly generated by computer based on all the telephone exchanges that cover the province of Ontario. An initial sample was drawn from each of three strata based on Census Metropolitan Areas: the urban CMA's of Toronto and Ottawa, and the rest of Ontario. The telephone numbers were used to identify households. In households with more than one individual in the target age range, one was randomly selected to be the respondent to the survey. Given that the aim was to obtain 400 completed interviews in Toronto CMA and 300 in the two other strata, for a total sample size of 1000, disproportionate sampling was employed. Interviews were conducted between January and March 2005. Following preliminary analysis of these data a second sample was drawn to furnish a further 1000 interviews. These were conducted between May and July 2005. This sample of 2000 persons allowed estimates to be generated with an acceptable degree of precision i.e. the standard error for an estimate of 50% was 1.1%. All sampling procedures and data collection were undertaken by a professional survey research organization (SOM, Montreal). At both data collection waves, up to eight call-backs were made to each telephone number in order to reach sampled households and individuals.

The questionnaire contained two initial questions concerning a history of injury to the mouth and/or teeth and for those reporting such a history, the number of times they had been injured. Subsequent questions concerned the worst injury that had been experienced. If only one injury was reported it was by definition the worst. The questions

addressed the age at which the injury occurred, the type of injury and, if injury to the teeth occurred, the nature of that injury. Questions were asked on whether or not the injury was treated and the type of treatment received. Finally, respondents were asked if they had suffered any type of injury other than to the mouth and teeth serious enough to warrant medical attention and the number of times they had experienced such injuries. Sociodemographic data included age, gender and educational attainment. Interviews were conducted either in English or French.

Prior to analysis data from the Canadian census of 2001 were used to calculate weights. These adjusted for disproportionate sampling within strata and for differences in the gender and age distributions of respondents and the target population (24). Data were analyzed using the survey estimation procedures available in STATA 7. These allowed standard errors to be adjusted to take account of the complex sample design. Chi-square tests were used to assess the significance of differences in proportions and t-tests to assess the significance of differences in means.

RESULTS

Response and characteristics of respondents

In all, 15,026 telephone numbers were randomly generated and called. Of these, 3524 were ineligible; that is they identified commercial organizations, were non-existent or not working or identified households where no-one spoke English or French. A further 3524 were numbers whose eligibility status could not be determined. That is, they were never reached or the initial household contact refused to give any information on the household so the call was terminated. Of the 3216 numbers that identified households

with one or more persons aged 18 to 50 years, interviews were completed with 2001 or 62% of randomly selected respondents.

Table 1 indicates that compared to the Ontario population in the target age range, female subjects were over-represented and subjects aged 30 to 39 years somewhat under-represented.

Table 1: Characteristics of respondents and the provincial population

	Sample %	Weighted sample %	Target population*
Gender:			
Males	43.9	49.4	49.3
Females	56.1	50.6	50.7
Age:			
18-24	18.7	18.9	18.5
25-29	13.2	12.8	13.1
30-34	13.9	14.5	14.9
35-39	14.8	17.3	17.8
40-44	18.4	17.0	17.4
45-50	19.2	17.8	18.3
Not known	1.6	1.6	-

*Age and gender distributions from Census 2001.

Following weighting, the age and gender characteristics of subjects matched that of the provincial population quite closely. In terms of educational attainment, 8.2% of the sample had less than high school education, 24.4% were high school graduates and 66.5% had completed post-secondary education. These figures are quite close to estimates derived from the Ontario component of the Canadian Community Health Survey 2003 in which data were weighted to the characteristics of the Ontario population. The educational attainment of 20 to 49 year-olds was; less than high school – 8.4%; high school – 21.6% and post-secondary –69.9%.

Prevalence of dental trauma

The prevalence of self-reported dental and oral trauma was 15.5% (s.e.=1.0%), with 64.4% of those injured reporting one episode of injury, 19.4% two episodes and 16.2% three or more injuries. Males were twice as likely as females to report injury (20.0% vs 11.0%) and reported more episodes of injury (means of 2.3 and 1.5 episodes respectively) (Table 2).

