Traumatic Dental Injuries in the First Year of Life and Associated Factors in Brazilian Infants

Carlos A. Feldens, MSc Paulo F. Kramer, MSc, PhD Simone G. Vidal, MSc
Italo M. Faraco Junior, MSc, PhD Márcia R. Vítolo, MSc, PhD

ABSTRACT

Purpose: The purpose of this study, was to investigate the incidence of traumatic dental injuries in the first year of life and their associated factors.
Methods: Five hundred children were recruited at the outset of the cohort (at birth); 397 had an initial assessment at 6 months (investigation of demographic, socioeconomic, and environmental variables), and 378 were examined for dental trauma at the 1-year assessment (12-16 months); 122 children were lost in the follow-up, and 2 edentulous children were excluded from analysis.
Results: Approximately 15% of the children (54/376) had dental trauma, with the most common type of injury being enamel fracture. The main reported causes of dental injuries were falls from the same level, furniture, and strollers or walkers. Logistic regression after adjusting for confounding showed that the odds of dental trauma was 2.6 times higher for children whose mothers with higher education compared to those with a lower education level (odds ratio [OR]=2.61; 95% confidence interval [CI]=1.41-4.84). Family structure was associated with dental trauma, with an adjusted model showing higher odds for children from non-nuclear families compared to those from nuclear families (OR=2.28; 95% CI=1.18-4.39).
Conclusions: These results demonstrated a high incidence of dental trauma in the first year of life, improving knowledge for future development of preventive strategies to reduce risk of dental traumatic injuries. (J Dent Child 2008;75:7-13) Received October 12, 2006 | Accepted December 1, 2006.

KEYWORDS: TRAUMA, DENTAL INJURIES, RISK FACTORS, INFANT, FACIAL INJURIES

Traumatic dental injuries in preschool children are a public health problem worldwide because of their prevalence, impact on the quality of life of children and treatment expense. The frequency of injuries in deciduous teeth is high, with epidemiological studies revealing that approximately one third of children are affected.[1-5] Dental trauma, with financial implications for families and society as a whole, may lead to pain, chewing difficulties, speech problems and aesthetic and psychological problems.[5-10] Moreover, injuries to the primary dentition have the potential for affecting the development of the permanent teeth and the developing occlusion, with these sequelae sometimes being severe and extremely difficult and expensive to treat, mainly in the early years.[11-13]

As a public health problem, dental trauma requires the implementation of educational and preventive programs based on a comprehensive understanding of the condition.[8,10,14-16] Unfortunately, few studies have investigated the occurrence of dental trauma in the first year of life, and none of them have evaluated associated factors. Thus, there is insufficient scientific evidence on which to base public health interventions to prevent dental trauma in primary dentition.

This study's aim was to evaluate the prevalence of dental trauma in the first year of life and its association with demographic, socioeconomic, and environmental variables in infants who were born and currently live in São Leopoldo, RG, Brazil.

Drs. Feldens, Kramer, Vidal, and Faraco Junior are professors, all in the Department of Pediatric Dentistry, Lutheran University of Brazil, Canoas, Brazil; Dr. Vitolo is professor of public health, Federal University of Health Sciences of Porto Alegre, Porto Alegre, Brazil.
Correspond with Dr. Feldens at cafeldens@terra.com.br.

METHODS

SUBJECTS AND STUDY DESIGN

This cohort study was based on a randomised trial, which investigated the effectiveness of nutritional advice about breast-feeding and healthy weaning[17] based on World Health Organization recommendations in the city of São Leopoldo, RG, Brazil, which has a population of approximately 200,000. Children were recruited in the maternity clinic of the town's only publicly funded hospital, which mainly serves low-income population.

