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Traumatic dental injuries in 6 to 12 years old schoolchildren: a multicenter cross-sectional study in Mexico

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Abstract: The aim of this study was to determine the prevalence of dental trauma in schoolchildren 6 to 12 years of age and associated clinical, sociodemographic, and socioeconomic variables. A cross-sectional study was conducted in 477 children from public elementary schools in four locations in Mexico. The dependent variable was dental trauma, which was dichotomized in 0 = without dental trauma and 1 = with dental trauma. For the statistical analysis, a multivariate binary logistic regression model was generated in Stata. Average age was 9.06±1.94 years and 51.1% were girls. The prevalence of dental trauma was 18.2%. Falls, automobile accidents and sports had the highest number of instances ($p < 0.01$). In the multivariate model, it was observed that the risk of dental trauma increased with age (OR = 1.28) and among boys (OR = 1.45). Schoolchildren with decreased overjet (OR = 0.38) had lower dental trauma. Father's age (OR = 1.03) and educational level (OR = 1.78) were associated with dental trauma. Schoolchildren without health insurance (OR = 0.62) presented dental trauma less often. This study provided important information regarding the association of different sociodemographic, socioeconomic and clinical variables with dental trauma in Mexican schoolchildren. Identifying factors associated with dental trauma may support health promotion opportunities to ameliorate the prevalence of dental trauma.

Keywords: Oral Health; Dentition, Permanent; Epidemiology.

Introduction

Dental caries and periodontal diseases continue to be the main oral health problems in both Mexico and worldwide.[1,2] Globally, there were 3.5 billion cases of oral conditions in 2017. This finding suggests oral health still needs to improve so that oral conditions stop being a major challenge for healthcare systems around the world.[1] Although traumatic dental injuries (TDI) research started decades ago, in recent years this problem has gained importance in oral public health, probably due to its frequency, its likely occurrence at early ages, and the fact that in some cases the treatment needs last for a long time. TDIs are lesions of the hard and soft tissues in and around the oral cavity, including teeth, gums, and alveolar bone.[5] TDI is

associated with pain, bleeding, tooth mobility, tooth loss, low self-esteem, and post-traumatic stress/anxiety. Untreated, TDI can be followed by pulp necrosis and infection, tooth discoloration, abscess, poor aesthetics, peri-radicular inflammation, and even psychological problems.[3] TDI occupies considerable clinical care in emergency clinics and hospitals, compared to other accidental injuries. Direct (clinical treatment) and indirect costs (*e.g.*, lost productivity and wages, transportation, and quality of life) are high.[4] Therefore, consequences of TDI are not only physical or economic but also involve a non-quantifiable psychosocial burden for the individual.[4]

During the last several decades, authors have reported different prevalence figures using diverse methodologies: between 6% and 59%.[4,6] TDIs currently have a high prevalence in young people: they are more frequent during the first 10 years of life, gradually decrease with age, and are very rare after 30 years of age. Its prevalence in children and adolescents in primary dentition is around 30% and in permanent dentition approximately 20%.[6] In a literature review[7] one third of all children suffered TDI in primary dentition, while for the permanent dentition one quarter of all schoolchildren and one third of adults had TDI. Worldwide TDI frequency in the primary dentition was 22.7% and in the permanent dentition,15.2%; among 12-year-olds, it was 18.1%, with an incidence rate of 2.82 per 100 person-years.[8]

TDI etiology includes a wide spectrum of variables. Oral factors (e.g., increased overjet, inadequate lip coverage, anterior open bite, protrusion of upper incisors, caries in permanent dentition, tongue piercing), environmental determinants (e.g., socioeconomic disadvantage), and human behavior (*e.g.*, risk-taking children, bullied children, emotionally stressful conditions, excess weight and obesity, and attention deficit hyperactivity disorder, use of alcoholic beverages and participation in sports) are associated with risk increase for dental trauma.[7,9] Other risk factors for TDI are presence of co-morbidities, learning disabilities, physical disabilities, and inappropriate use of teeth (e.g., including removing metal caps from soda bottles with teeth).[7] Sociodemographic, clinical and environmental factors are associated with a greater chance of TDI occurrence.[9] In general, boys suffer TDI more frequently than girls. TDI has been associated with multiple other factors – sometimes affected by contradictory findings – such as belonging to lower social strata or having higher income.[7,9-11] Epidemiological studies in Mexico in the TDI domain are almost non-existent. The objective of the present descriptive study was to determine the prevalence of TDI and outline relevant clinical, sociodemographic, and socioeconomic risk indicators in Mexican schoolchildren 6 to 12 years of age.

