Etiology and environment of dental injuries in 12- to 14-year-old Ontario schoolchildren

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The few studies of dental trauma to have included socioeconomic indicators have presented conflicting results. Hamilton et al. (1) reported a relationship between socio-economic status and dental injuries and showed a prevalence of 38% for dental injuries in the lowest socioeconomic group in contrast to 30% in middle and upper socio-economic groups. Conversely, Cortes et al. (2) reported that children with high socio-economic status were 1.4 times more likely to present with dental injury compared with children of low socio-economic status in Brazil. Marcenes et al. (3) found the prevalence of dental injuries in Brazil to be very high (58.6%), but did not find any statistically significant association between dental injuries and fathers' level of education, parents' employment status or family income. Locker (4) reported a prevalence of 18.5% of dental injuries to the permanent incisors of 14-year-old schoolchildren in six Ontario communities. As the etiology of dental trauma is multifactorial, information on the cause, age, and location of occurrence of dental injury is helpful. The present study was conducted to investigate the etiology and environment where dental injuries occurred and assess the relationship between trauma and to socio-economic status.

Materials and methods

This population-based, case-comparison study was conducted in schools in the communities served by two

Ontario public health departments: York Region and Brant County. Grade 6 and 8 children, n = 2422 (range: 12-14 years), with and without clinical evidence of dental injury were identified during mandatory screening at these health units. All children with a Dental Trauma Index (5) code 1 (untreated enamel fracture) through 5 (restored fracture) for at least one anterior tooth were designated as a case. Each case was then matched with a control subject of the same age and gender. The clinical examination also collected data on the oral health status of children, as measured by the Decayed, Missing and Filled Teeth (DMFT) Index. After clinical examination, health department staff sent questionnaires along with a letter that explained the aims and objectives of the study, including an information sheet and a consent and assent form, to the home addresses of the sample population (n = 810). The Research Ethics Board of the University of Toronto approved this project.

Child and parent questionnaires were used. The child questionnaire consisted of a section to be completed by injured children that contained questions concerning their injury: age injury occurred, location where it occurred (home, school, community) and causes of, or event responsible for the injury (sports, fall, collision, violence/assault, and road traffic accident). Information on socio-economic status of the children in both injured and non-injured groups was collected from the parent questionnaire and included: child's birthplace, family size/composition, dental insurance coverage (private or government program), government family support program, household income, and mother's educational level.

Mother's level of education was categorized into four groups; less than high school, high school, some college/ university and completed college or university. Government support program families are those who received welfare benefits. Total annual family income before tax (<\$10 000 to \$60 000 or over) was obtained. Incomes were dichotomized (\leq \$30 000) according to the method and classification used in Statistics Canada's low-income rate classification (6). Non-responders were issued two reminder notes and a second questionnaire.

A total of 270 of 810 eligible 12- to 14-year-old children agreed to participate in the study (33.3%). The sample included 152 boys (56.3%) and 118 girls (43.7%). The criterion of significance (alpha) was set at 0.05; all tests were two-tailed.

Data were analyzed using tests for paired-matched data, such as the McNemar's test and conditional logistic regressions. The variables were added to the regression model independent of whether they were statistically significantly related to the outcome. All variables studied were forced into the model instead of selecting only factors that were significant at the bivariate level. This was performed to give the opportunity to all the variables to contribute to the explanatory ability of the model.

Results

Of 2422 subjects, clinical evidence of dental trauma to the anterior dentition was observed in 270 (11.4%) children. One hundred and thirty-five of 270 participants who were identified with dental injuries consented to participate in the questionnaire phase of this study.

Dental Trauma Index codes were defined in this investigation to reflect minor injury (untreated enamel fracture not involving dentin, code 1), moderate injury (untreated enamel and dentin fracture, code 2), severe injury (pulp involvement, sinus tract, swelling, discoloration, and missing tooth because of trauma) and restored injury (injured tooth or fracture restored with a crown/pontic/composite restoration, codes 3–5). The majority of subjects (63.7%) had a minor injury (untreated enamel fracture). Moderate injury (untreated enamel and dentin fracture) had a prevalence of 5.9%. Severe injury consisted of 31.9% with restored teeth and 4.4% with missing tooth/teeth because of trauma.

The number of injured incisors per subject ranged from zero to four, with the majority of subjects (n = 95, 70.4%) having only one injured tooth. Maxillary central incisors were at greater risk of injury from trauma. More males than females had more than one injured tooth, 33% and 25%, respectively. The mean number of injured teeth for males was 1.45 (SD = 0.75) and for females it was 1.31 (SD = 0.59). There was no significant difference between males and females for the prevalence of injured teeth, the mean number of injured teeth or the prevalence of treated and untreated dental injuries.

Dental trauma occurred at different ages for boys and girls as illustrated in Fig. 1. Among boys (n = 76), the majority of the dental trauma (78%) occurred between the ages of 8 and 11 years, while for girls (n = 59) with



Fig. 1. Frequency distribution of age of occurrence of dental injuries by gender.



Fig. 2. Locations where dental injury occurred by gender.



Fig. 3. Causes of dental injury by gender.

clinical evidence of dental injuries, almost 80% of the injuries occurred in the ages between 7 and 10 years. The highest incidence of dental trauma occurred at 9 years of age in boys (n = 18, 30.5%) and 10 years of age in girls (n = 19, 25.0%). The mean age at time of injury was 9.5 years (SD = 1.49; range: 6–13 years).

The majority of injuries took place either at school or home (Fig. 2). School was the most frequent location of injury for boys followed by home and this was reversed for girls. Falls were the major cause of dental injuries amongst both sexes followed by athletic activities (Fig. 3).

