Etiology of Traumatic Dental Injuries in 11 to 13-year-old Schoolchildren

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Purpose: To assess place, activities and human intention related to Traumatic Dental Injuries (TDI) events in 11 to 13-year-old schoolchildren in Biguaçu, Brazil. Also, to test the association between socio-economic status and TDI.

Materials and Methods: A cross-sectional survey (n = 2,260) was carried out. A trained and calibrated dentist collected the data through clinical examinations and interviews. Clinical examination included the type of TDI, the treatment required and provided, the size of incisal overjet and the type of lip coverage.

Results: The response rate was 90.6%. The prevalence of TDI was 10.7%. Boys experienced more TDI than girls, 13.6% and 7.6% respectively ($P < 0.001$). Fathers' and mothers' levels of education were not statistically associated with TDI ($P > 0.05$). Children who had an incisal overjet greater than 5 mm had more dental injuries than those whose incisal overjet was less than 5 mm ($P = 0.003$). There was no association between inadequate lip coverage and TDI ($P > 0.05$). Multiple logistic regression analysis showed that maleness and incisal overjet remained statistically associated with dental injuries, after adjusting for other risk factors. The main activities associated with TDI were physical leisure activities (28.9%), playing with other people (18.2%), collisions (9.1%), and falls (8.3%). Common places where the TDI event occurred were at home (42.6%), in the street (21.5%) and at school (9.5%). 29.2% of TDI were the result of the actions of another person.

Conclusion: The most common TDI events were physical leisure activities, most TDI occurred at home, and the actions of another person were an important factor in relation to the occurrence of TDI.

Key words: causes, child abuse, dental injury, etiology, gender, sex, trauma

Oral Health Prev Dent 2003; 1: 317–323. Submitted for publication: 23.04.03; accepted for publication: 04.09.03.

Traumatic dental injuries (TDI) have a cause and are preventable. However, the belief that TDI are 'accidents' or 'random events' has resulted in this area being neglected within dental public health. The etiology of TDI needs to be further clarified. The great majority of existing published data on the etiology of TDI come from clinic and hospital-based studies. Thus, their results cannot be deduced from the general population (Hennekens and Buring, 1987). In addition, the studies tend to report only on biological predisposing risk factors in situations where a patient experienced a harmful incident rather than the actual causes of dental injuries. These are large incisal overjet (Andreasen and Andreasen, 1994; Nguyen et al, 1999) and inadequate lip coverage (Andreasen and Andreasen, 1994; O'Mullane, 1973). Few valid studies have reported the activities involved at the time when the TDI event occurred. Most were undertaken in a sample with the statistical emphasis on reporting

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the prevalence of TDI, but with very low emphasis on reporting the causes. This is because only a proportion of the sample experienced TDI. Furthermore, the human intention in the occurrence of TDI has rarely been studied.

The relationship between socio-economic status and the occurrence of TDI is not clear. A PubMed medline search identified only a few studies that have included socio-economic indicators in their reports, and the results were conflicting (Hamilton et al, 1997; Marcenes et al, 2000; Cortes et al, 2000; Nicolau, Marcenes and Sheiham, 2001; Perheentupa et al, 2001; Odoi et al, 2002). Further research needs to be carried out to elucidate the etiology of TDI to address the methodological weakness of most studies.

The aim of this study was to assess place, activities and human intention related to the TDI event in a large sample of 11 to 13-year-old schoolchildren in Biguaçu, Brazil. In addition, this study aimed to test whether or not socio-economic status is related to TDI.

MATERIALS AND METHODS

A cross-sectional survey was carried out. The minimum size of the sample was calculated in order to report the prevalence of activities related to TDI events. The 95% confidence level, a standard error of less than 3.5%, and a prevalence for each activity of 50% was used for the calculation. A smaller size of the sample would be required if any other percent was used in the formular. The minimum sample size to satisfy the requirements was estimated to be 204 children. Assuming that the prevalence of TDI would be higher than 10%, a minimum of 2,040 children needed to be screened to identify a minimum of 204 with TDI. Therefore, it was decided to invite all children enrolled at schools in the town of Biguaçu to participate in the study (n = 2,493), which would allow for potential refusers.

All children aged 11, 12 and 13 years old of both sexes attending public and private schools in Biguaçu, Brazil, were invited to participate in the study. Local authorities such as the Health and Education Councils provided the names and addresses of all schools in Biguaçu and the total number of students in each school by age.

Letters were sent to the parents of the children explaining the aim, characteristics and importance of the study, and asking for their participation. Parents who agreed that their children could participate signed a consent form. The researcher (JT) assured parents that no prejudice would be attached to the children who did not participate.

