

# Prevalence of Traumatic Dental Injury in Grade 8 Children in Six Ontario Communities

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## ABSTRACT

**Objectives:** To determine the prevalence of traumatic injury to the anterior dentition in Grade 8 children in six Ontario communities.

**Methods:** Clinical examination of 3,010 children attending a stratified random sample of 66 schools in the communities served by 6 Ontario Public Health departments. Trauma to the hard tissues was classified according to the Trauma Index.

**Results:** Damage to the anterior dentition was observed in 18.5% of those examined. Unrestored fractures of the enamel were present in 13.0%, with more severe damage or damage sufficiently severe to have been treated being present in 5.9%. Of those with the more severe injuries, 20% had not received treatment. The prevalence of injury was higher in males than in females (21.3% vs. 13.4%;  $p < 0.0001$ ) and varied across the six communities studied (10.7-29.4%;  $p < 0.01$ ). There was an association between dental decay experience and traumatic dental injury. Those with more severe injuries had higher mean Decayed, Missing and Filled Teeth (DMFT) scores and were less likely to have a DMFT score of zero than those without injury ( $p < 0.01$ ).

**Discussion:** The prevalence of traumatic dental injury in this Ontario child population was similar to those reported in national surveys in the US and UK. The association between injury and dental decay may reflect the fact that a subgroup of children live within environments or are prone to behaviours that place them at greater risk of multiple oral disorders. In order to provide a basis for prevention, further research needs to be undertaken to identify the causes of and the personal and environmental risk factors for such injuries in Ontario children.

**MeSH terms:** child; tooth injuries; prevalence

*La traduction du résumé se trouve à la fin de l'article.*

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While dental caries remains an important health issue among child populations and a significant source of disparities in oral health,<sup>1</sup> increasing attention is being paid to other oral conditions affecting children. One of these is traumatic dental injury. These injuries range from minor fractures of the enamel to major damage involving the displacement or avulsion of teeth. They entail significant emotional and social costs to children and their families<sup>2</sup> and constitute the most serious dental condition experienced by children.<sup>3</sup> In addition, the treatment of such injuries involves substantial economic costs. Estimates from Scandinavia have suggested that dental injuries cost US\$2-5 million per million population.<sup>4,5</sup>

Studies by the same investigators or studies using the same diagnostic protocol show differences in prevalence rates among countries. For children 12 years of age, prevalence rates range from 11.7%<sup>6</sup> to 58.6%.<sup>7</sup> There are also variations within countries and nations. A national study in the UK in 1993 found a prevalence of 17.0% for children age 14 years;<sup>8</sup> in Northern Ireland, the rate was 27.0%. Rates higher than national estimates have been reported for deprived communities in the UK. A study in the north of England found rates of 38.0% in children from lower socio-economic groups,<sup>9</sup> while a study in a deprived part of inner London found rates of 27.9%<sup>10</sup> in boys. Repeated cross-sectional studies in the same communities show that at best, rates are stable<sup>8</sup> and at worst, are increasing.<sup>11</sup>

There are few data on traumatic dental injury in Ontario. Consequently, a study was undertaken of Grade 8 children living in six Ontario communities. The specific objectives of this descriptive epidemiological study were: 1) to assess the prevalence and severity of traumatic dental injury to the anterior dentition of Ontario children aged 14 years, 2) to assess variations by geographic area and gender, and 3) to assess the association between traumatic injury and dental caries experience.

## METHODS

The above objectives were pursued by a school-based descriptive epidemiological study with data collected by clinical examination. All aspects of the study were

deemed to be ethical by the University of Toronto Health Sciences Review Committee.

The study was undertaken in the communities served by six Ontario Public Health departments (PHD): York Region, City of Hamilton, Durham Region, Halton Region, Simcoe County, Wellington-Dufferin-Guelph. The study population consisted of all children in Grade 8 attending schools in these areas. Data on injuries to the anterior dentition were collected as part of the usual school-based dental screening program, implemented by the participating PHDs as part of their mandatory responsibilities. As part of this program, schools are classified as 'high', 'medium' or 'low' risk according to the prevalence of dental caries among students in Junior and Senior Kindergarten.

The sampling design was a stratified random cluster sample. In each area, 12 schools were randomly selected, 4 from each of the three caries risk strata. All Grade 8 students in sampled schools were included in the study if they were present on the day of screening and had not been excluded at parental request.