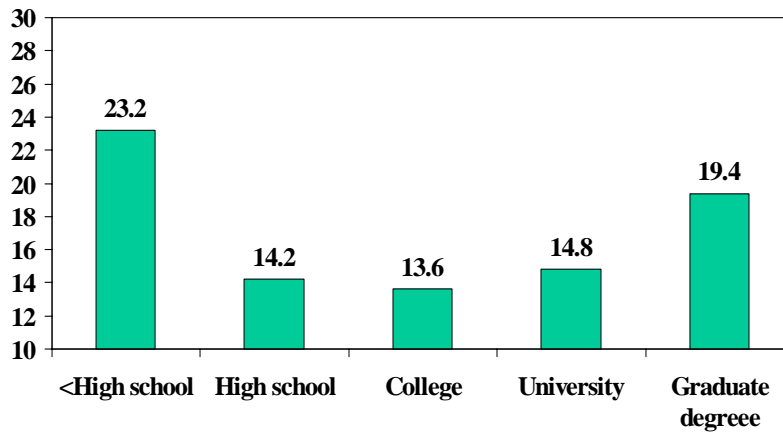
Table 2: Prevalence of injury to the mouth and teeth

	Prevalence %	Mean episodes of injury
Gender:		
Males	20.0***	2.3**
Females	11.0	1.5
Age:		
18-24	18.5	2.3
25-29	16.0	1.8
30-34	12.0	1.7
35-39	15.0	1.5
40-44	15.1	2.4
45-50	15.7	2.1
Stratum:		
Ottawa CMA	14.1*	1.6
Toronto CMA	13.1	1.9
Rest of Ontario	15.7	2.2

There was no association between age and injury but a significant association with educational attainment. The relationship with education was U-shaped with the highest rates being observed in those with less than a high school education and those

with a graduate degree (Figure 1). Those with less than high school education also reported the most episodes of injury.

Figure 1:
Prevalence of oral injury by education



There was also a small but significant difference in rates across the three sampling strata, with rates being lower in the two metropolitan census areas. However, there was no difference in rates between the two waves of the survey.

When those with injury were asked about the age at which their worst injury occurred the distribution was as follows: 1 to 13 years – 41.3%; 13 to 17 years – 23.9%; 18 to 30 years – 23.5%; 31 to 50 years – 11.3%. The distribution for those reporting a single episode of injury was very similar; 40.1%, 21.8%; 23.7% and 14.4% respectively.

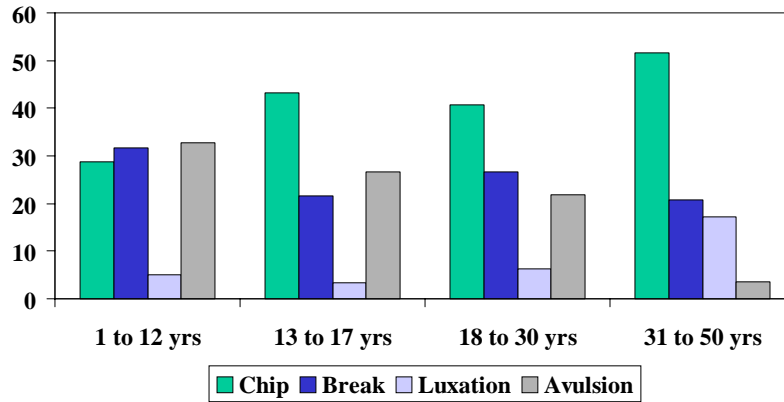
Extent and nature of injury

Those who had experienced one or more episodes of injury to the teeth and mouth were asked about the worst injury they had suffered. In terms of the types of injury, 34.8% reported cuts, 36.4% suffered bruises to the lips, cheeks or tongue, 85.0% damaged their teeth and 9.8% reported fracture of the jaw. Other, unspecified, types of injury were reported by 13.7%.

Of the 263 subjects reporting injury to the teeth, 46.7% damaged one tooth, 29.7% damaged two teeth and 23.6% damaged three or more teeth. When asked about the worst damage to the teeth, 38.5% reported one or more teeth were chipped and 26.0% broke one or more teeth. One quarter (25.4%) reported avulsions and 6.5% reported luxations. Other types of injury were reported by 3.5%.

There were no differences in the types of injury (cuts, bruises, damage to teeth, jaw fracture) suffered according to gender, age or education. Where teeth were damaged, there were no differences in the mean number of teeth affected and no differences in the type of damage to teeth according to these sociodemographic variables. However, the nature and extent of damage to the teeth did vary according to the age at which the injury occurred. Those injured between the ages of 31 and 50 years damaged more teeth (mean=4.5) than those injured at other ages (means=2.0) ($p<0.01$). However, their injuries were not so severe; they were more likely to report chips to the teeth and less likely to report avulsions (Figure 2).

