

# Traumatic dental injuries and associated factors among Brazilian preschool children

Oliveira LB, Marcenes W, Ardenghi TM, Sheiham A, Bönecker M. Traumatic dental injuries and associated factors among Brazilian preschool children. © Blackwell Munksgaard, 2006.

**Abstract** – The main objective of this study was to assess the epidemiology of traumatic dental injuries (TDI) to the primary teeth of preschool children and second, to investigate whether TDI were related to anterior open bite and, third, whether TDI are related to socio-economic circumstances in an urban Brazilian population. A clinical examination was performed during the National Day of Children's Vaccination. TDI were classified according to the modified classification proposed by Ellis. In addition to those criteria the presence of tooth discoloration was recorded. An interview was carried out with mothers or guardians. The data collected included mother's level of education and living conditions. The prevalence of TDI was 9.4%. The maxillary central incisors were the most affected teeth. Most children with a TDI experienced traumatic injuries to one tooth (6.3%), while 2.8% had two and 0.4% had three traumatized teeth. The most common crown fracture was in enamel only (68.8%), followed by crown fracture of enamel and dentin (13.8%). Missing teeth following trauma occurred in 10.9% of those with TDI. The prevalence of tooth discoloration was 5.1%. Children with anterior open bite had twice the level the level of TDI compared to those with normal occlusions ( $P = 0.001$ ). Socio-economic factors were not statistically significantly associated with the occurrence of TDI. The prevalence of dental injuries in Brazilian preschool children was low. Children with anterior open bite experienced more dental injuries. Neither of the indicators of socio-economic status was related to the prevalence of TDI.

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Traumatic dental injury (TDI) is a developing and challenging public health problem to oral health professionals, and it has been seriously neglected (1, 2). Reports on the prevalence of TDI in preschool children are rare and few relevant studies identified are summarized in Table 1. In Brazil, the prevalence of TDI in preschool children ranged from 10% to 36% (3, 4). The reported figures are likely to underestimate the prevalence of TDI because most studies use a cross-sectional design. A prospective study in

Denmark showed that about 30% of preschool children sustain a TDI (5).

TDI are associated with biological, socio-economic conditions, psychological and behavioural factors (6). Predisposing factors to TDI include physical features such as increased incisal overjet, open bite, protrusion and lip incompetence (1, 7–15). While there is clear evidence of an association between size of overjet and TDI, there is limited evidence whether anterior open bite is related to the occurrence of TDI. Similarly, there are few reports on the

Table 1. The prevalence of dental injuries in preschool children; summary of some studies

Reference	Country (year)	No. of children (n)	Age	Prevalence (%)
Zadik (25)	Israel (1976)	965	5 years	11.1
Bijella et al. (49)	Brazil (1990)	576	10–72 months	30.2
Jones et al. (29)	USA (1993)	493	3–4 years	23.0
Otuyemi (50)	Nigerian (1994)	1401	1–5 years	30.8
Mestrinho et al. (3)	Brazil (1998)	1853	1–60 months	10.0 (<2 years) – 20.0 (5 years)
Carvalho et al. (42)	Belgium (1998)	750	3–5 years	18.0
Hargreaves et al. (43)	South Africa (1999)	1466	1–5 years	15.0
Cunha et al. (48)	Brazil (2001)	1654	0–36 months	16.3
Kramer et al. (4)	Brazil (2003)	1545	12–72 months	36.0

relationship between malocclusion traits and the occurrence of TDI to the primary teeth (16–18) compared to large number of studies assessing this association in the permanent dentition (7, 16–20).

The association between socio-economic indicators and TDI is inconsistent and needs to be clarified. Jamani and Fayyad (21) reported a higher prevalence of TDI in children attending private (higher social economic status) schools than in state (lower social economic status) schools. Conversely, Hamilton et al. (22) reported that significantly more children in the lower socio-economic groups had TDI compared with those in the higher socio-economic groups. A Brazilian study showed that higher socio-economic groups experienced more dental injuries than lower socio-economic groups (7). Two others studies in Brazil did not find a statistically significant relationship between TDI and socio-economic indicators (23, 24). Nicolau et al. (6), using a life course, concluded that adolescents who experienced adverse psychological environments along the life course had more TDI than their counterparts who experienced more favourable environments. The family environment was a significant determinant of TDI whereas socio-economic factors were not significant. Only one study reported an association between socio-economic indicators and TDI in anterior primary teeth in 5-year-old children. The social class based on father's education was not associated with the distribution of TDI (25).