In each geographic area, 12 schools were estimated to result in approximately 420 children being included for a total sample size of 2,520. Assuming a simple random sample and assuming that the prevalence of traumatic dental injury in the target population is 20%, 420 children will produce an estimate with a standard error of 1.95% and a 95% confidence interval of  $\pm 3.8\%$ . For the pooled sample, the standard errors will be less than 1%. A sample size of 420 per area was sufficient to detect a difference in prevalence of  $\pm 10\%$  between geographic areas if  $\alpha = 0.05$  and  $\beta = 0.20$  (Lemeshow et al., 1990), with a two-tailed test allowing for design effects.

Data were collected by experienced hygienists from each of the six PHDs who were trained in the use of a common screening protocol and diagnostic criteria. Screening for evidence of dental trauma was undertaken using the Trauma Index originally developed for use in the 1993 UK Child Oral Health Survey.<sup>8</sup> The index is applied to the eight permanent incisor teeth or tooth spaces with codes ranging from 0 to 9. A code of 0 indicates a tooth that was present and sound, while

TABLE I

## Percent of Subjects with One or More Teeth with Each Trauma Index Code

Code	Definition	Percent of Subjects
1	Unrestored enamel fracture that does not involve dentine	13.0
2	Unrestored fracture that involves dentine	0.8
3	Untreated damage as evidenced by: a) dark discolouration as compared to other teeth b) presence of a swelling or fistula in the labial or lingual vestibule adjacent to an otherwise healthy tooth	0.1
4	Tooth missing due to trauma	0.3
5	Fracture restored either with a full crown or a less extensive restoration, a missing tooth replaced by a denture or bridge pontic, or presence of a lingual restoration as a sign of endodontic treatment	4.7
9	Any tooth or space not categorized as 0 through 5	0.2

Percentages with codes 1 to 5 total to more than the prevalence rate of 18.5% since some children had two or more teeth affected and more than one code assigned.

TABLE II

## Prevalence of Dental Injury by Geographic Region, Gender and Caries Risk Status of the School Attended

	Prevalence 1	Prevalence 2	Mean Number of Injured Teeth
Geographic Location			
Simcoe County	29.4	6.0	0.44
Hamilton	20.5	8.6	0.26
Durham Region	17.4	5.3	0.24
Wellington-Dufferin-Guelph	22.1	8.0	0.31
York Region	10.7	3.3	0.15
Halton Region	16.0	6.4	0.20
	p<0.01	p<0.01	p<0.01
Gender			
Males	23.1	7.6	0.32
Females	13.4	4.2	0.18
	p<0.0001	p<0.01	p<0.001

Prevalence 1: Trauma codes 1 to 5; Prevalence 2: Trauma codes 2 to 5

1 through 5 indicates various levels of trauma. A code of 9 is given if for any reason a tooth or tooth space cannot be scored (see left-hand column of Table I). Prior to the visual examination, each child was asked, "Have you ever had an injury to your front teeth?" The yes/no response was recorded. Regardless of the response, the visual examination was conducted. Trauma codes 4 and 5 were assigned only if there was a verbal history of trauma.

Each child's caries experience was recorded using the Decayed, Missing and Filled Teeth (DMFT) index with the D, M and F components scored separately. Caries is scored at the D3 level. Each child was also scored according to the following treatment needs – urgent restorative need, non-urgent restorative need, need for sealants, need for topical fluoride, need for scaling.

Data were analyzed using the survey estimation procedures available in Stata 7. This statistical software package allows data to be weighted for differential probabilities of selection of schools and children from each of the three risk strata, and adjusts standard errors to take account of the stratification and clustering compo-

nents of the sampling design. Simple descriptive analyses of the data were undertaken.

Prevalence estimates, and estimates of the mean number of teeth injured, were generated for the population as a whole, for each geographic area, and for males and females. The caries experience of children with and without evidence of dental injury was compared. Logistic regression analyses were used to assess the independent associations of geographic location, gender and dental decay experience with the presence and severity of traumatic dental injury.

## RESULTS

The study was undertaken in 66 schools, 14 of which were designated as high risk, 23 as medium risk and 29 low risk. Overall, 3,010 children were examined.

