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Influence of clinical and socioeconomic indicators on dental trauma in preschool children

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Abstract: The aim of the present study was to determine the prevalence of traumatic dental injury (TDI) in the primary dentition and investigate associations with clinical and socioeconomic indicators. A population-based, cross-sectional study was carried out with a randomly selected sample of 301 children aged one to five years. Data were collected through clinical oral examinations and interviews with parents/guardians during immunization campaigns. Statistical analysis involved Pearson's Chi-squared test and Poisson regression with robust variance. The prevalence of TDI was 33.9%. TDI was more prevalent in children with overjet > 3 mm ($p < 0.001$) and those with inadequate lip coverage ($p < 0.001$). A statistically significant association was also found between TDI and household income ($p = 0.024$). According to the adjusted Poisson regression model, greater prevalence rates of TDI were found for children from families with a monthly income ≥ twice the Brazilian minimum monthly wage (PR: 1.52; 95%CI: 1.10-2.12), those with accentuated overjet (PR: 1.53; 95%CI: 1.05-2.22) and those with inadequate lip coverage (PR: 2.00; 95%CI: 1.41-2.84). The prevalence of TDI was high in the present study and was associated with a higher family income, accentuated overjet and inadequate lip coverage.

Descriptors: Tooth Injuries; Child, Preschool; Socioeconomic Factors.

Introduction

Traumatic dental injury (TDI) in the primary dentition is a public health problem, because of its high prevalence rates, treatment costs and long-term consequences.[1] TDI can also have a negative impact on quality of life,[2,3] with physical, esthetic and psychological repercussions that can affect both the child and the parents.[4]

The occurrence of TDI in the primary dentition has been associated with accentuated overjet and inadequate lip coverage,[5,6,7,8] as well as behavioral characteristics, such as hyperactivity.[9] Studies have also investigated associations with socioeconomic indicators, but have reported divergent results.[5,10,11] Studies addressing the influence of socioeconomic indicators on the occurrence of TDI have mainly involved the permanent dentition.[12] In the primary dentition, studies have investigated the association between TDI and proxy measures of socioeconomic status. While some investigations have found that household income[13] and a mother's education level[7,14,15] exert an influence on the occurrence of TDI in preschoolers, others have not found such associations (Table 1).[1,5,6,11,12,13,14,15,16,17,18,19,20]

Table 1. Studies on associations between TDI in deciduous teeth and characteristics of child, socioeconomic indicators and clinical factors.

Author	Year	Country	Sample	Age	Socioeconomic indicators	Significant association
Oliveira *et al*.[5]	2007	Brazil	892	5-59 months	Mother's schooling and house ownership	No
Feldens *et al*.[14]	2008	Brazil	500	6-16 months	Mother's schooling, household income per capita, mother's occupational status, family structure, and number of residents in the home	Yes (mother's schooling, family structure)
de Vasconcelos Cunha Bonini *et al*.[12]	2009	Brazil	778	5-59 months	Schooling, income, employment status, house ownership, having moved to different address in previous year, and overcrowding	No
Ferreira *et al*.[13]	2009	Brazil	3,489	3-59 months	Household income	Yes (household income)
Jorge *et al*.[7]	2009	Brazil	519	1-3 years	Social Vulnerability Index (SVI) and mother's schooling	Yes (SVI and mother's schooling)
Robson *et al*.[6]	2009	Brazil	419	0-5 years	Economic criteria of Brazilian Advertisers' Association	No
Feldens *et al*.[15]	2010	Brazil	888	3-5 years	Mother's schooling and household income	Yes (mother's schooling)
Wendt *et al*.[1]	2010	Brazil	645	12-71 months	Mother's schooling and household income	No
Viegas *et al*.[17]	2010	Brazil	388	60-71 months	Social Vulnerability Index (SVI), household income, number of residents in home and parents'/caregivers' schooling	No
Dutra *et al*.[18]	2010	Brazil	407	1-4 years	Schooling of heads of family, monthly household income based on Brazilian minimum wage and economic class of family, and number of siblings	Yes (number of siblings)
Tümen *et al*.[16]	2011	Turkey	727	2-5 years	Parents' schooling and household income	No
Piovesan *et al*.[11]	2012	Brazil	441	12-59 months	Parents' schooling and household income	No
Goettems *et al*.[19]	2012	Brazil	501	24-71 months	Mother's schooling and household income	No
Carvalho *et al*.[20]	2012	Brazil	305	2-5 years	Family's socioeconomic conditions (number of siblings, mother's schooling, father's schooling, mother works outside home, father works outside home, and household income)	No