Because there was so little information on the prevalence of TDI and associated factors in preschool children the main objective of this study was to assess the epidemiology of TDI to the primary teeth of preschool children and second, to investigate whether TDI were related to anterior open bite and, third, whether TDI were related to socio-economic circumstances in an urban Brazilian population.

## Materials and methods

A cross-sectional survey was carried out on children aged 5–59 months, of both sexes, living in Diadema,

Brazil. It was estimated that a minimum sample size of 625 children was required to achieve a level of precision with a standard error of 2% or less. The 95% confidence interval level and a prevalence of TDI of 50% were used for the calculation. The decision to use a prevalence of 50% was due to lack of information of the actual prevalence figures. However, any calculation using a different figure than 50% would require a smaller sample size to achieve the same precision (26).

Participants were randomly selected from all children attending a National Day of Children's Vaccination. A sampling quota was selected from all children attending each of the 15 health centres in the city of Diadema. Health centres were used as sampling points because the city was administratively divided into 15 regions and each had a public health centre that was responsible for the vaccination of those living in that area. Quota sampling was adopted because the population was equally distributed in all regions (27). The vaccination programme in Diadema consistently had uptake rates above 98%.

Data were collected through clinical oral examinations and structured interviews. A letter was given to all parents explaining the aims of the study and asking them for consent for their children to participate in the study. Examiners assured parents there was no prejudice to the children who had opted not to participate in the study. Ten examiners and 10 dental assistants participated in the study. They had a training and calibration exercise before the survey. Children were examined in a dental chair. One of the parents sometimes helped to hold very young children. Their teeth were dried and examined under standard illumination provided by a conventional operating light.

The dental examination for TDI included only anterior primary teeth. Duplicate examination was carried out to assess intra and inter examiner agreement. The criteria used to assess TDI were derived from a modified version of Ellis' classification (28). It included fracture of the crown involving the enamel only, fracture of the crown involving

enamel and dentin, fracture of the crown involving the pulp, tooth missing due to trauma, and treated TDI. Pulp involvement was assessed through the presence of discoloration and presence of fistulous tract without signs of caries. Root fractures and pulp status recorded in Ellis' classification were not recorded in this study because dental radiographs or pulp tests are not appropriate for epidemiological surveys. The presence of anterior open bite was assessed based on the criterion of lack of vertical overlap of the incisors in the occlusal position (29).

The 10 dental assistants carried out the interviews with guardians of the children. The data collected included mother's level of education and house ownership. Level of mother's education was measured in number of years at school.

A sample of 20 children was used to train the examiners and test the feasibility of the dental examination and the interview procedures. No changes were made to the methodology previously proposed. Ethical clearance was obtained from the Ethical Committee of the School of dentistry of Sao Paulo, University of Sao Paulo.

Data analysis included descriptive statistics (frequency distribution). Statistical significance for the association between the occurrence of TDI and presence of anterior open bite, mother's level of education and house ownership was determined using chi-square, Fisher's exact tests, simple and multiple logistic regression analysis. The level of significance was set at 5%.

## Results

Eight hundred and ninety two children were examined. The sample size was bigger than the minimum size to satisfy the requirements ( $n = 625$ ) due to a good response rate. Kappa values were calculated on a tooth-by-tooth basis. A very good intra and inter examiner agreement were obtained and the all scores were greater than 0.89.

Of the 892 children, 84 (9.4%) had some type of TDI to a total of 138 teeth. The prevalence increased with increasing age, from 0.8% in 1–12-month old to 14.4% in those aged 36–48 months (Table 2). There were no significant differences in the prevalence of TDI between boys and girls. The most common type of injury was enamel fracture (68.8%), followed by enamel-dentin fracture (13.8%) and missing teeth following trauma (10.9%) (Table 3). Most children experienced TDI to one tooth (6.3%), while 2.8% had two, only 0.4% three traumatized teeth, and 90.5% had no TDI. The maxillary central incisors were the most frequently traumatized teeth. Among the 84 children with TDI, only 6 (7.1%) had the affected teeth treated. Children with anterior open bite were twice as likely

Table 2. Prevalence of dental injuries in the primary dentition, by age in months, Diadema, Brazil ( $n = 892$ )