A sample of 350 1-year-old-children was estimated in the larger study to detect the effect of the intervention during the first year. Then, allowing for confounding and losses of 25% during the follow-up, 500 children were recruited at the trial's outset (at birth). This sample size (N=350) was compatible with the sample size required to estimate the prevalence of traumatic dental injuries in the first year of life (N=341) if the following parameters were adopted: (1) a standard error of 3.0% or less; (2) a confidence level of 95%; and (3) a prevalence of 10%, based on a similar population.[4]

From October 2001 to June 2002, all mothers who gave birth to an apparently normal, single, full-term (≥37 weeks) and normal birth-weight (≥2,500 g) baby and who did not have an impediment to breast-feeding (such as HIV/AIDS) were invited to participate in the larger study; 90% of them agreed to participate after being informed of the research procedures.

RESEARCH ASSESSMENT QUESTIONNAIRES

At 6 months, 16 field workers carried out face-to-face structured interviews with mothers. Demographic, socioeconomic, and environmental variables were investigated, including child's gender, mother's education (in number of years at school), family income per capita, mother's occupational status, family structure, and number of people living in the house. Family structure was considered: (1) nuclear (child living with mother and father); or (2) non-nuclear (child not living with both). Family income per capita was calculated dividing the family's per capita monthly wage by the current Brazilian minimum wage (approximately $100 US).

The questionnaire was tested, and modified accordingly, through a pilot study of 16 mothers of 12-month-old children attending primary care services.

CLINICAL DENTAL EXAMINATION

Visual examination of the erupted teeth, defined as any part of the dental crown appearing on the mucosa, was conducted in the 1-year assessment. Dental examinations were conducted at a municipal health centre São Leopoldo, RG, Brazil, by a pediatric dentist who was blinded to the children's baseline variables. The teeth were inspected under natural light, with the help of a mouth mirror and by having the child lay on a stretcher. Initially, the teeth were brushed and dried with gauze and the mouth was checked for dental caries and traumatic dental injury. Traumatic injuries were recorded, as described by Andreasen.[5] These criteria included crown discoloration, enamel fracture, enamel/dentin fracture with or without pulp exposure, subluxation, lateral luxation, intrusive luxation, and avulsion. If any type of dental injury was detected, mothers were asked by the examiner about how trauma had occurred (possible cause) and the response was registered on the dental record. Since no children were affected at the cohort's outset, the frequency of children presenting dental trauma at the 1-year assessment represented the cumulative incidence, defined as the proportion of a fixed population that becomes diseased in a stated period of time.[18]

Intraexaminer reproducibility was previously assessed in 2 dental examinations conducted 10 days apart in 28 children 10 to 18 months old (K=0.84).

ETHICAL ASPECTS

This study was approved by the Ethical Committee of the Federal University of Rio Grande do Sul, Brazil. The study's procedures, possible discomforts, and possible benefits were explained fully to parents, and their informed consent was obtained prior to the investigation. Children with dental trauma or caries requiring any professional intervention were referred for treatment at the pediatric dental clinic of the Lutheran University of Brazil, Canoas, Brazil At the 1-year assessment, all children had nutritional evaluation (anthropometric measurements, blood haemoglobin measurement) and development examinations. Children with anaemia, overweight, wasting, stunting, or developmental problems were referred to their primary care paediatricians for further assessment and treatment.

STATISTICAL ANALYSIS

Data analysis was carried out using the SPSS for Windows 8.0 software (Statistical Package for the Social Sciences, SPSS Inc, Chicago, Ill). Since this study was based in a randomized trial to evaluate the effectiveness of a nutritional program on other outcomes, incidence of dental trauma at 1 year had to be compared between groups (intervention vs control) to demonstrate the assumed study hypothesis that the intervention had no effect on the odds of dental injuries. The confirmation of this hypothesis would allow that children from the intervention group could be analysed together, increasing the study power. Afterwards, the analysis included simple and multiple logistic regression following a hierarchical approach to determine the factors associated with dental trauma. The variables were grouped in 3 levels representing distal, mediating, and proximate determinants of traumatic dental injuries:

1. The first level included the child demographic variables and maternal educational level.
2. The second level included family income per capita and maternal occupation.
3. The third level represented the immediate social environment of the child including family structure and number of people living in the house.