A history of traumatic injury was reported by 16.8% (SE=0.02%) of subjects and clinical evidence of injury (trauma index codes of 1 to 5 for one or more anterior teeth) was found in 18.5% (SE=0.02%). The number of traumatized incisors per person ranged from 0 to 7, with a mean of 0.25 (SE=0.03) for all subjects and 1.38

**TABLE III**  
**Mean DMFT and Component Scores for Those with and without Traumatic Injury**

	No Injury	Unrestored Enamel Fracture Only	More Severe Injury	p
Percent caries free (DMFT=0)	64.5	61.2	38.5	<0.001
Mean DMFT	1.00	1.16	1.70	<0.01
Mean D teeth	0.09	0.10	0.11	NS
Mean M teeth	0.04	0.01	0.08	NS
Mean F teeth	0.87	1.00	1.50	<0.05

**TABLE IV**  
**Results of the Logistic Regression Analyses**

<b>Dependent variable: Probability of any traumatic injury (codes 1 to 5)</b>				
<b>Independent variables</b>	<b>Odds Ratio</b>	<b>95% CI</b>	<b>p</b>	
Gender (Females=0, Males=1)	1.97	1.52-2.54	<0.001	
Geographic area (Coded 1 to 6)	0.81	0.70-0.93	<0.01	
Caries experience (DMFT 0=0, DMFT 1 or more=1)	1.35	1.01-1.81	<0.05	
<b>Dependent variable: Probability of severe traumatic injury (codes 2 to 5)</b>				
<b>Independent variables</b>	<b>Odds Ratio</b>	<b>95% CI</b>	<b>p</b>	
Gender (Females=0, Males=1)	1.84	1.27-2.67	<0.01	
Geographic area (Coded 1 to 6)	0.93	0.81-1.06	NS	
Caries experience (DMFT 0=0, DMFT 1 or more=1)	2.68	1.69-4.24	<0.001	

(SE=0.06) for subjects with at least one injured tooth. One in twenty children had two or more injured teeth. Approximately one in eight subjects had one or more teeth with unrestored enamel fractures not involving dentine, while 5.9% had one or more teeth with more extensive damage or damage sufficiently severe to warrant treatment (Table I). Of those with more extensive damage, 20.0% had not been treated.

There were significant differences across the six geographic regions included in the study in the prevalence of traumatic dental injury (Table II). There were also significant differences in the percentages with more severe injury (as indicated by trauma index codes of 2 to 5) and in the mean number of traumatized teeth. For both of these latter measures, there was approximately a twofold difference between the community with the highest and the community with the lowest values.

The prevalence of traumatic injury was higher in males than in females, with the prevalence of more serious injury being almost twice as high in males. The mean number of teeth with injury was also significantly higher in males than in females (Table II).

There was a significant association between caries experience and traumatic dental injury. Almost two thirds of those without injury were caries free compared to less than two fifths of those with more severe injury. The mean DMFT of those with one or more teeth showing evidence

of relatively severe trauma was 1.70 compared to 1.00 for those without evidence of injury. The difference in DMFT scores was largely the result of differences in the number of filled teeth (Table III).

Two logistic regression analyses were undertaken; the first with the probability of any traumatic injury (codes 1 to 5) as the dependent variable, and the second with the probability of more severe injury (codes 2 to 5) as the dependent variable. Predictor variables were gender, geographic area and caries experience. These analyses also indicated that gender and caries experience had significant independent associations with the probability of injury and the probability of more severe injury (Table IV). For example, those with a DMFT score of one or more were at almost three times greater risk of having severe injury to the anterior dentition than those who were caries free. Geographic area was an independent predictor of the probability of any injury only.

## DISCUSSION

This study estimated that almost one in five of the Grade 8 children living in six Ontario communities had experienced traumatic injury to the anterior dentition. This estimate is very similar to those revealed by national child oral health surveys in the UK<sup>8</sup> and the US.<sup>12</sup> Other studies have reported much higher prevalence rates, but these were of children living in

non-industrialized countries or in economically disadvantaged communities.