Dental examinations were performed and interviews carried out by a dentist (JT) supported by a secretary and a monitor. Before the commencement of the field work, the examiner, the secretary and the monitor participated in a training exercise which involved 50 children aged 11 to 13 years that attended a public school in a neighboring town, as described elsewhere (Peres et al, 2001).

All the schools were visited twice and the children were examined and interviewed at school during class hours. Dental examinations included only upper and lower incisors and adjacent soft tissues. The examiner (JT) recorded the type of damage sustained, any treatment or treatments needed as a result of TDI, the size of the incisal overjet and whether lip coverage was adequate. The types of damage included treated and untreated crow fractures at all levels, and discoloration, sinus tract and missing teeth resulting from trauma. These criteria are comparable with the ones used in the Children's Dental Health Survey in the UK (O'Brien, 1994). A strict cross-infection control regime was adopted. The examiner used disposable gloves, and examination packs with plane mirrors, CPI periodontal probes and gauze pads were sterilized in sufficient numbers to cover a day's work. Intra-examiner variability was checked by duplicate examination of every tenth child.

Socio-demographic data included sex, age and the parent's level of education in years. Further data was categorized into: greater than and less than eight years, which represents completed and unfinished primary schooling respectively. In addition, all children who had TDI were asked to provide details of the injury event. These details included place and activity performed when the incident happened and the intent.

A pilot study was carried out using a sample of 30 children to test the administration of questionnaires and dental examination procedures. The results confirmed that the protocol was feasible and the questionnaire appropriate for use in respect of the age and culture of the target population.

Data analysis included descriptive statistics (frequency distribution and cross-tabulation). Statistical significance for differences was assessed using the chi-square test. Multivariate logistic regression

Table 1 Frequency distribution of traumatic injuries to permanent incisors in 2,260 schoolchildren by age, sex, parents' levels of education, size of incisal overjet and type of lip coverage in Biguaçu, Brazil, 2001

	Dental injury n (%)	No dental injury n (%)	All n (%)	P value for chi-square test
Age (years)				
11	75 (10.4)	649 (89.6)	724 (32.0)	
12	86 (10.6)	727 (89.4)	813 (36.0)	
13	81 (11.2)	642 (88.8)	723 (32.0)	0.864
Sex				
Boys	159 (13.6)	1,014 (86.4)	1,173 (51.9)	
Girls	83 (7.6)	1,004 (92.4)	1,087 (48.1)	< 0.001
Father's level of education*				
≤ 8 years	118 (10.1)	1,053 (89.9)	1,171 (64.3)	
> 8 years	62 (9.5)	589 (90.5)	651 (35.7)	0.385
Missing information			438	
Mother's level of education*				
≤ 8 years	161 (10.9)	1,316 (89.1)	1.477 (67.6)	
> 8 years	76 (10.7)	632 (89.3)	708 (32.4)	0.485
Missing information			75	
Incisal overjet size				
≤ 5 mm	189 (9.9)	1,724 (90.1)	1,913 (84.6)	
> 5 mm	53 (15.3)	294 (84.7)	347 (15.4)	0.003
Lip coverage				
Adequate	167 (10.0)	1,509 (90.0)	1,676 (74.1)	
Inadequate	75 (12.8)	509 (87.2)	584 (25.9)	0.053
All	242 (10.7)	2,018 (89.3)	2,260 (100.0)	

*Incomplete data set used in the calculation of the chi-square test due to missing information in the variable.

was used to assess the individual contribution of the variables studied. The level of significance was set at 5%. The kappa statistic test was used to verify reliability and it was performed on a tooth-by-tooth basis.

RESULTS

A total of 2,260 out of 2,493 children enrolled in all 28 public and private schools in Biguaçu were examined and interviewed. The response rate was 90.6%. The intra-examiner agreement for the presence of TDI was perfect (Kappa values = 1.0). This was because an experienced examiner carried out the clinical examinations and agreement on recording clinical signs of TDI is easier than for other oral conditions.

Frequency distribution of demographic variables is presented in Table 1. The overall prevalence of TDI was 10.7%. The difference in prevalence between ages was not statistically significant (P = 0.864, Table 1). Boys had more TDI than girls, 13.6% and 7.6% respectively (P = 0.001, Table 1). Children who had an incisal overjet greater than 5 mm had more TDI than those whose incisal overjet was less than 5 mm (P = 0.003, Table 1).

