Prevalence and associated factors of traumatic dental injuries in Brazilian schoolchildren

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Abstract

Objectives: This study investigated the prevalence of traumatic dental injury (TDI) and associated factors in the permanent incisors of Brazilian schoolchildren.
Methods: A cross-sectional survey was carried out with 1,612 male and female children aged 11 to 14 attending public and private elementary schools in Belo Horizonte, Brazil. A multistage sampling technique was adopted to select the children. Oral examinations were performed by calibrated examiners for the diagnosis of TDI (criteria proposed by Andreasen) and dental caries [Decayed, Missing and Filled Teeth Index (DMFT)]. The Social Vulnerability Index was used for socioeconomic classification. Data analysis involved descriptive statistics and the Poisson regression model.
Results: The prevalence of TDI was 17.1%. Falls (43.6%) were the most common cause of TDI, mainly at home (41.8%). Boys were more affected than girls. There was no statistically significant association between TDI and socioeconomic status. The adjusted results revealed that TDI was significantly associated with DMFT [1.11, 95% confidence interval (CI): 1.06 to 1.16] and overjet (1.15, 95% CI: 1.00 to 1.31).
Conclusions: TDI was associated with dental caries and overjet and was not influenced by socioeconomic status.

Introduction

The prevalence and characteristics of traumatic dental injury (TDI) in schoolchildren have been extensively studied. The majority of these studies conclude that falls are the most common cause of TDI (1-4) and enamel fracture is the most prevalent type (1-3,5,6-9). These studies demonstrate that the upper central incisors are the most affected teeth (2,3,6) and boys experience more TDI than girls (1,5,7-12). Increased overjet is considered a risk factor for the occurrence of TDI (2,6,11,13,14).

However, there is no agreement in the literature regarding the association between TDI and other factors, such as socioeconomic status and experience with dental caries (1-3,5-8,12,14,15). Findings from a number of studies suggest that the occurrence of TDI is not influenced by socioeconomic status (2,3,7,8,12). However, the heterogeneity of the methods for the classification of TDI and socioeconomic indicators could be the reason for the lack of agreement (15). The association between TDI and dental caries experience in permanent teeth has not been extensively studied, especially in Brazil. In Canada, children with caries were found to have more experience with TDI than those who were caries free (3,16). Thus, the relationship between oral conditions and socioeconomic conditions should be studied in order to allow the improvement of the effectiveness of public health policies.

In the present study, the null hypothesis is that TDI is not associated with socioeconomic status or dental caries experience, against the alternative hypothesis that such associations exist. The aim of this study was to test the null hypothesis and investigate the prevalence of TDI in the permanent incisors of 11-to-14-year-old schoolchildren in the city of Belo Horizonte, Brazil.

Methods

A cross-sectional survey was carried out in the city of Belo Horizonte, which is located in southeastern Brazil and has 2,412,937 inhabitants, with 170,388 children enrolled in 450

elementary schools (17). A total of 1,612 children aged from 11 to 14 years were randomly selected to represent the population of schoolchildren in Belo Horizonte.

The sample size was calculated to give a standard error of 2%. The 95% confidence interval (CI) level and a 16.1% prevalence of TDI (6) were used for the calculation of the sample. A correction factor of 1.2 was applied to increase the precision, as a multistage sampling method was adopted rather than random sampling (18). The minimal sample size needed to satisfy the requirements was estimated as 1,558 individuals. However, an additional 20.0% were asked to participate in the study ($n = 1{,}870$) in order to compensate for potential refusals.

For the list of all elementary schools in Belo Horizonte, the State of Minas Gerais Department of Education was contacted and provided the information for each school. The first-stage units comprised one randomly selected public and private elementary school in each administrative district in Belo Horizonte. The second-stage units comprised randomly selected classes within the selected schools. All 11-to-14-year-old students attending the selected classes on the day the researcher visited the school were asked to participate. The sample was completed when the target number was reached. A letter was sent to the parents of the selected children, explaining the aim, characteristics, importance, and methods of the study and asking for their children's participation.