**Figure 2:
Worst damage to teeth by age injury occurred**



Of those with damage to the teeth, 78.9% were treated by a health professional. Those who received treatment damaged more teeth than those who did not (means of 2.7 and 1.5 respectively; $p < 0.05$), but there were no differences according to the type of injury suffered. For example 20.0% of those reporting that their worst injury involved chips to the teeth were not treated compared with 13.4% of those reporting avulsions. There was also an association between educational attainment and the probability of receiving treatment; only 67.4% of those with less than a high school education reported being treated compared with 88.6% of those with a graduate degree. The most common types of treatment received were restorations, crowns, root canal treatments and extractions (Table 3).

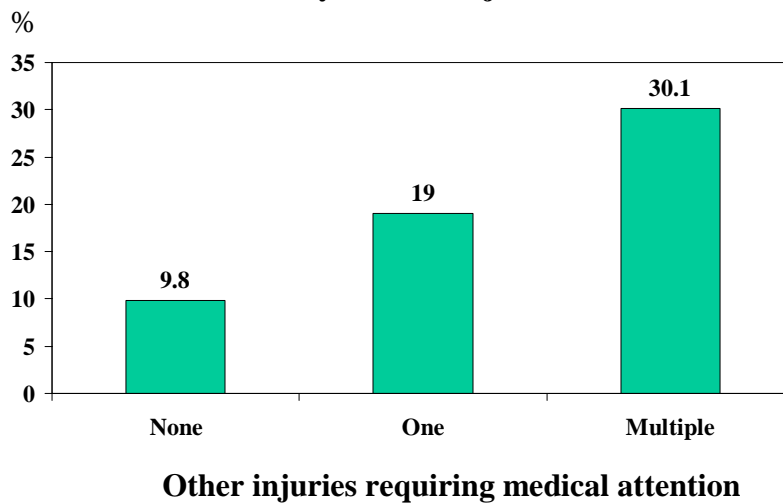
Table 3: Type of treatments received by those reporting being treated by a health professional

Treatment:	Percent
Tooth replantation	10.7
Restoration	40.0
Root canal treatment	26.1
Crown	32.0
Veneers	8.3
Extraction	21.8
Bridge	8.2
Denture	4.0
Implant	6.1
Other	16.8

Other types of injury

Injuries other than to the teeth and mouth that required medical attention were reported by 35.7% of respondents. There was a significant association between the history of such injuries and the reporting of trauma to the mouth and teeth. Almost one third of those with multiple injuries had a history of dental trauma (Figure 3).

**Figure 3:
Percent reporting injury to the mouth and teeth by
history of other injuries**



Causes of injury

The main locations in which injuries were reported as having occurred were: home (25%), public spaces such as the street or park (18.3%); sporting facilities (18.0%) and schools (15%). One tenth (7.1%) occurred in work locations or farms. The causes of these injuries are shown in Table 4.

Table 4: Causes of injury

Cause:	Percent
Playing sports	27.4
Falls	13.3
Car accident	5.9
Bicycle accident	6.3
Collision with person or object	18.9
Violence/assault	9.9
Biting/chewing food	5.4
Other	12.9

The most common cause of injury was playing sports, followed by collisions and sports Violence accounted for 10% of injuries.

The causes of injury varied according to gender. Sports and collisions were the most common causes among men while spots and falls were the most common causes among women. There was no gender difference in terms of the proportion of injuries due to violence. This was 9.9% in mean and 10.0% in women. Women were also more likely to report car and bicycle accidents are the cause of their injury.

The causes of injury also varied according to educational attainment and the age at which the injury occurred (Figures 4 and 5).