Methodology

Design, population and sample

A cross-sectional study was carried out in children from public elementary schools in four Mexican cities: Pachuca, San Luís Potosí, Tepatitlán, and Toluca. Data collection was carried out during 2019: dental caries treatment estimates have been previously published.[12] The inclusion criteria consisted of several parameters: either boy and girl students, six to 12 years old, enrolled in one of the selected schools, with any permanent teeth completely erupted. Exclusion criteria were: children with only primary dentition, those who had a congenital defect that could affect dentition, and children did not assent to the clinical examination. Mother or guardian signed the consent to participate in the study and filled out the questionnaire. A cluster and stratified sampling were performed. Cities had different number of schools. Schools were selected according to a probability proportional to the number of students. The number of schools per stratum was proportional to the total students in the stratum, subject to the condition of visiting at least two schools per city. The following formula was used to determine sample size in schools:

Estimate of proportions:

$$n = Z^2 \frac{p\,(1-p)}{d^2 k}\,(1 + \rho\,(k-1))$$

where p was the proportion of children with at least one decayed tooth (NB note the present analysis is part of a larger project in which various oral health indicators were measured),[12] d the half-width of the confidence interval, ρ the intra-conglomerate correlation coefficient, k the number of students per school and Z=1.96 the quantile 97.5% of a standard normal distribution, the value of p was 60%, leading to a final selection of 500 students. The participation rate was different in each city, and ranged from 76 to 95%. Some schoolchildren (46) were excluded because their parents / guardians did not sign authorization for the study or children did not assent to clinical examination; 23 were removed because they had no permanent teeth. After inclusion and exclusion criteria, 477 schoolchildren were finally included in the study.

Data collection and variables

Data were standardized through training and a manual created to ensure all sites (where data collection took place) followed a stringent protocol. The selected children were given a form on which parental consent was requested for the child to be included in the study, together with a questionnaire to collect sociodemographic and socioeconomic data. For the oral clinical examination, the participants were evaluated in a supine position with natural light; the examiner used disposable gloves, facemask, a flat dental mirror, and a WHO periodontal probe. A training exercise was carried out on 10 separate subjects in each city; and were analyzed with the intraclass correlation coefficient (for overjet in this analysis).

TDI criteria recommended by O'Brien were used.[13] O'Brien's classification includes 6 categories: 1. dislocation, 2. dyschromia due to trauma, 3. enamel fracture, 4. enamel and dentin fracture, 5. enamel, dentin and pulp lesions and 6. missing tooth due to avulsion. This classification is useful for large samples and no radiographic imaging is needed. The dependent variable was dichotomized as 0 = without TDI and 1 = with TDI. The independent variables were age, sex, lip coverage, overjet, mother and father's age, and diverse socioeconomic position indicators (automobile at home,[14,15] health insurance, socioeconomic status [SES], and education level of mother and father). In addition, the reasons for TDI (automobile accident, recreational activity, fall, sports, misuse of the teeth [such as onychophagy, removing bottle caps with teeth, biting pencil or pen], violence, and 'does not remember') were collected from caregiver, as well as consequences of TDI.

An indicator of socioeconomic status (based on the ownership of household appliances) was created[14,15] using a principal component analysis approach, specifically polychoric correlation analysis.[16] Tertiles were calculated for this variable, in which the first tertile represented the group with the lowest SES and the last tertile the group with the highest SES.

Statistical analysis

In the univariate analysis measures of central tendency and dispersion were calculated for quantitative variables. Frequencies and percentages were calculated for qualitative variables. Chi-square, Mann–Whitney, and Fisher's exact tests were used in the bivariate analysis.

Binary logistic regression model was used in multivariate analysis. The strength of association between dependent and independent variables was expressed as odds ratio (OR) with 95% confidence intervals (CI). The variance inflation factor test was performed in order to analyze, and where appropriate, avoid multicollinearity between independent variables. To fit the model, variables that in bivariate analysis showed a value of $p < 0.25$ were taken into account.[17] The global fit of the model was performed with goodness-of-fit test. In the multivariate model, confidence intervals with robust standard Huber–White errors were calculated to obtain valid estimates, given correlation by groups (cluster on the city variable).[18] This calculation was done because schoolchildren in a given city could be more similar to each other, and therefore be more strongly correlated within them than between those from other cities. Statistical analyses were performed with the Stata program.

Ethical considerations

This project was approved by the Research Ethics Committee of the Health Sciences Institute at Autonomous University of the State of Hidalgo (CEEI 000019-2019). It complies with requirements for health research laws in place in Mexico, and with Helsinki regulations. A parent or guardian signed a written informed consent after reading study stipulations, after having their questions addressed as needed, and given opportunity to obtain information about the study and child's participation.

