

# Use of Mouthguards Among 12- to 14-Year-Old Ontario Schoolchildren

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## ABSTRACT

**Objectives:** To investigate the frequency of use of mouthguards among a representative sample of Ontario schoolchildren, the type of mouthguard most commonly used and reasons for noncompliance during sporting activities.

**Materials and Methods:** A population-based, matched case-control study was undertaken in a total of 30 schools in 2 suburban Ontario communities. Dental hygienists trained in the use of the Dental Trauma Index screened 2,422 children 12 to 14 years of age. Of 810 children identified as potential cases (with evidence of dental trauma) and controls (no dental trauma), 270 responded to a mail survey (135 cases and 135 age- and sex-matched controls). The children with dental injuries provided information such as the age at which the injury occurred and the setting and causes of the injury. Children from both case and control groups answered questions concerning use of mouthguards during sports. Parents provided demographic and other information.

**Results:** Only 5.5% of children wore mouthguards for school sports, and 20.2% wore protection in league sports. Of those who wore mouth protection, 48.2% wore boil-and-bite mouthguards and 21.4% wore stock-type mouthguards; only 30.4% wore professionally made, custom mouthguards. This high proportion of ill-fitting mouthguards was the major contributor to the commonly perceived problems of speech, breathing discomfort and poor appearance associated with mouthguard use. Boys were 1.52 times more likely to wear mouthguards than girls. Data on history of dental trauma and regularly visiting a dentist were not related to mouthguard use. The single most important predictor of mouthguard use was parents who had private dental insurance ( $p = 0.02$ ), followed by having a family dentist ( $p = 0.16$ ).

**Conclusion:** Mouthguard use was very low in both school and league sports in this sample of Ontario schoolchildren, and the largest proportion of those who wore mouth protection used generic products rather than custom-fitted mouthguards. Lack of parental or coaching advice on mouthguard usage and peer beliefs about esthetics and function were the main reasons for noncompliance.

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Vigorous physical activities offer a variety of benefits for children,<sup>1</sup> but they also place participants at increased risk for dental injury.<sup>2</sup> Sports-related incidents account for 10% to 38% of all childhood dental

injuries.<sup>3,4</sup> Locker recently reported a prevalence of 18.5% for dental injuries to the permanent incisors among 14-year-old schoolchildren in 6 Ontario communities.<sup>5</sup> Many dental injuries could be avoided or minimized

**Table 1** Severity and treatment of dental injuries among 135 children with such injuries<sup>a</sup>

Code	Definition	Severity	No. (%) of subjects	
1	Untreated enamel fracture that does not involve dentin	Minor	86	(63.7)
2	Untreated enamel and dentin fracture	Moderate	8	(5.9)
3	Pulp involvement, sinus tract involvement, swelling, discoloration	Severe	0	(0)
4	Tooth missing because of trauma	Severe	6	(4.4)
5	Fracture restored (crown, pontic, composite)	Severe	43	(31.9)

<sup>a</sup>Some children had more than one injured incisor and hence more than one code assigned.

if sports participants used proper protective equipment, such as a custom-fitted mouthguard,<sup>2</sup> yet mouthguards are still not widely accepted among preadolescents and adolescents who engage in contact sports.<sup>6</sup> Two surveys<sup>7,8</sup> reported that the use of mouthguards by schoolchildren ranged from 4% to 6% despite an annual orofacial injury rate of 31%.

This study was undertaken to investigate the frequency of use of mouthguards, the type of mouthguard most commonly used and reasons for noncompliance during sporting activities in a representative sample of suburban Ontario schoolchildren.

## Materials and Methods

The Research Ethics Board of the University of Toronto approved the project.

This population-based case-control study was undertaken in community schools served by 2 Ontario public health departments: York Region and Brant County. A total of 2,422 grade 6 and grade 8 children were screened by trained dental hygienists, who identified those with and those without clinical evidence of dental injury. Any child with a Dental Trauma Index<sup>9</sup> code 1 (enamel fracture) through 5 (restored fracture) for at least 1 incisor was designated as a potential case (Table 1). During the clinical examination, data were also collected on the oral health status of children, as measured by the decayed, missing and filled teeth (DMFT) index for permanent teeth.