Figure 4
Causes of injury by educational attainment

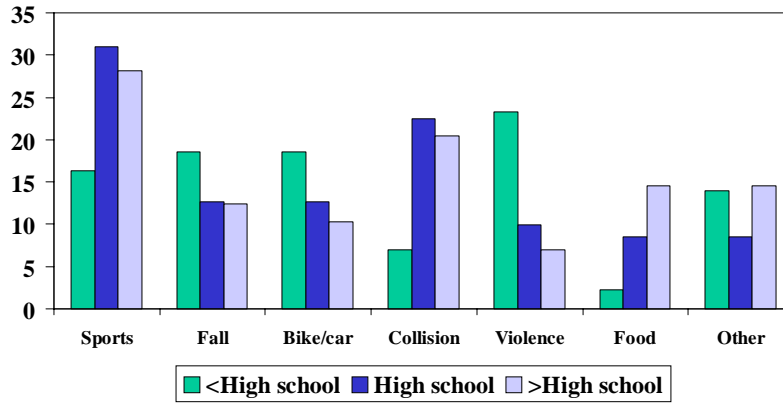
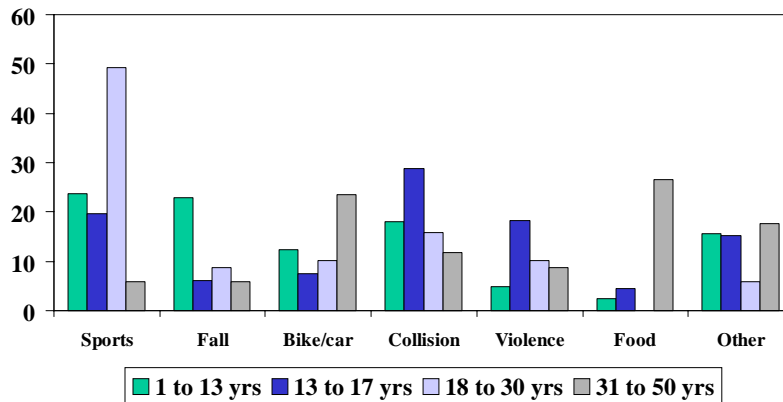


Figure 5
Causes of injury by age injury occurred



Of most interest are variations in cause by age of injury. Sports was a common cause under the age of 30 years, accounting for half of all injuries in 18-30 year olds and one-fifth of injuries in those under 17 years of age. Collisions were prominent as a cause

in the 13 to 17 years age group. In this group violence accounted for almost 20 of injuries. Traffic accidents and injuries while chewing or biting hard foods were the most common causes among the oldest age group in the study.

Sports as a cause of dental and oral injury

Just over half the sample (56.3%) reported playing sports such as hockey, basketball, football, rugby, volleyball, squash, ice-skating, roller-blading, gymnastics or bicycling. Almost one-in-five (19.2%) of these subjects reported a dental/oral injury compared to one-in-ten (10.7%) of those who did not engage in such activities ($p < 0.001$; $OR = 1.99$, 95% $CI = 1.53-2.58$). Multiple i.e. two or more episodes of injury, were reported by 7.9% of the former and 2.6% of the latter. The majority of those playing such sports (79.6%) reported never wearing a mouthguard or other protection for the teeth; 13.0% wore a mouth guard 'sometimes' and 7.3% 'always'. Those who wore mouthguards were more likely to report having experienced an oral injury than those who did not (31.7% vs 15.7%; $p < 0.001$).

DISCUSSION

Although relatively cost-effective in collecting small amounts of data from large samples, telephone interview surveys of the type reported here have a number of disadvantages when attempting to assess the prevalence of a population characteristic. First, since the number of eligible units (households containing persons aged 18 and over) identified by the randomly selected telephone numbers is not known, response rates are difficult to calculate. Moreover, since the characteristics of non-responders are not

known, non-response bias cannot be estimated. However, the age and gender distribution of respondents were broadly similar to that of the provincial population in the target age range and virtually identical following weighting. The educational attainment of respondents was also similar to estimates for the target population derived from the Canadian Community Health Survey, a government-sponsored study with a response rate of 87%. Further, the study was done in two waves, each based on a separate random sample of telephone numbers. The yield was identical for the two waves and there were no differences in the sociodemographic characteristics of respondents to the two waves and no differences in the prevalence of injury, the age at which the worst injury occurred and the type of injury reported. This suggests that the methodology is quite robust and produced a sample broadly representative of the target population.

A second limitation is that data are retrospective and may be subjects to recall bias. Recall periods, that is, the difference between age at the time of interview and the age at which the worst injury occurred varied from 0 to 42 years, suggesting the possibility of failure of memory and recall. It could be argued, however, that traumatic dental injuries are, as their name suggests, traumatic and have significant social, emotional, economic or oral health consequences. Consequently, they are less likely to be forgotten than other types of events.

Third, the data collected here are based on self-reports and no clinical examination was undertaken that could verify respondents' reports of injury. The impact of this limitation is difficult to assess given that no studies have examined the correspondence between self-reports of dental injury and clinical examination findings. In a recent study of Grade 8 children in Ontario (22), the prevalence of trauma based on

children's reports was 17.2% and 17.8% based on clinical examination. However, this comparison is complicated by the fact that the more severe categories of the trauma index used, such as missing teeth, required both a self-report of injury and clinical evidence of that injury.