A higher proportion of children with caries history had dental injuries (75.9%), compared with caries-free children (37.7%). This difference was statistically significant (P < 0.001; OR = 5.81; 95% CI: 3.20–10.51). The

Table 1. Mean DMFT and its components for those with and without dental injury

	Injured (<i>n</i> = 135)	Not injured $(n = 135)$	<i>P</i> -value*		
Mean DMFT (SD)	1.09 (1.55)	0.50 (1.43)	0.001 0.378		
Mean DT (SD)	0.07 (0.29)	0.07 (0.46)			
Mean MT (SD)	0.15 (0.59)	0.09 (0.53)	0.252 0.001		
Mean FT (SD)	0.87 (1.49)	0.35 (1.08)			
DMFT, Decayed, Missing and Filled Teeth Index; DT, Decayed Teeth; MT, Missing Teeth; FT, Filled Teeth. *Obtained using the Wilcoxon signed-rank test.					

mean DMFT of those with one or more injured incisors was 1.09 compared with 0.50 for those with no evidence of injury (P < 0.001) and this difference was largely the result of differences in the number of the filled component of DMFT (Table 1).

None of the four socio-economic indicators chosen, family income, mother's level of education, family composition, or government social support recipient were statistically significantly associated with the occurrence of dental injuries (Table 2).

The association between caries and dental injuries remained statistically significant after adjustment was made for gender and socio-economic indicators using conditional logistic regression (Table 3).

No difference was found between participants and non-participants in the questionnaire follow-up phase in terms of baseline mean number of missing teeth, filled teeth, or overall DMFT. A significant difference was detected for the decayed component of the DMFT index, albeit not clinically meaningful (0.19 \pm 0.53 for non-participants and 0.07 \pm 0.38 for participants).

Discussion

This study confirms reports that dental trauma affects a small percentage of children aged 12-14. The prevalence of dental trauma to incisors was 11.4% in 2422 children who were screened for clinical evidence of dental injury. The majority of 12- to 14-year olds (63.7%) had

Table 3. Conditional logistic regression of explanatory variables for dental injuries

Indicators	Adjusted odds ratio (95% CI)	<i>P</i> -value			
Caries status (DMFT 0 = 0; DMFT 1 or higher = 1)	5.03 (2.86-8.85)	0.001			
Gender (female = 0; male = 1)	1.35 (0.37-4.72)	0.650			
Family income (low income = 0; middle-/high-income bracket = 1)	0.83 (0.34–1.89)	0.622			
Mother's educational level (less than high school/high school = 0; college/university level = 1)	0.70 (0.35–1.36)	0.301			
Family size (up to 4 people = 0; 5 or more people = 1)	0.52 (0.22–1.06)	0.070			
Government social support recipients (no = 0; yes = 1)	0.51 (0.12-2.18)	0.324			
DMFT, Decayed, Missing and Filled Teeth Index.					

untreated enamel fractures, a finding reported by other studies (2, 7-9). In addition, most injuries involved one upper central incisor, the tooth most likely to be injured (10, 11). The most frequent types of crown fractures were those of enamel only followed by those involving both enamel and dentin.

This study agrees with other epidemiological studies that reported the prevalence of dental injuries was highest among children aged 9–12 years and that dental injury incidence decreases with age (1). This study shows that most dental accidents occurred either at home or at school. Consistent with findings of various epidemiological studies, accidental falls appear to be the predominant cause of dental injuries (12–14). These findings illustrate that while mouthguards can protect a niche high-risk population, most dental injuries occur when mouthguards will not be worn i.e., during falls, violence or non-organized recreational sports, (e.g., skating and rollerblading).

Only a few studies have looked at the relationship between dental trauma and socio-economic status. The results of these studies often show conflicting findings (1, 2). This analysis did not yield significant results with

Table 2. Frequency distribution of dental injuries by socio-economic indicators

	Dental injury			
Socio-economic indicators	Yes, <i>n</i> (%)	No, <i>n</i> (%)	McNemar's odds ratio (95% CI)	P-value*
Educational level of mother				
Less than high/high school	58 (43.0)	51 (37.8)	0.85 (0.42-1.71)	0.396
College/university education	76 (56.3)	84 (62.2)		
Family income				
Low-income bracket (<\$30 000)	34 (25.2)	30 (22.2)	1.85 (0.78-4.41)	0.451
Middle/high income bracket (>\$30 000)	97 (71.9)	105 (77.8)		
Government social support recipients				
Yes	5 (3.7)	7 (5.2)	0.95 (0.91-0.98)	0.774
No	130 (96.3)	128 (94.8)		
Family size				
Up to 4 people	94 (69.6)	96 (71.1)	1.08 (0.64-1.81)	0.791
Five or more people	41 (30.4)	39 (28.9)		
*Obtained using the McNemar's test.				

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respect to the socio-economic indicators chosen, at neither the bivariate nor multivariate level of analysis. This lack of a significant relationship between dental trauma and socio-economic status might be due to the predominance of suburban children from high socioeconomic categories. Perhaps psychosocial factors such as a child's behavior, family structure and family function, not selected for this study may be more pertinent. Nicolau et al. (15, 16) indicated that social factors such as family structure (nuclear/non-nuclear family, step/single parent) and family environment could lead to the development of behavioral (emotional symptoms, hyperactivity, conduct disorder, and peer relationship) and other health-related problems, that could in turn lead to higher caries experience and increased risk of dental injuries (16, 17).

Perhaps the most important finding from this study is the relationship between a child's caries experience and dental trauma, which was also reported in Locker's (4) prevalence study; children with dental injuries had higher caries experience. In this study population, health-related behavioral problems or other psychosocial risk factors could be playing a role in both caries and dental injuries. It may be that a common-risk factor relationship between caries and trauma may exist. At risk children might benefit from a common-risk factor approach to dental injuries and caries prevention.

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