The results of multiple logistic regression analysis (Table 2) confirmed the statistically significantly associations found between TDI and sex (P = 0.001) and size of the incisal overjet (P = 0.009). However, the type of lip coverage was not statistically signifi-

Table 2 Results of multiple logistic regression of sex, mother's level of education, size of the incisal overjet and type of lip coverage on TDI in 2,185 schoolchildren. Biguaçu, Brazil, 2001

Variables	Unadjusted OR (95% C.I.)	P values	Adjusted* OR (95% C.I.)	P values
Sex				
Female	1.00		1.00	
Male	1.90 (1.43 – 2.51)	0.001	1.88 (1.41 – 2.49)	0.001
Mother's level of education				
≤ 8 years	1.00		1.00	
> 8 years	0.98 (0.73 – 1.31)	0.907	0.98 (0.73 – 1.31)	0.892
Incisal overjet size				
≤ 5 mm	1.00		1.00	
> 5 mm	1.67(1.20 – 2.33)	0.002	1.59 (1.12 – 2.24)	0.009
Lip coverage				
Adequate	1.00		1.00	
Inadequate	1.31 (0.97 – 1.75)	0.075	1.47 (0.84 – 1.56)	0.385

* Adjusted for all variables in the model.

cantly in relation to TDI after adjusting for the other variable in the model (P = 0.385). Also, the relationship between TDI and the mother's level of education was not statistically significant (P = 0.892). Adjusted odds ratios showed that boys were 1.88 times (95% CI = 1.41–2.49) more likely to have dental injuries than girls. Also, children with an overjet size greater than 5.0 mm were 1.59 times (95% CI = 1.12–2.24) more likely to present with a dental injury than children with an overjet size equal to or less than 5.0 mm. The base for this data analysis was 2,185 children rather than the 2,260 examined. This was because of missing information in 75 cases on the mother's level of education variable. Multiple logistic regressions were also carried out including the father's as opposed to the mother's educational level in the models. These results were not presented because they were the same as when the mother's level of education was used as an indicator of socio-economic status. Differences in the level of statistical significance observed when qui-square (Table 1) and simple logistic regression (Table 2) tests were carried out were due to missing information in connection with variables leading to different sub-samples in each calculation.

Table 3 shows the place where the injury event occurred. The most common place for the occurrence of a TDI event was at home (42.6%), followed by in the street (21.5%), and at school (9.5%). The activities related to the TDI were physical leisure activities (28.9%), playing with others (18.2%), collisions (9.1%), falls (8.3%), eating (5.8%), inappropriate using of teeth (3.3%), traffic accidents (2.1%), and violent incidents (1.2%). In total 23.1% of children who had dental injuries did not remember how their teeth were damaged (Table 4).

The assessment of intent demonstrated that 18 out of 22 collisions (81.8%) were intentionally caused by another person as well as 6 out of 20 falls (30%). The former represented 7.4% and the latter 2.5% of the total number of TDI. Furthermore, 16.5% were the result of rough playing with others, 1.6% due to mock fighting/wrestling, and 1.2% due to assaults or mugging. Therefore, 29.2% of the total numbers of TDI were the consequences of the actions of another person.

DISCUSSION

This cross-sectional survey adopted a slightly different approach from most previous studies on the causes of TDI by further exploring what happened at the time of the TDI event. It is of interest to note

Table 3 Frequency distribution of places where TDI event occurred in a sample of 242 schoolchildren aged 11 to 13 years who have experienced injuries to the permanent incisors, Biguaçu, Brazil, 2001

	N	%
Home	103	42.6
Inside the house	62	25.6
Outside the house	41	16.9
Street/Road/Pavement	52	21.5
School	23	9.5
Outside the school building (Leisure areas)	15	6.2
Inside the school building	8	3.3
Public leisure areas	5	2.1
Playground equipment areas	2	0.8
Swimming pool areas	2	0.8
Parks	1	0.4
Public buildings	3	1.2
Unknown place	56	23.1
TOTAL	242	100.0

Table 4 Frequency distribution of activities related to the TDI event in a sample of 242 schoolchildren aged 11 to 13 years who have experienced injuries to the permanent incisors, Biguaçu, Brazil, 2001

Activities	N	%
Physical leisure activities	70	28.9
Bicycling	18	7.4
Playing soccer	18	7.4
Running	17	7.0
Jogging	5	2.1
Swimming	3	1.2
Skateboarding	3	1.2
Using playground equipment	2	0.8
Scootering	1	0.4
Rollerskating	1	0.4
Diving	1	0.4
Playing handball	1	0.4
Playing with others	44	18.2
Rough playing	40	16.5
Mock fighting/wrestling	4	1.6
Collisions	22	9.1
Doors/walls	7	2.9
Toys	6	2.5
Furniture	5	2.1
Another person	4	1.6
Falls	20	8.3
From ground level	12	5.0
Running	6	2.5
Down stairs	1	0.4
From furniture	1	0.4
Eating	14	5.8
Inappropriate using teeth	8	3.3
Biting a pen	2	0.8
Opening hair clips	2	0.8
Opening screw top bottles	2	0.8
Opening packets of savory snacks	1	0.4
Opening an umbrella	1	0.4
Traffic accidents	5	2.1
Riding a bike	3	1.2
In a car	1	0.4
Pedestrian	1	0.4
Violent incidents	3	1.2
Assault	2	0.8
Mugging	1	0.4
Cannot remember	56	23.1
TOTAL	242	100,00

that the assessment of intent demonstrated that 29.2% of TDI were due to the action of another person. A fall or collision due to pushing should not be recorded simply as an accidental fall or collision. This is an undesirable injury risk behavior that can be easily covered up if not properly assessed. This is a significant finding as most studies tend to report falls and collisions as the main causes of TDI, thereby covering up the actual injury event.