The divergent results in the literature may be explained by the use of different indices and variables in the categorization of socioeconomic indicators, thus hindering comparison of the findings. Parents' schooling was evaluated based on the education level of both parents in some studies[11,12] and the education level of the mother alone in others.[1,5,7,14] Socioeconomic status has been evaluated based on household income[1,11,12,13,14,15,16] or on different validated indices.[6,7,15] The lack of a consensus regarding the influence of socioeconomic indicators on the occurrence of TDI underscores the need for further studies that can test this association to allow susceptible children to be identified and preventive measures to be established.

The aims of the present study were to determine the prevalence of TDI in the primary dentition and investigate the influence of clinical and socioeconomic indicators.

Methodology

A cross-sectional study was conducted with preschoolers treated during immunization campaigns in the city of Diamantina, which is located in southeastern Brazil. The study population comprised 301 children aged 1 to 5 years. The exclusion criteria were primary teeth with extensive carious lesions that rendered the diagnosis of TDI impossible, as well as the absence of one or more incisors caused by caries.

The sample size was calculated considering a 5% margin of error, a 95% confidence level (CI) and a 21.0% prevalence rate of TDI.[21] The minimum sample size was estimated at 247 preschoolers, to which 20% was added to compensate for possible losses, giving a total sample of 297 preschoolers. Randomization was performed using systematic sampling. Accordingly, the children were arranged in a line, with the first

child examined, the second not examined, the third child examined, and so on.

The fieldwork team was composed of ten dentists and their assistants. One team made up of three researchers (an examiner and two assistants) was installed at each of the ten basic healthcare units. Data were collected through clinical oral examinations and structured interviews administered to parents/caregivers.

A questionnaire provided information on sex, age, history of TDI, mother's schooling (categorized as ≤ 8 years and > 8 years), monthly household income (categorized as ≤ 2 times and > 2 times the Brazilian minimum wage) and number of children in the family. A question was also posed to parents/caregivers regarding where or with whom the child spent most of his/her time, in order to determine the main caregiver: mother, other family member or daycare center.

The children were examined in a reserved room at the different healthcare units, seated in a chair in front of the examiner, under natural light. The upper and lower incisors were cleaned and dried with gauze prior to the clinical exam. TDI was diagnosed based the criteria proposed by Andreasen *et al.*,[22] and was classified as enamel fracture and enamel/dentin fracture with or without pulp exposure. Root fractures and alveolar fractures were not recorded, because radiography could not be used due to operational limitations.

Overjet was measured using a millimeter periodontal probe positioned parallel to the occlusal plane, and was considered accentuated when surpassing 3 mm. Lip coverage was evaluated without the child knowing that he/she was being observed. Adequate lip coverage was recorded when the upper lip completely covered the maxillary incisors at rest. Inadequate lip coverage was recorded when part of the dental crown remained visible.

The training and calibration exercise consisted of two stages. The theoretical stage involved a discussion of the criteria proposed by Andreasen *et al*.[22] and an analysis of photographs. A specialist in pediatric dentistry was the gold standard in the theoretical framework and coordinated this step, instructing ten general dentists on how to perform the examination. The analysis of photographs was performed on two separate occasions with a one-week interval between sessions. Data analysis involved the calculation of Kappa coefficients (K = 0.80 to 0.81 for both interexaminer and intraexaminer agreement).

This study received the approval of the Human Research Ethics Committee of the *Universidade Federal dos* Vales do Jequitinhonha e Mucuri (Process no. 181/10). The participants' rights were protected and parents signed a statement of informed consent prior their participation. Children with dental problems were referred to the pediatric dental clinical of the University for free treatment.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, version 19.0, SPSS Inc., Chicago, USA). Associations between TDI and the independent variables were tested using the Chi-squared test. Poisson regression analysis with robust variance was performed for the analysis of factors associated with TDI. The magnitude of each association was assessed using unadjusted and adjusted prevalence ratios (PR), respective 95% confidence intervals (CI) and *p*-values (Wald test). Explanatory variables with a *p*-value of < 0.20 in the bivariate analysis were incorporated into the model.