Dental examinations were carried out by three calibrated dentists (CBB, DG, and CST), who had participated in a training and calibration exercise based on the criteria proposed by Andreasen (19). It was not possible to record root fractures, as X-rays were not employed in the present study. The clinical examination also collected data on dental caries using the Decayed, Missing and Filled Teeth Index (DMFT) (20) and incisal overjet measured in millimeters. Dental caries were visually diagnosed based on World Health Organization (WHO) recommendations. Training for the three clinical diagnoses entailed the use of color photography to show the major clinical characteristics of each condition and the conditions to be considered in the differential diagnosis. Seventy-six children (not part of the study population) were randomly selected and included in the calibration process. Forty-four children were examined by each of the three dentists separately for the purposes of determining inter-examiner agreement and 10 children were re-examined after a 1-month interval for the calculation of intra-examiner agreement. Kappa values ranged from 0.70 to 1.00 for intra-examiner agreement and from 0.68 to 1.00 for inter-examiner agreement. Specifically, mean Kappa values were 0.76 for intra-examiner and 0.79 for inter-examiner agreement regarding TDI; 0.78 for intra-examiner and 0.85 for inter-examiner agreement regarding dental caries; and 0.96 for intra-examiner and 0.90 for inter-examiner agreement regarding incisal overjet, thereby demonstrating good to excellent agreement. These same 76 children were also used in the pilot study, which was carried out in order to test the methods, dental examination, and administration of the questionnaires as well as to prepare the examiners.

The children were examined in a predetermined order at school during class hours. Artificial illumination (Petzl Zoom head lamp, Petzl America, Clearfield, UT, USA) was used and the examiners used appropriate individual cross-infection protection equipment. Disposable mouth mirrors (PRISMA®, São Paulo, Brazil) and periodontal probes (WHO-621 Trinity, Campo Mourão, Brazil) were packed and sterilized in sufficient quantities for each day of work. Children who were diagnosed with TDI answered an interview addressing the history of the injury.

The Social Vulnerability Index (SVI) was used for socioeconomic classification. The SVI is an area-based measure drafted by the City of Belo Horizonte and was used to analyze family exposure to social influence factors. This index measures the vulnerability of the population to social exclusion through the determination of neighborhood infrastructure, access to work, income, sanitation services, health care services, education, legal assistance, and public transportation. Thus, the SVI measures social access and determines to what extent the population of each region of the city is vulnerable to social exclusion. There are five different classes – Class I comprises the most socially vulnerable families and Class V comprises the least socially vulnerable families. SVI scores from the city hall database were used for each district. As children usually live near their schools and study in social environments similar to their homes, the school districts were used for this classification (21,22).

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 16.0, SPSS Inc., Chicago, IL, USA). Overjet was dichotomized using five millimeters as the cutoff point (6,7,14). DMFT was dichotomized as caries-free children (DMFT = 0) and children with one or more affected teeth (DMFT $\geq$ 1). Classes I and II of the SVI were grouped in the "high vulnerability" category and classes III to V were grouped in the "low vulnerability" category (22). Data analysis involved descriptive statistics (frequency distribution and cross-tabulation). The chi-square test was used to determine the statistical significance of associations between the occurrence of TDI and the independent variables as well as the association between SVI and dental caries experience. The Poisson regression model with robust variance was used. Independent variables were introduced into the model based on their statistical significance ($P < 0.20$) and/or clinical epidemiological importance. The significance level was set at 5%.

The Human Research Ethics Committee of the Federal University of Minas Gerais approved the study and terms of informed consent were signed by the parents and children.

Table 1 Frequency Distribution of Children with TDI (n = 275) According to Etiology, Site, and Type of TDI; Belo Horizonte, Brazil, 2009

Variables	Frequency *n* (%)
Etiology of TDI	
Falls	120 (43.6)
Sports	56 (20.4)
Others	29 (10.5)
Unknown	70 (25.5)
Site of TDI	
Home	115 (41.8)
School	39 (14.2)
Street	29 (10.5)
Others	25 (9.1)
Unknown	67 (24.4)
Type of lesion	
Enamel fracture	175 (63.6)
Enamel-dentin fracture	42 (15.3)
Complicated crown fracture	5 (1.8)
Lateral luxation	1 (0.4)
Avulsion	2 (0.7)
Restoration	64 (23.3)

TDI, traumatic dental injury.