For the purpose of this report, it has been assumed that teeth with trauma index code 1 (unrestored enamel fracture) have suffered minor injury and that teeth with trauma index codes of 2 to 5 (unrestored fracture involving dentine; untreated damage with pulp involvement; missing teeth and restored fractures) have suffered more severe injury. This means that 13.0% have relatively minor injury and approximately 6% have injuries sufficiently severe to warrant treatment or to have been treated. Of those with more severe injury, one fifth had not been treated. The study also confirmed many previous reports that indicated a gender difference in injury rates, with males having a higher probability of injury than females.

The Trauma Index used in the study is relatively crude. It describes visible damage to the hard tissues of the anterior dentition but does not assess treatment needed or the type and adequacy of treatment provided. Code 5, for example, does not indicate whether the treatment provided consisted of a composite restoration or more extensive therapy involving root canal treatment, crowns or the replacement of missing teeth by fixed or removable appliances. Consequently, these data do not allow the costs of treating dental injury in the target population to be estimated.

Because this was a simple study of the prevalence of dental injury to the anterior dentition of 14-year-old children, comprehensive data on risk factors for injury were not collected. Apart from gender, the only variables examined for their association with injury were geographic location and dental caries experience. With respect to geographic location, there was a threefold difference in overall injury rates between the community with the lowest rate and the community with the highest rate. This confirms studies undertaken in the UK where considerable variations in rates have been observed across communities. The reason for this variation is not immediately apparent, although it may indicate the role of social and community-level factors in determining the prevalence of dental injury in child populations.

Perhaps the most interesting preliminary finding from this study is the association between dental injury and caries experi-

ence. Children with evidence of traumatic injury had experienced more caries than those without, with caries experience being particularly high in children who had experienced the more severe forms of injury. Again the connection between the two conditions is not altogether clear. It may be due to the confounding effects of variables such as socio-economic status, or may reflect the fact that a subgroup of children live within environments or are prone to behaviours that place them at greater risk of multiple oral disorders. Certainly, the nature of the link warrants further investigation since it may reveal common risk factors and indicate the need for a common risk factor approach. One demonstrated risk factor for dental injury that needs to be examined in this context is that of childhood obesity.<sup>13</sup>

Further studies are required to identify the specific causes of dental injury in Ontario child populations and to investigate the oral, personal and social factors that increase the risk of damage to the incisors of children. Such information is necessary to develop and implement effective preventive strategies for reducing the prevalence and costs of this condition.

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## RÉSUMÉ

**Objectifs :** Déterminer la prévalence des lésions traumatiques aux dents antérieures chez les élèves de 8<sup>e</sup> année vivant dans six collectivités ontariennes.

**Méthode :** Nous avons procédé à l'examen clinique de 3 010 élèves fréquentant un échantillon aléatoire stratifié de 66 écoles dans les collectivités desservies par six services de santé publique de l'Ontario. Les traumatismes aux tissus durs ont été classés selon l'Indice des traumatismes.

**Résultats :** Nous avons observé des lésions aux dents antérieures chez 18,5 % des élèves examinés. Des fractures non traitées de l'émail étaient présentes chez 13 % des sujets, avec des lésions plus graves ou suffisamment graves pour nécessiter un traitement dans 5,9 % des cas. Chez les élèves présentant des lésions graves, 20 % n'avaient pas reçu de traitement. La prévalence des lésions était plus élevée chez les garçons que chez les filles (21,3 % c. 13,4 %,  $p < 0,0001$ ) et variait dans les six collectivités étudiées (10,7-29,4 %,  $p < 0,01$ ). Nous avons constaté un lien entre les caries dentaires et la présence de lésions traumatiques aux dents. Les élèves dont les lésions étaient les plus graves ont obtenu un score supérieur selon l'indice CAOD (dents cariées, absentes et obturées), et ils étaient moins susceptibles d'avoir un score CAOD nul que les élèves ne présentant aucune lésion ( $p < 0,01$ ).

**Discussion :** La prévalence des lésions dentaires traumatiques dans cette population d'enfants ontariens était semblable aux taux déclarés dans les enquêtes nationales menées aux États-Unis et au Royaume-Uni. Le lien entre les lésions et les caries dentaires pourrait s'expliquer par le fait que certains des sujets de notre étude vivent dans des milieux où sont prédisposés à des comportements qui les exposent à un plus grand risque pour leur santé bucco-dentaire. Pour assurer une meilleure prévention, il faudrait pousser la recherche sur les causes de ce type de lésions chez les enfants ontariens et sur les facteurs de risque dans leur environnement.