Age (months)	Traumatic dental injuries					
	Yes		No		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
5–12	1	0.8	131	99.2	132	100.0
12–24	9	4.7	183	95.3	192	100.0
24–36	21	11.0	170	89.0	191	100.0
36–48	27	14.4	161	85.6	188	100.0
48–59	26	13.8	163	86.2	189	100.0
Total	84	9.4	808	90.6	892	100.0

Table 3. Types of TDI, by type of injury to individual teeth, Diadema, Brazil ( $n = 138$ )

Type of dental injuries	<i>n</i>	%
Crown fracture of enamel only	95	68.8
Crown fracture of enamel and dentin	19	13.8
Crown fracture involving pulp	1	0.7
Missing teeth following a trauma	15	10.9
Presence of fistulous tract without signs of caries	1	0.7
Discoloration	7	5.1
Total	138	100

to have a TDI than their counterparts with a normal occlusion (95% CI: 1.33–3.34) (Table 4). This difference was highly statistically significant even after adjusting for age, sex and socio-economic indicators.

TDI were not significantly related to socio-economic indicators. Children with mothers with less or more than 8 years of education experienced similar levels of TDI ( $P = 0.762$ ). House ownership was not associated to the prevalence of TDI ( $P = 0.547$ ). Results of multiple regression analysis confirmed that sex of the child ( $P = 0.469$ ) and house ownership were not statistically significantly associated with the occurrence of TDI (Table 4).

## Discussion

The prevalence of TDI reported in this study (9.4%) was similar to the one reported by Mestrinho et al. (3) (10%) and lower than in most other studies on primary teeth (Table 1) taking age into account. Comparisons between studies should be interpreted with caution due to the lack of uniformity in sample selection, examination procedures, diagnostic criteria and age groups. The differences in prevalence observed in Table 1 are mainly due to age differences between studies.

Whereas males tend to experience more TDI than females in the permanent dentition (7, 30–33), there does not appear to be a sex difference in TDI in the primary dentition. However, recent studies show a

Table 4. Simple and multiple logistic regressions of explanatory variables on injuries to the anterior primary teeth in a sample of preschool children, Diadema, Brazil

Variables	All	Dental injury <i>n</i> (%)	<i>P</i> -values	Unadjusted OR (95% CI)	<i>P</i> -values	Adjusted OR (95% CI)	<i>P</i> -values
Sex							
Female*	454	40 (8.8)	0.527 <sup>†</sup>	1.18 (0.75–1.87)	0.527	0.527	0.469
Male	438	44 (10.0)					
Mother's level of education							
Up to 8 years	560	56 (10.0)	0.762 <sup>‡</sup>	–	–	–	–
More than 8 years	332	28 (8.5)					
House ownership							
Rented house*	281	30 (10.7)	0.382 <sup>†</sup>	0.86 (0.53–1.40)	0.382	0.82 (0.51–1.32)	0.547
Private house	611	54 (8.8)					
Anterior open bite							
Yes*	255	37 (14.5)	0.001 <sup>†</sup>	2.19 (1.38–3.49)	0.001 <sup>§</sup>	2.11 (1.33–3.34)	0.001 <sup>§</sup>
No	637	47 (7.4)					
Total	892	84 (9.4)					

\*Reference variable used for comparison.

<sup>†</sup>Chi-square test.

<sup>‡</sup>Fisher's exact test.

<sup>§</sup>Statistically significant.

reduction in this difference, which may reflect a change in girls' behaviour in playing sports traditionally regarded as boys' games, such as ice hockey and soccer (34, 35). In boys, there was a tendency for the more socially supportive school environment to be more protective rather than the effect of any type of physical environment. In girls, this protective tendency was only apparent when school environments were both more socially supportive, and the physical environment more favourable (36).

The prevalence of TDI increased with age. This is due to its cumulative effect. In a Swedish study oral injuries were most frequent during the first 10 years of life, decreasing gradually with age and were very uncommon after the age of 30, whereas non-oral injuries were seen most frequently in adolescents and occurred throughout life (37).

Data from several studies demonstrated that the majority of TDI occur during childhood and adolescence. It is estimated that 71–92% of all TDI sustained in a lifetime occur before the age of 19 years (38, 39). Shulman and Peterson (8) reported a decrease of traumatic tooth injuries after the age of 30. Gassner et al. (40) also reported that 81.2% of all TDI occur before 30 years of age. Of that, almost 50% occur before 10 years of age. The first peak in TDI appears at 2–4 years of age. By the age of 7 years, 28% of the girls and 32% of the boys have suffered a TDI to the primary dentition. In the permanent dentition, a marked increase in the prevalence of TDI is seen in boys aged 8–10 years while the incidence is rather stable for girls. This peak incidence in boys is probably related to the more vigorous play styles of this age group of boys, compared to girls.