Stepwise logistic regression analysis was carried out to select the best predictors at each level, with the probabilities being 0.25 to enter and 0.10 for removal from the equation. Selected variables at each level were included in the final model. Since the study hypothesis assumes that the odds of dental trauma in infants increases with the number of erupted teeth, this variable was also included in the final model, independent of its statistical significance. Therefore, the final model estimates odds ratios for the selected variables after adjusting for the variables of the same level or upper selected in the final model and number of erupted teeth.

A 2-tailed *P*-value of less than .05 was used for a result to be considered statistically significant.

RESULTS

Among the 500 children initially recruited, 397 received the 6-month research assessment and oral examinations were carried out on 378 of them at the 1-year assessment. The reason for losses to follow-up were address not found (N=31), refusal (N=22), family moved no another city (N=43), infant given for adoption (N=1), genetic illness in the child (N=2), child death (N=2), severe illness of the mother (N=1), maternal death (N=1), and children who did not attend dental examination (N=19). Two children were excluded from the study because they were edentulous. Of the 376 analysed children:

1. there were 220 boys (59%) and 156 girls (42%);
2. age varied from 12 to 16 months, with 86% of them being examined between 12 and 14 months of age; and
3. the number of teeth varied from 1 to 16 per child (meaN=7.55±3.17 SD).

Approximately 15% (54/376) of the children had dental trauma; 50 of them had only 1 traumatized tooth, and the others (4) had 2 teeth with dental trauma. Thus, there were 58 traumatized teeth. The teeth most frequently affected were, in order, the: (1) maxillary central incisor (88%); (2) mandibular central incisor (9%); and (3) mandibular lateral incisors (3%; Table 1).

Table 1. Distribution of Traumatic Dental Injuries by Teeth and Classification

Teeth/classification	N	(%)
Affected teeth		
61	26	45
51	25	43
71	3	5
81	2	3
82	2	3
Type of injury		
Enamel fracture	47	81
Enamel/dentin fracture	1	2
Subluxation	1	2
Lateral luxation	5	9
Avulsion	1	2
Crown discoloration	1	2
Combined trauma	2	3

Table 1 also shows that the most common types of injury were, in order: (1) enamel fracture (81%); (2) followed by lateral luxation (9%); and (3) the combination of both (3%). Other types of traumatic injuries were: (1) crown discoloration; (2) enamel/dentin fracture; (3) subluxation; and (4) avulsion.

The main reported causes of dental traumatic injuries were, in order:

1. same-level falls while standing up, walking, or running (14/54: 26%);
2. falls from strollers or walkers (6/54: 11%);
3. falls from beds or cribs (5/54: 9%);
4. balance loss while crawling (3/54: 6%); and
5. other causes (5/54: 9%).

The mothers of 21 children (39%) did not know or remember the cause of dental injury.

There was no difference in dental trauma incidence between intervention and control groups (23/157: 15% vs 31/219: 14%), demonstrating no effect on the intervention in the odds of dental injuries (chi-square test: *P*=.893).

Table 2 presents the crude and adjusted odds ratios of dental trauma after multivariate analysis. There was no evidence of difference between gender, age, income per capita, and mother's occupation. The results of stepwise logistic regression selected the mother's education in the first level and the family structure and number of people living in the house in the third level as the best predictors for traumatic dental injuries (*P*<.25). None of the variables of the second level were significantly related to dental trauma (*P*>.25).

The odds of dental trauma were higher when maternal schooling was higher than 8 years compared to 8 years or less. After adjusting, the difference remained significant, with the odds of dental trauma being 2.6 times higher for children whose mothers studied more than 8 years compared to those with lower maternal education. Family structure was associated with dental trauma. Both crude (odds ratio [OR]=2.70; 95% confidence interval [CI]=1.49-4.90) and adjusted (OR=2.28; 95% CI=1.18-4.39) models showed higher odds of traumatic dental injuries for children from non-nuclear families, compared to nuclear families.

The crude model revealed higher odds of dental trauma for children living in houses with 6 people or more compared to 3 people or less. The difference between groups, however, was not significant after adjusting, suggesting a confounding effect of the number of teeth, mother's education, and/or family structure.