Table 2 Association between Traumatic Dental Injuries (TDI) in Schoolchildren (n = 1,612) and Independent Variables; Belo Horizonte, Brazil, 2009

	TDI		
Variables	Yes *n*(%)	No *n* (%)	*P*-value*
Gender			
Girls	141 (15.0)	799 (85.0)	0.009
Boys	134 (19.9)	538 (80.1)	
Age (years)			
11-12	133 (15.5)	723 (84.5)	0.084
13-14	142 (18.8)	614 (81.2)	
DMFT			
DMFT = 0	119 (13.3)	776 (86.7)	<0.001
DMFT ≥ 1	156 (21.8)	561 (78.2)	
Overjet			
<5 mm	252 (16.5)	1,278 (83.5)	0.007
≥5 mm	23 (28.0)	59 (72.0)	
Socioeconomic status			
High vulnerability	124 (18.2)	557 (81.8)	0.294
Low vulnerability	151 (16.2)	780 (83.3)	
Total	275 (17.1)	1,337 (82.9)	

* Chi-square test.

DMFT, Decayed, Missing and Filled Teeth Index; TDI, traumatic dental injury.

Results

A total of 1,612 children (41.7% boys and 58.3% girls) representing 11-to-14-year-old schoolchildren living in Belo Horizonte, Brazil, participated in this survey. Because of the good response rate (86.2%), the sample size was slightly larger than the estimated minimal size to satisfy the requirements (n = 1,558). The main reasons for refusals were the lack of parental agreement for the child's participation and the child's absence from school during dental examination visits.

There was a 17.1% prevalence of TDI. Falls were most common cause (43.6%) and the majority of accidents occurred at home (41.8%). Fractures in enamel only (63.6%) were the most common type of TDI. Only 23.3% of the children had undergone restorative treatment due to TDI (Table 1).

The results of the bivariate analysis (Table 2) reveal that boys had more TDIs than girls [19.9% and 15.0%, respectively (P = 0.009)]. There was no statistically significant association between TDI and age of the children.

A higher proportion of children with dental caries experience had TDI (21.8%) compared with those who were caries free (13.3%) (P < 0.001). Children with overjet equal to or greater than 5 mm had more TDIs than those with overjet less than 5 mm (P = 0.007). Socioeconomic status was not statistically associated with the occurrence of TDI in these children (P = 0.294), despite the fact that children with high social vulnerability had a tendency toward a higher prevalence of TDI (18.2%) (Table 2).

The results of bivariate analysis demonstrated no significant association between the SVI and DMFT (P = 0.220) (Table 3).

The results of the Poisson regression analysis are displayed in Table 4. Age and SVI were initially included in the model. However, these variables did not remain in final model, as they did not meet the statistical significance required. The final model confirmed that TDI was significantly associated with gender (1.12, 95% CI: 1.09 to 1.15), DMFT (1.11, 95% CI: 1.06 to 1.16), and overjet (1.15, 95% CI: 1.00 to 1.31).

Discussion

The present cross-sectional survey identified a 17.1% prevalence of TDI in permanent incisors among schoolchildren aged 11 to 14 years in the city of Belo Horizonte, Brazil. This

Table 3 Association between DMFT Index and SVI in Schoolchildren (n = 1,612); Belo Horizonte, Brazil, 2009

	DMFT		
Variable	Yes *n* (%)	No *n* (%)	*P*-value*
Socioeconomic status (SVI)			
High vulnerability	315 (46.3)	366 (53.7)	0.220
Low vulnerability	402 (43.2)	529 (56.8)	
Total	717 (44.5)	895 (55.5)	

* Chi-square test.

DMFT, Decayed, Missing and Filled Teeth Index.