The number, location, type and severity of dental injuries per person differ according to their age and the cause of the accident (41). The majority of studies found that trauma to primary teeth usually involved a single tooth, and rarely more than two teeth (25, 3, 42–44). The explanation for the difference in numbers of teeth involved in the traumatic episodes may be the individual characteristics of the children and the varied methodologies of the studies.

There is a consensus that the anterior teeth are the most commonly traumatized. The upper central incisors are generally more proclined than the lower centrals and tend to be the first to receive a direct blow producing a fracture. In addition, the upper jaw is fixed to the skull which makes it rigid, while the lower jaw, being a flexible part, tends to reduce the impact forces directed on the lower anterior teeth by movement (45).

Fractures of crowns involving the enamel only were the most common type of injury in the group studied. This finding corroborates previous researchers (5, 25, 43, 44, 45).

This study also showed that children with an open bite had experienced more dental injuries. According to Nguyen et al. (46) children presenting with an open bite are more prone to trauma and the maxillary incisors are the teeth most frequently involved. The results suggest that in younger children, open bite is an important predisposing factor of injuries to primary incisors.

Increased overjet with protrusion of upper incisors and insufficient lip closure are significant predisposing factors to TDI (7–15). Dental injuries are approximately twice as frequent among children

with protruding incisors as in children with normal occlusion, and the greatest number of injured teeth in the individual subjects is associated with protrusive occlusion. People with inadequate lip coverage are at a threefold greater risk of traumatic injuries to the maxillary incisors, compared to those with adequate lip coverage (2). However, other studies show no significant relation to either incisal overjet or inadequate lip coverage and TDI (23). The conflicting findings may be due to the interaction between size of the overjet and lip coverage.

It is important to emphasize that the skeletal open bite together with the tendency to a negative overbite may be frequently associated with incompetency of the lips, which is an additional potential risk factor for dental trauma (7).

Socio-economic status was not significantly related to the occurrence of TDI in this study. Most of the mothers were from low socio-economic background, which reflects the socio-economic distribution of Brazil. There is little information on the prevalence of injured anterior teeth by socio-economic indicators. The relationship is not clear because very few studies have included socio-economic indicators and there is no agreement among those that have included it (7, 47). Some studies carried out in Brazil showed that there was no relationship between socio-economic backgrounds and dental injuries in permanent teeth (23, 24). Only one study reported an association between socio-economic indicators and TDI in preschool children. The social class, indicated by the father's education, did not show any association with the distribution of trauma (3).

Finally, it is interesting that, in the present study, only six children (7.1%) with dental trauma had their traumatized teeth treated. The results suggest that parents do not present their injured children for treatment. They may not be aware of possible long-term consequences of dental trauma, both in terms of the primary and the permanent dentitions (48).

Epidemiological studies have demonstrated that the treatment needs of TDI are not properly met. This applies to both poor developing countries and rich developed countries. In Britain only 10–15% and in Finland only 25% of children who had sustained a TDI had received treatment. Previous studies in Brazil corroborate that treatment of TDI is often neglected (23, 24). One may argue that these studies did not assess normative treatment need and that most injuries may be too small, therefore they need no treatment. However, it may also be argued that epidemiological studies include only visual assessment and therefore tend to underestimate the need for treatment of TDI. Marcenes and Murray (1) evaluated the need of treatment in

addition to assessing whether the damage was treated or untreated, and showed that not all untreated dental injuries needed treatment because some injuries were minor and some previously treated injuries need treatment. The more accurate estimation of treatment need used in this study confirmed that the treatment of TDI was neglected, as 56% of incisors that sustained damage were assessed as needing treatment but were untreated. Studies using radiographs to assess the treatment provided reported that more than half (59%) were inadequately treated (22). Considerably more efforts and health promotion policies are required to encourage implementation of preventive strategies to reduce the frequency of TDI in preschool children and to avoid its financial consequences.

## Conclusions

The results of this study showed that the prevalence of TDI in primary teeth in Diadema, Brasil, was low (9.4%) compared to other studies. The results also showed that children with anterior open bite experienced more TDI in primary teeth than their counterparts with normal occlusion, and that sex of the child and socio-economic indicators were not significantly associated with TDI.

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