Results

Of the 477 children included in the final study sample, 51.1% were girls. Average age was 9.06 ± 0.94 years. Other sociodemographic and socioeconomic variables are in Table 1. TDI prevalence was 18.2% (n=87); 79.9% of children had adequate lip coverage, 20.4% presented a decreased overjet, and 34.3% an increased overjet (Table 1). Most of the schoolchildren had TDI due to recreational activity (34.5%), followed by sports-related injuries (31.0%), and misusing teeth (19.6%). Other reasons for TDI can be seen in Table 2. Table 3 shows causes and consequences of TDI, falls, automobile accidents, and sports as well as causes of TDI with the highest percentage of instances ($p < 0.01$).

Table 2 shows the bivariate analysis between dental trauma and independent variables. Age was older ($p < 0.0001$) among children with TDI than those without. TDI prevalence was higher ($p < 0.01$) among those with no overjet than among those with decreased and increased overjet. Ages of mother ($p < 0.05$) and father ($p < 0.01$) were higher among children with TDI. Father's schooling level ($p < 0.05$) also showed statistically significant differences between children who had and did not have TDI. At this level of analysis, significant differences were not observed in TDI by sex, lip coverage, car ownership in the home, mother's education level, health insurance, neither socioeconomic status.

Multivariate model

Table 4 presents the multivariate binary logistic regression model for TDI: for each year of age, the likelihood of TDI increased 28%. Boys were more likely to have had TDI (OR = 1.45; 95% CI:1.10–1.91) than girls. Schoolchildren with decreased (OR = 0.38; 95% CI:0.32–0.44) and increased overjet (OR = 0.59; 95% CI: 0.28–1.27) had lower risk of TDI than those with no overjet. For each year increase in father's age (OR = 1.03; 95% CI: 1.01–1.06) the probability of having a TDI event increased. Schoolchildren whose parents attained schooling beyond high school were 78% (OR=1.78; 95% CI:1.06–3.00) more likely to have a TDI event. Finally, schoolchildren who did not have health insurance (OR=0.62; 95% CI:0.42–0.92) were less likely to have had a TDI event.

Discussion

This study aimed to determine TDI prevalence together with some indicators of clinical, socioeconomic, and sociodemographic risks identified in public schools, in a group of mid-size cities in Mexico. TDI has various impacts on quality of life, aesthetic, psychological, social, and clinical care. TDIs are not the result of a disease but rather are a result of various contributing factors. The TDI frequency observed in the present study was higher than the prevalence reported in other countries such as Australia,[19] with 5.8% and 6.4% and very close to the 17.5% reported in a meta-analysis.[20] In Latin America, a pooled prevalence of 18.6% (15–20%) has been reported;[21] most of these studies were carried out in Brazil. Although a few studies on treatment or knowledge about TDI have been reported in Mexico, epidemiological research is scarce and not current. A prevalence of 28% has been reported in children 3 to 13 years of age,[22] a range much wider than in the present study, and as 12% in children 2 to 12 years of age.[23] Such differences between global and local prevalence can be explained by various factors, such as the considerable variation across countries in levels of development where studies were conducted, the TDI classification systems, study designs, age ranges, and types of sampling.

Although some studies did not find sex-based differences,[23] in general it has been observed that boys are more likely to suffer TDI in permanent dentition than girls.[24] Most explanations for such

Table 1. Descriptive characteristics of the study subjects.

Variable	Average ± SD (Median)	Min–Max	Trauma		p-value
			No	Yes	
Child´s age	9.06 ± 1.94 (9)	6–12	8.88 ± 1.93	9.86 ± 1.81	0.0000**
Mother's age	34.75 ± 5.99 (34.5)	21–54	34.42 ± 5.80	36.25 ± 6.65	0.0116**
Father's age	37.29 ± 6.58 (37)	22–57	36.87 ± 6.50	39.18 ± 6.64	0.0028**
	Frequency	Percentage			
Sex					
Boys	233	48.9	185 (79.4)	48 (20.6)	
Girls	244	51.1	205 (84.0)	39 (16.0)	0.192*
Health insurance					
With health insurance	383	81.5	316 (82.5)	67 (17.5)	
Seguro popular[a]	38	8.1	26 (68.4)	12 (31.6)	
None	49	10.4	42 (85.7)	7 (14.3)	0.075*
Missing (n = 7)					
Automobile at home					
Yes	258	55.2	217 (84.1)	41 (15.9)	0.237*
No	209	44.8	167 (79.9)	42 (20.1)	
Missing (n = 10)					
Father's educational level					
High school or less	337	76.2	282 (83.7)	55 (16.3)	0.018*
More than high school	105	23.8	77 (73.3)	28 (26.7)	
Missing (n = 35)					
Mother's educational level					
High school or less	369	78.8	310 (84.0)	59 (16.0)	0.056*
More than high school	99	21.2	75 (75.8)	24 (24.2)	
Missing (n = 9)					
Lip coverage					
Yes	381	79.9	77 (80.2)	19 (19.8)	0.659*
No	96	20.1	313 (82.1)	68 (15.9)	
Missing (n = 2)					
Overjet					
Decreased: ≤ 0	97	20.4	90 (92.8)	7 (7.2)	
Normal: 1–3 mm	215	45.3	164 (76.3)	51 (23.7)	
Increased: ≥4	163	34.3	134 (82.2)	29 (17.8)	0.002*
Socioeconomic status					
Low SES	160	34.2	129 (80.6)	31 (19.4)	
Average SES	153	32.8	130 (85.0)	23 (15.0)	
High SES	153	32.8	125 (81.7)	28 (18.3)	0.578*
Missing (n = 1)					
Dental trauma					
No	390	81.8			
Yes	87	18.2			