It was of concern that 23% of the children in the survey reported 'unknown cause'. The majority of these responses may be due to recall bias. However, a proportion of TDI may be related to the intentional action of another person. Often the victim of physical abuse tends to report 'unknown cause' when asked about the injury event. Thus, it is likely that the proportion of TDI as a result of another person's actions may have been underestimated. The extent of this is unknown.

Interestingly, two previous studies carried out in Brazil in Jaragua do Sul and Cianorte demonstrated

that violence accounted for 16.4% of TDI in the former, while only 1.5% of TDI in the latter. What is intriguing is that while only 7.7% of children reported 'unknown cause' in Jaragua do Sul, 40.6% of children reported 'unknown cause' in Cianorte (Marcenes et al, 2000; Nicolau et al, 2001).

Comparison with other studies was difficult, as different protocols have been used. A standardized protocol should be adopted to allow for comparisons. Questions about the reasons for falling, or having a collision, should be asked. Probability samples should be used because they assess the causes of treated and untreated TDI in a randomly selected sample. The size of the sample to report the activities related to dental injuries should be calculated taking into account the expected prevalence of dental injuries to achieve a satisfactory level of accuracy. Most of the previous studies were carried out on dental surgery patients and the size of the sample was calculated to assess the prevalence of dental injuries rather than their causes.

Two previous studies carried out in Brazil using a similar protocol reported that falls and collisions were the most commonly related activities for TDI in Jaragua do Sul (32.8%), and Cianorte (39.1%) respectively (Marcenes et al, 2000; Nicolau et al, 2001). Unfortunately, these studies did not report what caused the falls or collisions. A previous study in Damascus, Syria, using similar methodology showed that violence was the major cause of TDI (Marcenes et al, 1999).

The indicators of socio-economic status used, referred to as the level of education of the father and mother, were not related to the occurrence of TDI. This finding corroborates previous research carried out in South of Brazil (Marcenes et al, 2000; Nicolau et al, 2001) but not one carried out in Southeast of Brazil (Cortes et al, 2000). The latter showed a positive relationship between socio-economic status and TDI. In Bury and Salford, England, the prevalence of TDI in the low socio-economic group was 38% compared with 30% in the middle and upper socio-economic groups (Hamilton, Hill and Holloway, 1997), while a study carried out in a deprived area of London reported a higher prevalence among children from parents with higher levels of schooling (Odoi et al, 2002). These contradictory findings may suggest that the interaction between individual socio-economic status and physical environment may play a role on the occurrence of TDI. Greater ownership of bicycles and access to swimming pools, skateboards and roller skates are associated with children from higher socio-economic background, but if they use these devices in an unsafe environment they may experience more TDI. Thus, the direction of the association, if any, may depend on the balance between these factors. Further research must be carried out to elucidate the relationship pathways between socio-economic status and TDI, and to identify pathways and interactions with other risk factors.

Dental health professionals may significantly contribute to health promotion strategies to reduce injuries due to the TDI activities identified in this study, physical leisure activities and playing with others. Dental health professionals can provide well-fitting mouth guards to children for use when playing sports. Dental health professionals may pressure for legislation to enforce the use of protective devices when engaging in risky physical activities. Health education should focus on increasing awareness of the risk of engaging in physical activities without adequate protection, for example, when rollerblading without protective devices. Health education should also stress the benefits of formal training and improving fitness before engaging in risky physical leisure activities.

The role of violence due to the intentional action of another person was also identified as 29.2% of TDI. This may be related to physical abuse including bullying from peers. Dental health professionals should be able to identify and act against violence. It is important that dental health professionals start to recognize the signs and symptoms of physical abuse, developing office policies and procedures for documenting and reporting suspected cases, and for collaborating with other community members to help prevent violence.

The findings from this study may contribute to elucidate, in part, the etiology of TDI and provide some directions for health professionals and policy makers to help them generate appropriate health promotion strategies based on population data.

ACKNOWLEDGEMENTS

J Traebert is grant assisted by PIQDT-CAPES/BR.

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