Table 4 Poisson Regression Model Explaining the Independent Variables in Children with TDI (n = 1,612); Belo Horizonte, Brazil, 2009

Variables	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	*P*-value
Gender			
Girls	1	1	0.014
Boys	1.33 (1.07-1.65)	1.12 (1.09-1.15)	
DMFT			
DMFT = 0	1	1	<0.001
DMFT ≥ 1	1.64 (1.32-2.03)	1.11 (1.06-1.16)	
Overjet			
<5 mm	1	1	0.050
≥5 mm	1.70 (1.18-2.45)	1.15 (1.00-1.31)	

CI, confidence interval; DMFT, Decayed, Missing and Filled Teeth Index; PR, prevalence ratio.

result corroborates a previous study carried out in Belo Horizonte involving 9-to-14-year-old schoolchildren, which found a prevalence of 16.1% among 14-year-old children (6). Other studies carried out in Brazil, Canada and the United Kingdom with a similar age group have found a prevalence of TDI ranging from 10.5 to 58.6% (2,3,5,7-10,12,16).

Boys had more episodes of TDI than girls and this association was statistically significant ($P = 0.014$), which confirms studies performed on the same age group using similar methodology (4,6-8,12). Behavioral factors in early adolescence may explain this fact, as boys tend to engage more frequently in vigorous outdoor activities or sports than girls (2). On the other hand, a recent study found that girls may be exposed to the same risk behavior for TDI as boys, which is becoming a characteristic of modern Western society. However, this study was carried out in a small town in Brazil, where girls are probably more involved in physical leisure activities (9).

In agreement with previous studies, the present study found that falls (43.6%) were the most common cause of TDI, followed by sports-related injuries (20.4%) (1-4). As behavioral risk for TDI involves sports and other leisure activities and the majority of schools in Brazil do not concern themselves with healthy environments, it is necessary for families, school staff, and public authorities to recognize the importance of providing safe environments and equipment for children's activities (2,9).

Few children reported violence as a cause of TDI. Cases of violence may go unreported because of fear or shame. In the present study, the answer "unknown cause" was given by 25.5% of the children with TDI, when asked about the cause of the injury. When TDI is a result of violence, children tend to report they do not remember what caused the injury (10,19). Another study carried out in Brazil found that children who suffered high degrees of paternal punishment are 1.89-fold more likely to have a TDI than those who suffered low degrees of paternal punishment. Moreover, children in an adverse family environment throughout the course of life have more TDIs than those who experienced a more favorable family environment (10). It is important to recognize the signs and symptoms of violence and physical abuse. Oral health professionals should be responsible for reporting suspected cases to the authorities, thereby contributing to prevent violence (12). Thus, changes in professional attitudes and better supervision at schools are needed. Considering the importance of this issue, further studies should be encouraged, including those with a qualitative approach, to investigate the role of domestic violence and physical abuse as reasons for the occurrence of TDI. Consequently, the high rate of "unknown cause" answers could be biased information. Perhaps the children did not state the truth because of fear or shame. However, these responses may also be due to recall bias (12,23).

The present study found that only 23.3% of the children had restorative treatment following a TDI. Previous studies have found that the treatment of TDI is generally neglected (8,9). A study carried out in southern Brazil found that 27.6% of TDIs were treated, while 66.7% needed treatment (9). Another study performed in the UK found that only 4.8 per thousand incisors were treated with restorations, whereas 20.7 per thousand incisors needed treatment (8). In developing countries, the majority of the population cannot afford private dental care and public services are unable to offer complex treatment. Another factor that may determine the low treatment rates in both developing and developed countries is the fact that TDI is not a disease and parents do not pay it concern (9). However, depending on the severity of the fracture, there may be physical and psychosocial consequences, as TDI is generally an irreversible lesion affecting anterior teeth (24,25). Although treatment does not eliminate the impact of TDI on a child's life, it can reduce this impact, especially its social aspects (24).