DISCUSSION

This study presents the distribution of dental traumatic injuries in the first year of life and also shows factors associated with this outcome. An important aspect of this study's validity is that the numerator data were obtained from a

Table 2. Logistic Regression: Crude and Adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) for the Association Between Independent Variables With Dental Trauma

Variables	N	Trauma N (%)	OR	(95% CI)	*P*-values	OR*	(95% CI)	*P*-values
Level 1: Demographic variables and mother's education								
Sex								
Male	220	33 (15)	1.13	(0.63-2.05)	.675			
Female	156	21 (14)	1.00				#	
Age (mos)								
12-13	241	31 (13)	1.00					
14-16	135	23 (17)	1.39	(0.77-2.50)	.270		#	
Mother's education level (ys)								
≤8	270	30 (11)	1.00			1.00		
>8	103	23 (22)	2.30	(1.26-4.19)	.006	2.61	(1.41-4.84)	.002
Level 2: Income and mother's occupation								
Income percapita (BMW†)								
<0.5	120	18 (15)	1.00					
0.5-1.0	170	23 (14)	0.89	(0.45-1.73)	.723		#	
>1.0	73	13 (18)	1.23	(0.56-2.68)				
Mother's occupation								
Yes	129	22 (17)	1.34	(0.74-2.42)	.328		#	
No	241	32 (13)	1.00					
Level 3: Immediate social environment								
Family structure								
Nuclear	267	28 (11)	1.00			1.00		
Non-nuclear	104	25 (24)	2.70	(1.49-4.90)	.001	2.28	(1.18-4.39)	.013
No. of people living in the house								
≤3	94	10 (11)	1.00			1.00		
4-5	201	27 (13)	1.30	(0.60-2.82)	.500	1.11	(0.49-2.51)	.794
≥6	77	17 (22)	2.38	(1.02-5.56)	.045	2.04	(0.80-5.23)	.135

** Level 1=adjusted for no. of teeth in eruption; level 3=adjusted for no. of teeth in eruption, maternal education, and the other variable of the level.*

† BMW=Brazilian minimum wage.

 # =variables not included in the final model.

cohort which was followed up in the first year of life. Different from data from hospitals and trauma centres, where the trauma register depends on the request for dental or medical assistance, selection bias in this study is unlikely to be a problem. Minor traumas are largely missed in data from trauma services, especially enamel and enamel/dentin fractures. On the other hand, some information bias is likely to have occurred, since signs and/or symptoms of minor luxations or subluxations may not be evident weeks or months after the injury. The effect of this bias is not expected to be large, since the period between possible injuries and dental examination was short.

This study's main result was the fairly high incidence of dental trauma in the first year of life. Cross-sectional studies have demonstrated a higher prevalence (>25%) among 3- to 5-year-old preschool children,[2,3,19] but this fact does not mean that they are more vulnerable. The cumulative measurement of dental trauma indicates that a significant number of injuries registered at 3 years of age or later may have occurred at younger ages. The first 3 years of life have been identified

as unique in terms of rapid growth and development changes, influencing the risk for general injuries.[20] An analysis of 23,173 injury hospitalizations or deaths from US children revealed that 1-year-old or younger children had the highest injury rates before age 15 years. In that population, the injuries began at age 3 to 5 months and increased rapidly with increased age, peaking at 15 to 17 months.[20] This study's findings are in line with these data and suggest the need for strategies to prevent traumatic events in the first year of life.

The finding that crown fractures were the most common type of trauma is also in line with previous studies in the primary dentition,[3,4,21,22] but differed from others,[19,23,24] which found a higher proportion of luxation injuries. The possible explanation for this fact is the subregister of enamel and enamel/dentin fractures in studies conducted in hospitals and clinics. In these situations, numerator data are obtained from a trauma registry, which contains only data on patients who had significant injuries.[25]

The most common mechanisms of dental injury in this population were falls from the same level, furniture, and strollers/walkers. This finding is not surprising and corroborates other studies which investigated general injuries at the same age group.[20,26] Since a high proportion of injuries to infants is associated with falls and because even low-level falls may lead to serious head and abdominal injuries,[26,27] fall preventing counselling should be considered as a priority in health promotion programs targeted to parents and/or caregivers. The orientation needs to account for the various motor developmental stages during the first year of life, including the process of learning to walk and exploring the surrounding environment at the age of 10 to 12 months.[20]