A further limitation is that time and cost constraints mean that a comprehensive history of injury cannot be obtained. Rather, in common with other population health surveys that address injury (23), details were only collected on the worst injury that had been experienced.

Notwithstanding these caveats, the results of this study suggest that approximately one-in-six of the target population had experienced injury to the mouth and teeth and that one-third of these, or approximately 5% of the sample overall, had experienced more than one episode of injury. Consistent with other studies males were almost twice as likely than females to report injury and rates were highest among those with the lowest and highest levels of education. Rates were also marginally higher outside the two major urban areas that formed sampling strata for the study. The U-shaped association with education may indicate that the causes of trauma differ across groups defined by socio-economic status.

Of those with injuries, the majority involved injury to the teeth. Population estimates derived from this study suggest that 13.1% have suffered damage to the teeth, and 8.2% have experienced relatively severe forms of injury such as a broken, displaced or avulsed tooth. The data also suggest that up to the age of 50 years, 3.5% of adults in the target population have lost a tooth through trauma. While this estimate seems high, the clinical examination study by Kaste et al (21) suggests that at age 21 to 30 years,

approximately five percent of trauma calls were teeth missing due to trauma, while at age 41 to 50 years, approximately 25% of trauma calls were in this category.

The prevalence rate reported by Kaste et al (21) for 21 to 50 year-olds was twice that reported in this study. However, a clinical examination may identify many cases of simple enamel fracture of which the individuals concerned are unaware. If these are excluded, then the rates are somewhat closer; approximately 14% vs 8%. Such differences may be due to social and cultural factors and mirror differences in the prevalence of dental trauma observed between countries. Other similarities between the US study and this study is that approximately one-third of all injuries to the mouth and teeth occur in adulthood and that prevalence rates remain more or less constant in adulthood. Kaste et al (21) suggest that some people may be trauma prone so that the injuries occurring in adulthood are in people who have already been injured earlier in life.

The idea that some individuals may, because of personality characteristics or lifestyles, be trauma prone is given some support in this study. First, one third of subjects reporting dental injury reported more than one episode of injury, and there was a close association between dental injuries and injuries in other body locations. It is possible that a single episode of injury involved both the teeth and other body locations so further data on these injuries and whether they were separate or coincident is needed before the 'trauma prone individual' can be properly examined. Longitudinal studies are also needed to calculate dental trauma incidence rates among adults and the relative risks for those who do and do not have a prior history of trauma.

Other findings that warrant further investigation concerns treatment for dental injuries. Just over one-fifth of those reporting being injured had not been treated by a

health professional. This did not appear to be related to the severity of the injury but to socio-economic factors such as education. This reflects the fact that many of the treatments received were complex and expensive. Given that those in the lower educational attainment categories are less likely to be insured and must therefore pay for treatment out-of-pocket, cost is probably a barrier to the receipt of dental care even for serious dental conditions such as traumatic injury. Given that this group has the highest rate of injury, health promotion programs are needed to reduce their incidence. In turn this requires information on causes and the circumstances in which injuries occur.

This study has also provided data on causes of injuries to the mouth and teeth. The results agree with previous studies of child populations and suggest that violence, traffic accidents and sporting activities have contributed to the establishment of traumatic dental injuries as a public dental health problem. (5). Dental clinics and hospital-based studies have reported that falls and collisions, sporting activities, violence and traffic accidents are the main causes of injury to permanent incisors (4). What was notable here was the variation in cause according to the age at which the injury occurred. This suggests that health promotion programmes to prevent such injuries need to be targeted at specific age groups and the most prominent causes of injury in that group.

The study also confirms the role of sports as a cause of injury. It was the most common cause in children and young adults and the second most common in adolescents. In addition, the data showed that those who played certain types of sports were twice at risk of dental and oral injury than those who did not. This may be because the majority, 80%, report that they never wear mouthguards or other protective devices when playing sports that place them at risk. Paradoxically, those who report wearing mouthguards had

the highest rates of oral injury. This may be because such an injury motivates an individual to use protective devices. It may also be because those wearing protection play those sports, such as hockey, which carry the highest risk of injuries to the anterior dentition. These issues cannot be explored in this retrospective study that did not collect information on the different types of sports played and their attendant risks of injuries. Consequently, this study does not challenge efforts to increase the use of mouthguards during sporting activities. Further work is needed to examine different sports, their role in injuries and the extent of protection provided by mouthguards when playing those sports.

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