Results

A total of 301 children were examined. Mean age was 43.8 months (SD = 13.3); 51.8% (n = 156) were boys and 53.5% spent most of the day at a daycare center (main caregiver). The majority of mothers had > 8 years of schooling (59.5%) and had two children (65.4%). Monthly household income was < twice the minimum Brazilian wage in 82.4% of the families.

The prevalence of TDI was 33.9% and crown fracture was the most common type (32.6%). The teeth most affected by TDI were the left upper central incisor (15.0%), followed by the right upper central incisor (14.3%). Most parents/guardians (79.4%) of children with clinically diagnosed TDI were unaware of the presence of tooth fractures in the children. TDI was significantly associated with lip coverage ($p < 0.001$), overjet ($p < 0.001$) and monthly household income ($p = 0.024$) (Table 2).

In the adjusted multivariate regression, accentuated overjet (PR: 1.53; 95%CI: 1.05-2.22), inadequate lip coverage (PR: 2.00; 95%CI: 1.41-2.84) and monthly

Table 2. Distribution of TDI according to characteristics of the child, socioeconomic indicators and clinical variables.

	TDI		*p*-value*
	No n (%)	Yes n (%)	
Sex			0.082[1]
Male	96 (61.5)	60 (38.5)	
Female	103 (71.0)	42 (29.0)	
Age (years)			0.562[2]
1	14 (70.0)	6 (30.0)	
2	45 (67.2)	22 (32.8)	
3	52 (70.3)	22 (29.7)	
4	62 (60.2)	41 (39.8)	
5	26 (70.3)	11 (29.7)	
Main caregiver			0.064[1]
Mother	55 (61.8)	34 (38.2)	
Daycare center	117 (72.7)	44 (27.3)	
Other family member	25 (56.8)	19 (43.2)	
Lip coverage			< 0.001[1]
Adequate	192 (71.1)	78 (28.9)	
Inadequate	7 (22.6)	24 (77.4)	
Overjet			< 0.001[1]
≤ 3 mm	176 (71.8)	69 (28.2)	
> 3 mm	23 (41.1)	33 (58.9)	
Mother's schooling			0.150[1]
≤ 8 years	84 (71.2)	34 (28.8)	
> 8 years	113 (63.1)	66 (36.9)	
Household income			0.024[1]
< 2 times minimum wage	171 (69.0)	77 (31.0)	
≥ 2 times minimum wage	25 (52.1)	23 (47.9)	
Number of children			0.244[1]
1 or 2	128 (65.0)	69 (35.0)	
> 2	71 (71.7)	28 (28.3)	

*[1]Pearson's Chi-squared test; [2]Linear trend Chi-squared test – $p < 0.05$

household income ≥ twice the Brazilian minimum wage (PR: 1.52; 95%CI: 1.10-2.12) remained associated with a greater frequency of TDI, regardless of sex, main caregiver, mother's schooling, and number of children (Table 3).

Discussion

A high prevalence rate of TDI was found. This finding is in agreement with data reported in previous studies.[3,4,21] This data becomes more important when considering that TDI can occur in an isolated fashion or may be associated with multisystem injuries and traumatic brain injury. Trauma is the leading cause of morbidity and mortality in children. Thus, pediatric dentistry should identify and refer for medical evaluation pediatric patients with neurologic signs and symptoms following trauma to the maxillofacial region.[23] Child abuse is another factor contributing to the high frequency of TDI, since approximately 65% of cases of abuse involve injuries to the head and neck region, with the possible occurrence of fractured, dislocated or avulsed teeth. In such cases, pediatric dentists should report their suspicions of child abuse to the proper authorities.[24]

In this study, the mother's schooling, the number of children in the family and the monthly household income were used as socioeconomic indicators, and a greater TDI prevalence rate was found among children from families with a higher income. A similar finding is described in another study involving Brazilian children under five years of age,[13] whose family income was categorized according to

Table 3. Prevalence ratios and confidence intervals for associations between TDI and independent variables.