After the clinical examination, health unit staff sent 2 questionnaires (one for the children and the other for their parents), along with a letter explaining the aims and objectives of the study, an information sheet and a consent form, to the home addresses of the sample population of children with and without dental trauma ( $n = 810$ ). The children's questionnaire contained a section to be completed by injured children only, with questions about the injury: the age at which the injury occurred, the setting (home, school, community) and the cause of or event responsible for the injury (sports, fall, collision, violence/assault, traffic incident). Another section com-

pleted by all participants (cases and controls) contained questions on the use of mouthguards during sporting activities.

The parental questionnaire covered sociodemographic characteristics (family income, family size, mother's educational level, government support, country of birth and family dental insurance) and oral health status indicators (self-reported child's dental health, family dentist and year of child's most recent dental visit). The mother's level of education was categorized into 1 of 4 groups: less than high school, completion of high school, some college or university, or completion of college or university. Families receiving benefits through government support programs were identified. Data on total annual family income before tax were dichotomized (up to \$30,000 or more than \$30,000) according to the method and classification used in Statistics Canada's low-income rate, which measures the percentage of families below the low-income cutoff.<sup>10</sup>

Two reminder notices were sent to those who did not respond, and a second questionnaire was mailed 1 month after the first mailing. A total of 270 of the 810 eligible 12- to 14-year-old children agreed to participate in the study (33.3%). The sample consisted of 152 boys (56.3%) and 118 girls (43.7%). The  $\chi^2$  statistic and logistic regression were used to test the significance of association between variables, with  $p \leq 0.05$  as statistically significant (2-tailed tests).

## Results

Of the 270 respondents to the survey (out of the 810 who were randomly selected), clinical evidence of dental trauma to the incisors was observed in 135 children. These 135 cases were matched with 135 injury-free children of the same sex and closest in age, who also returned the questionnaire and served as controls. The mean DMFT for the 270 cases and controls was 0.8 (standard deviation [SD] 1.5, range 0 to 9) and the mean age at which the dental injury occurred in the 135 cases was 9.5 years (SD = 1.5; range 6 to 13 years). There were no differences between participants ( $n = 270$ ) and non-

**Table 2** Mouthguard use in relation to sex, history of dental injury and caries experience (n = 270)

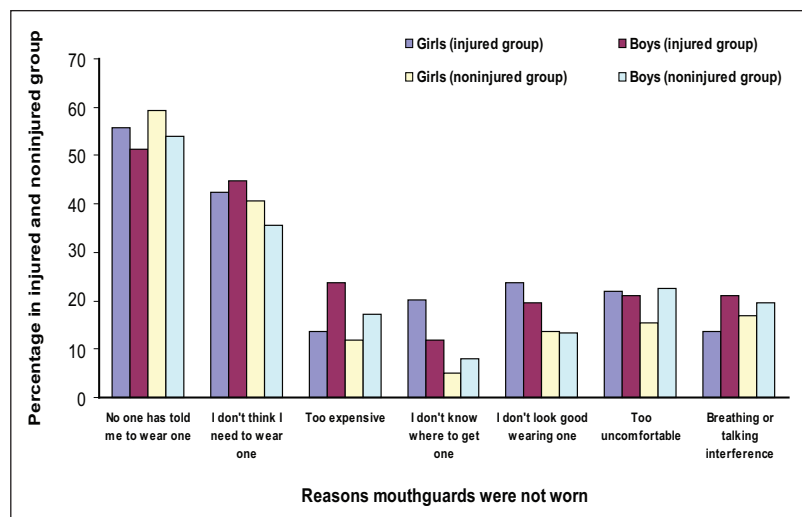
	Use of mouthguards			Odds ratio (95% CI)	p value <sup>a</sup>
	Yes (n and %)	No (n and %)	Total		
<b>Sex</b>					
Boys	36 (23.7)	116 (76.3)	152	1.52 (0.82–2.79)	0.18
Girls	20 (16.9)	98 (83.1)	118		
<b>Dental injury</b>					
Injured	31 (23.0)	104 (77.0)	135	1.31 (0.73–2.37)	0.37
Not injured	25 (18.5)	110 (81.5)	135		
<b>Dental caries</b>					
DMFT > 0	21 (24.1)	66 (75.9)	87	1.35 (0.73–2.49)	0.34
DMFT = 0	35 (19.1)	148 (80.9)	183		

CI = confidence interval; DMFT = decayed, missing and filled permanent teeth  
<sup>a</sup>Obtained with the  $\chi^2$  test

participants (n = 540) in terms of mean numbers of missing teeth, filled teeth or overall DMFT. There was a statistically significant difference for the decayed component of the DMFT index, but it was not clinically meaningful ( $0.2 \pm 0.5$  for non-participants and  $0.1 \pm 0.4$  for participants).