No statistically significant association was found between socioeconomic status and the occurrence of TDI. This result corroborates findings from other studies on the same age group (2,8,10,12). Another study on TDI in Belo Horizonte involving schoolchildren from 9 to 14 years of age, which used the ABA-ABIPEME (Brazilian Advertising Association/

Brazilian Association of Market Institutes) criteria, found that children from families with a higher socioeconomic status were more likely to have TDI than those from families with a lower socioeconomic status (6). The ABA-ABIPEME criteria classify the population into socioeconomic classes and estimate buying power. It is possible that socioeconomic indicators alone (which mainly consider the physical environment) are not enough. It is necessary to investigate the influence of social conditions over the occurrence of TDI. Social environments, such as family structure, family relationships and social relationships at school have been correlated with the occurrence of TDI in previous studies (10,11).

The conflicting results may be due to differences in the socioeconomic classification used. There is no consensus in the literature regarding this association. However, the majority of the studies involving children and adolescents have found no significant association between TDI in permanent teeth and socioeconomic status (15).

A statistically significant association was found between TDI and incisal overjet, regardless of the influence of the other variables studied (1.15, 95% CI: 1.00 to 1.31). Other studies have also described overjet as an important risk factor for the occurrence of TDI (2,6,11,14). Incisal overjet has been associated with the occurrence of new episodes of TDI in children who had previously suffered this injury, thereby demonstrating the importance of this malocclusion (14). A systematic review concluded that children with accentuated overjet are approximately twice as much at risk of TDI as those with lesser overjet and the risk of injury tends to increase with the increase in overjet (13). These findings are important, as this malocclusion is an important predictor for the occurrence of TDI and correcting it is a necessary preventive measure for avoiding TDI.

The most interesting finding in the present study was the strong association between the experience of dental caries and TDI. Children with dental caries experience had a 1.11 greater prevalence of TDI than children who were caries free. The present study supports the findings of two previous studies carried out in Canada involving large samples of schoolchildren from 12 to 14 years of age, which found such an association despite using another TDI criterion. These Canadian studies suggest the existence of common risk factors for both conditions and the need of a more appropriate approach to TDI and dental caries prevention (3,16).

The association between the occurrence of TDI and dental caries experience could be explained by the environment in which children live or their behavior (16). In the present study, neither TDI nor DMFT was associated to the environment or SVI. For TDI, the absence of such an association is a usual finding in the literature (2,3,7,8,12). However, for dental caries experience, recent studies have reported that socioeconomic variables have little power to explain the decline in the DMFT index in Brazil (26,27). The shift in oral health public policies, with an emphasis on preventive dentistry and oral health promotion, could be considered the main cause for the decline in DMFT values (26,27). Moreover, the fluoridation of the public water supply and dentifrices has also played an important role in the decline of the incidence of dental caries (26,27). The improvement in access to public oral health services (28) may be another important reason for the decrease of dental caries experiences in populations of high social vulnerability. Thus, factors such as health-related behavioral problems or other psychosocial risk factors may be common risk factors of TDI and dental caries (3).

This study has some limitations that must be recognized. Since dental caries was diagnosed by a visual exam alone, the prevalence of approximal caries may be underestimated. However, the use of the WHO criteria for the diagnosis of dental caries without X-rays made it possible to obtain a large population-based sample with an epidemiological nature representative of the city of Belo Horizonte (Brazil), while rendering the use of complex, costly exams unviable. Another point we should consider is the lack of individual socioeconomic indicators, such as parents' levels of education and household income, to supplement the SVI data.

It is crucial to implement health promotion strategies with the aim preventing TDI, dental caries, and overjet, since these oral conditions are associated. Furthermore, rehabilitating the aesthetics and function of individuals who have suffered TDI should be included in public oral health programs. It is important to bear in mind that TDI may cause psychosocial impact (25).

In summary, the results of the present study support the hypothesis that boys, individuals with accentuated incisal overjet and those with dental caries experience are more likely to experience TDI. The important association found between the experience of TDI and dental caries suggests that further studies are needed to investigate the common risk factors between these two conditions. Consequently, such knowledge could enable the drafting of common preventive actions, thereby reducing the cost and increasing the effectiveness of oral health care programs.

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