Variable	PR (unadjusted)	95%CI	*p*-value	PR (adjusted)	95%CI	*p*-value
Lip coverage						< 0.001
Adequate	-	-		-	-	
Inadequate	2.68	2.05-3.49	< 0.001	2.00	1.41-2.84	
Overjet						0.024
≤ 3 mm	-	-		-	-	
> 3 mm	2.09	1.55-2.81	< 0.001	1.53	1.05-2.22	
Household income						0.011
< 2 times minimum wage	-	-		-	-	
≥ 2 times minimum wage	1.54	1.08-2.18	0.015	1.52	1.10-2.12	

monthly minimum wage in the country, as was the case of the present investigation. However, other studies have found no association between TDI and monthly household income, as confirmed in multivariate analyses.[11,12,14,15,16] Multivariate analysis allows evaluating interactions among variables, which is an important aspect when studying conditions with multifactor etiology, such as TDI. Comparisons among studies must be done cautiously because of methodological differences.[25] In this study, monthly household income was evaluated using a cutoff point of two times the Brazilian monthly minimum wage, whereas other studies used different cutoff points, such as three times the Brazilian minimum wage,[16] representative values of the minimum wage in other countries,[18] or specific indicators, such the Social Vulnerability Index, which was designed for the city of Belo Horizonte.[7]

A mother's schooling exerted no influence on the occurrence of TDI. This finding is in agreement with data described in previous studies,[1,5,11,12] but differs from findings described in cross-sectional and longitudinal investigations carried out on Brazilian children, in which TDI was associated with a higher level of a mother's schooling in some studies,[14,15] and a lower level of a mother's schooling in others.[7] These differences may be attributed to how this variable is categorized. In this study, a mother's schooling was dichotomized into two categories using eight years of study as the cutoff point,[11,14,15,16] whereas other studies have categorized a mother's schooling as elementary education, high school education or university education.[12] Moreover, one of the studies cited had a longitudinal design with follow-up beginning in the first year of the children's lives,[14] an aspect that limits comparisons with the present findings.

One must also take into account the influence of the surrounding environment and the activities in which children participate, when analyzing the association between TDI and socioeconomic indicators. Children who play contact sports, play in the street with friends and play games involving a ball are more prone to collisions and falls that can lead to TDI. Conversely, children who spend most of their time at home and use electronic devices, such as tablets and video games, are less susceptible to such accidents. The practice of physical activities is related to socioeconomic status. Children from low-income families often participate in activities with greater physical contact and are more exposed to urban violence, whereas children with a higher socioeconomic status are more accustomed to using electronic devices. These aspects suggest that the activities of children, as well as the environment in which these activities are carried out, constitute additional information which should be incorporated in evaluating the association between socioeconomic status and TDI.

TDI was associated with inadequate lip coverage, insofar as the majority of children with inadequate lip coverage had at least one fractured tooth. This variable is recognized in the literature as associated with TDI in both the primary dentition[6,11] and the permanent dentition,[26] since the absence of lip seal exposes the incisors, making these teeth more prone to fracturing during an impact. Thus, the adoption of preventive measures is recommended, such as the use of protective equipment during the practice of sports and recreational activities. Moreover, identification of children with inadequate lip coverage may allow other problems to be diagnosed, such as mouth breathing, insofar as a partially open mouth and consequent absence of lip seal is one of the characteristics of this breathing pattern.[27]

Children with accentuated overjet had a greater frequency of TDI. [16,26] However, caution should be exercised when comparing investigations that address the influence of overjet, because different cutoff points are employed. Whereas some researchers consider accentuated overjet to be > 3 mm,[11,28] others use > 5 mm as the cutoff point.[16]

This study has limitations, such as the use of different criteria to diagnose TDI and evaluate socioeconomic indicators, as well as the absence of radiographic examinations. Moreover, some cases of TDI may have been missed, because of lack of recall on the part of parents, or because diagnosis of certain types of TDI may require more than just a clinical examination. Since the cross-sectional design does not allow establishing a temporal relationship between TDI and independent variables, longitudinal studies are needed to assess the causal relationship between

socioeconomic indicators and TDI. Furthermore, investigation into the circumstances leading to TDI is also important in establishing prevention strategies and in minimizing possible harm stemming from such injuries.

Measures aimed at changing the attitudes and behavior of parents/guardians and children are urged. Thus, informative campaigns, such as television ads, newspaper articles, distribution of pamphlets and web-based strategies, could be useful in the prevention of dental trauma.

Conclusion

The prevalence of TDI was high and was associated with a higher family income, accentuated overjet and inadequate lip coverage.

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