Most of the case children (86/135 or 63.7%) had a minor injury (code 1, for untreated enamel fracture). The prevalence of moderate injury (untreated enamel and dentin fracture) was 5.9% (8/135), and that of severe injury was 36.3% (combined code 4, for tooth loss caused by trauma, and code 5, for a restored injury) (Table 1). Most of the injuries took place either at school or at home. For boys, school was the most frequent location of injury, followed by home; the pattern was reversed for girls. A high percentage of the 255 children who reported playing sports at school (whether or not they had an injury) had never worn a mouthguard (241/255 or 94.5%), whereas only 14 (5.5%) reported using mouthguards sometimes or always during athletic activities in school. Among users of mouthguards, there were no significant differences in compliance between boys and girls.

Similarly, of the 252 schoolchildren who played sports in clubs or leagues, 201 (79.8%) reported that they had never worn a mouthguard, and 51 (20.2%) reported that they wore mouthguards sometimes or always. The frequency of mouthguard use was 3.7 times higher for sports played at clubs or in leagues than for sports played at school. Among both cases and controls who played sports in clubs or leagues, more of the boys wore mouthguards: injured group, 16/72 (22.2%) of the boys vs. 8/52 (15.4%)



**Figure 1:** Reasons cited for not wearing mouthguards, according to sex and injury.

of the girls; noninjured group, 18/73 (24.7%) of the boys vs. 9/55 (16.4%) of the girls.

Among the 56 children who wore mouthguards (both cases and controls), 48.2% wore the boil-and-bite type and 21.4% used the stock type usually purchased at sporting goods stores. Only 30.4% wore professionally made custom mouthguards.

Over 50% (148 of 270) reported that they had never been told to wear a mouthguard by parents and/or coaches, and 40.7% (110) believed that they did not need to wear one during sporting activities (Fig. 1). Other reasons for not wearing a mouthguard were discomfort, difficulty in breathing and talking, and appearance.

The odds of wearing a mouthguard were 52% greater for boys than for girls. Among children who had had a dental injury in the past and among those with one or

**Table 3** Association between mouthguard use and treatment for prior dental injury (*n* = 135)

Subject group	Use of mouthguards			Odds ratio (95% CI)	<i>p</i> value <sup>a</sup>
	Yes (n and %)	No (n and %)	Total		
With untreated injury	20 (21.7)	72 (78.3)	92	1.24 (0.53–2.88)	0.62
With restored injury	11 (25.6)	32 (74.4)	43		

CI = confidence interval  
<sup>a</sup>Obtained with the  $\chi^2$  test

**Table 4** Mouthguard use in relation to dental history and socioeconomic indicators

	Use of mouthguards			Odds ratio (95%CI)	<i>p</i> value <sup>a</sup>
	Yes (n and %)	No (n and %)	Total		
<b>Dental insurance</b>					
Yes	41 (25.6)	119 (74.4)	160	2.18 (1.14–4.18)	0.02
No	15 (13.6)	95 (86.4)	110		
<b>Family dentist</b>					
Yes	51 (22.2)	179 (77.8)	230	1.99 (0.74–5.35)	0.16
No	5 (12.5)	35 (87.5)	40		
<b>Mother's education</b>					
Less than high school or high school	23 (21.1)	86 (78.9)	109	0.97 (0.54–1.75)	0.87
At least some college or university	33 (20.6)	127 (79.4)	160		
<b>Family income</b>					
Low ( $\leq$ \$30,000)	10 (15.6)	54 (84.4)	64	1.59 (0.76–3.32)	0.28
Middle or high ( $>$ \$30,000)	46 (22.8)	156 (77.2)	202		
<b>Government social support</b>					
Yes	1 (8.3)	11 (91.7)	12	0.34 (0.04–2.65)	0.28
No	55 (21.3)	203 (78.7)	258		

CI = confidence interval  
<sup>a</sup>Obtained with the  $\chi^2$  test

more teeth affected by dental caries the odds were 31% and 35% greater, respectively, but these findings were not significant at the 5% level (**Table 2**). No statistically significant association was found between children with treated or untreated dental injuries and the use of mouthguards (**Table 3**).

Of the 4 socioeconomic indicators, only the presence of dental insurance was associated with use of mouthguards: the children of parents with dental insurance were 2.18 times more likely to report using mouthguards than those without such insurance (**Table 4**). Children with a family dentist were 1.99 times more likely to wear mouthguards, but this result did not reach statistical significance (*p* = 0.16).