The present study demonstrated higher odds of dental trauma in children from non-nuclear families. Some investigations have identified this category as a risk factor for dental trauma[28], injuries to the face[29,30], femur fracture[25] or even unintentional death.[31,32] This finding may be explained, at least in part, by the more effective visual supervision, auditing supervision, and physical proximity among nuclear families and fact that children from non-nuclear families are more prone to neglect.[25,28,29]

The physical proximity has been related as an aspect of supervision behaviour that serves a protective function,[33,34] with parents who remained close to their children having children with decreased risk taking. Moreover, parents who showed more engagement with their child (a variable related to physical proximity) had children with fewer injuries.[33] A recent study with 405 cases of accidental injury in infants younger than 1 year in Singapore showed that parents were the caregivers at the time of injury in 76% of the cases.[26] Nevertheless 41% of injuries occurred when infants were left alone and the event resulting in injury was not witnessed. This finding confirms the importance of physical proximity to avoid accidents at this age group.

The higher odds of dental trauma observed in children from mothers with a higher education level should be analysed with caution. Maternal education level is a widely used indicator of socioeconomic status (**SES**). Previous studies in developed countries[29,35] have demonstrated that children from a lower SES present higher rates of dental injuries. Investigations in developing countries,[36,37] however, have shown a reverse association (in line with this study's findings) with children from a higher SES presenting higher odds of dental trauma. The higher risk of dental injuries among higher SES adolescents in developing countries may be associated with greater access to bicycles, skateboards, swimming pools, and other risk conditions in unsafe environments.[36] The role of maternal education on dental trauma among younger children (as in this study's sample) is even more difficult to explain. It is possible that mothers with higher education levels are more involved in other activities than caring for their children, determining less physical proximity. This study's results, however, cannot help explain how a mother's education affects the occurrence of dental trauma.

This study's findings suggest the implementation of programs commencing in the first year of age to educate parents and caregivers on supervising infants and providing home safety to prevent falls, particularly those from non-nuclear families and mothers with high education levels. Moreover, these results reinforce the need for preschool- and community-based programs to improve safety in the first years, including anticipation of risks, limitation of access to hazards, and protection from heights.[25,34,28] Any educational program designed to prevent injuries should recognize risky environments and behaviors and the understanding of accidents as something that can be avoided. Some specific messages for the prevention of traumatic injuries in the first year have been suggested, such as the use of stair gates and the elimination of infant walkers.[20,39]

It is possible that some of the traumatic dental injuries diagnosed in this study may have occurred because of neglect or abuse. It is recognized that head, face, and dental injuries are related to child abuse and neglecting,[40] with family environment being related to the occurrence of dental injuries through physical abuse.[28] Health professionals should be aware of this possibility and collaborate to increase the prevention and detection of these conditions.[40]

In an economic perspective, safety interventions cost less than the medical/dental or other resources they save.[6,8,9] It is possible that benefits obtained by health promotion behaviours and practices in the first year of life are maintained in the following years, with a positive effect on oral health up to school age.

Further research is needed to explore the association between dental trauma in the first year of life and other covariates not measured in this study, such as lip coverage and overjet and clarify the association of socioeconomic status and dental trauma in this population.

Also, research is required to evaluate the effectiveness of community-based injury prevention programs. Although these programs have become a broadly accepted strategy among safety promotion specialists, there is still a lack of

consensus concerning the real effect of this approach.[14,41,42] This could help the development of more cost-effective programs to prevent dental and general trauma.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

1. The incidence of traumatic dental injuries in the first year of life is high, indicating the need for preventive programs to educate parents and caregivers on supervising infants and providing home safety.
2. Any educational program designed to prevent injuries in the first year of life should include orientation to prevent falls, the main cause of injuries identified in this study.
3. Children from non-nuclear families and from mothers with a high education level are at a higher risk of traumatic dental injuries in this population, suggesting directions for future preventive strategies.

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