The single most important predictor of wearing a mouthguard in this adolescent population was parents' private dental insurance (**Table 5**). The association be-

tween dental insurance and mouthguard use remained statistically significant after adjustment for sex and prior history of dental injury, as well as the other variables studied.

### Discussion

Although the highest percentage of dental injuries occurred at school, and falls were the major cause of injuries (closely followed by sports-related injuries),<sup>11</sup> only 5.5% of children wore mouthguards while playing school sports. This may reflect a lack of knowledge about the benefits of mouthguard use, school policies and attitudes toward mouthguard use among staff teaching physical education, or the level of vigilance of mouthguard use by coaching staff during school-sponsored practices and games. Although 20.2% of children reported wearing

**Table 5** Logistic regression model for mouthguard use (*n* = 270)

Indicators	Adjusted odds ratio (95% CI)	
	Full model	Reduced final model
Dental insurance (no = 0; yes = 1)	1.99 <sup>a</sup> (0.98–4.02)	2.18 <sup>b</sup> (1.14–4.18)
Sex (girl = 0; boy = 1)	1.52 (0.82–2.82)	–
Family dentist (no = 0; yes = 1)	1.39 (0.47–4.10)	–
Dental injury (no = 0; yes = 1)	1.28 (0.68–2.42)	–
DMFT (0 = 0; ≥1 = 1)	1.22 (0.63–2.38)	–
Mother’s educational level (less than high school or high school completion = 0; at least some college or university = 1)	1.00 (0.99–1.01)	–
Family income (low income = 0; middle or high income = 1)	0.99 (0.99–1.00)	–

CI = confidence interval, DMFT = decayed, missing and filled permanent teeth

<sup>a</sup>*p* = 0.056

<sup>b</sup>*p* = 0.019

mouthguards (either sometimes or always) while playing sports at locations other than school, almost 80% never wore mouthguards while playing club or league sports. Even though mouthguard use is mandated in some league sports (e.g., hockey), it is rarely required for school sports. Moreover, previous injuries appeared to have little effect on either boys or girls accepting mouthguards for prevention. Some sports, such as skateboarding and in-line skating, do not have a culture of mouthguard use, and for others, such as basketball and street hockey, mouth protection is rarely used for recreational play.

In this study, the main reasons for noncompliance with mouthguard use reported by children were related to a lack of instruction or advice on usage by parents and coaches and physical factors such as interference with breathing and speech, discomfort and esthetics. Noncompliance among those reporting physical factors as an influence might be explained by the fact that almost 70% of those who did wear mouthguards used over-the-counter stock or boil-and-bite brands, which do not fit as well as custom-made mouthguards. In addition to the need to educate parents that mouth protection is necessary and that they need to be vigilant about compliance, there is also a need to educate parents about the best types of mouthguards. Although all mouthguards are invasive, a custom-fitted mouthguard will be more comfortable and effective and will last longer than boil-and-bite or stock types.

Although the children of parents who had private dental insurance exhibited the highest frequency of

mouthguard use, over 74.4% of these children still did not wear mouthguards. Children whose parents were receiving social support exhibited a lower frequency of mouthguard use, even though the support program would have covered the fee for mouthguards.<sup>12</sup> This suggests that parents were unaware of this coverage or that their lack of regular dental care did not allow for education about mouth protection.

Gardiner and Ranalli noted that most parents have little or no information about mouthguards or the risk of injury associated with certain physical activities.<sup>13</sup> Furthermore, since parents often decide whether mouthguards are worn,<sup>14</sup> they need more information to advise their children on when and how to select and use mouth protection.

Although most dental injuries are produced by nonsporting activities,<sup>15</sup> sports represent a niche of increased risk for dental injury. This study showed a lack of awareness about the benefits of wearing properly fitted mouthguards while playing sports either at school or in leagues and hence a lack of perception of the need for such protection. The substantial use of ill-fitting mouthguards identified in this study contributed to complaints of interference with speech and breathing, discomfort and poor appearance. These problems can be expected to reinforce peer perceptions, which in turn reduce compliance with mouthguard use among schoolchildren. Compliance checks must come from teachers, coaches and parents who are actually present at events. The value and importance of properly fitted mouthguards must

be understood by school athletic associations, as well as sports associations. Insurance companies should educate their clients about the risk of dental injuries and the high cost associated with their treatment relative to the cost of mouth protection. ♦

## THE AUTHORS

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