[a]The *Seguro Popular* (SP) is a voluntary public insurance scheme. The SP is financed primarily by the federal and state governments and, to a lesser extent, by household contributions; it is free of charge for those households in the lowest three income deciles. *chi square test; **Mann-Whitney test.

Table 2. Analysis of the distribution of schoolchildren by the reason for trauma and the consequences of the trauma.

Variable	n	%
Reason for trauma		
Recreational activity	30	34.5
Sports	27	31.0
Misuse of teeth	17	19.6
Falls	6	6.9
Automobile accident	4	4.6
Not remember	2	2.3
Violence	1	1.1
Consequence type		
Without consequences	62	71.3
Enamel fracture	15	17.2
Missing tooth	7	8.1
Wound on the lip	3	3.4

Table 3. Crosstabulation of variables: reason for trauma and consequences of trauma.

Variable	Consequence of trauma	
	n (%)	n (%)
	No	Yes
Reason for trauma		
Automobile accident	2 (50.0)	2 (50.0)
Recreational activity	27 (90.0)	3 (10.0)
Falls	1 (16.7)	5 (83.3)
Sports	17 (63.0)	10 (37.0)
Misuse of teeth	13 (76.5)	4 (23.5)
Violence	1 (100)	0 (0)
Not remember	1 (50.0)	1 (50)
Total	62	25
Fisher's exact test p-value	0.004	

difference seem to be ascribed to stereotypical perspectives about practice of sports, so that males are preferentially engaged in physical contact sports than females.[25] Girls might also tend to avoid risky behaviors, thereby reducing incidence of traumatic injuries.[26] However, some authors suggest that boys and girls are largely exposed to the same risk factors; this trend is likely to continue and reverse as girls are engaging more in activities that were previously unique to boys.[27] It is unclear whether "aesthetic concerns" may not be a major factor for young children, but it may be for their families. Again, it is difficult to draw definitive conclusions in the absence of appropriate investigations about the mechanisms for care seeking behaviors. Future research, context-specific, is needed in this regard.

Increased overjet has been considered a predisposing factor for TDI.[28] In the present study most students had a normal overjet, which was more frequently associated with TDI than in students with decreased overjet, but about same in those with increased overjet. These results are similar to Acharya et al.[29] Most studies have found a significant association between increased overjet and TDI.[21, 28] This difference is probably due to the considerable diversity of cutoff points used in

Table 4. Logistic regression analysis between dental trauma and the independent variables.

Variable	RM IC95%	p-value
Age	1.28 (1.11–1.48)	0.001
Sex		
Female	1*	
Male	1.45 (1.10–1.91)	0.008
Overjet		
Decreased: ≤ 0	0.38 (0.32–0.44)	<0.001
Normal: 1–3 mm	1*	
Increased: ≥ 4	0.59 (0.28–1.27)	0.182
Father's age	1.03 (1.01–1.06)	0.006
Father's educational level		
High school or less	1*	
More than high school	1.78 (1.06–3.00)	0.029
Health insurance		
With health insurance	1*	
Seguro popular	2.27 (0.86–5.95)	0.095
Uninsured	0.62 (0.42–0.92)	0.019

Goodness-of-fit test: Chi square = 383.26, p-value = 0.2119

overjet measurements (3 mm, > 3 mm, > 3.5 mm, and > 5 mm), as well as variability in measuring instruments. This finding emphasizes the limits of classification standardization, as well as the disparity in measurements of overjet across ages and dentitions.[30]

The socioeconomic differences for TDI prevalence in children and adolescents are likely due to factors specific to the context in which they live. It can be speculated that father's educational level and health insurance may be associated with family lifestyle; at present time, it is unfeasible to Venture firm interpretations. A more detailed description of the TDI mechanics in the family context should be the subject of future research. In a similar way, the association of trauma to SES is unclear.[11,26,31-34] Some studies show clear social inequalities in dental trauma prevalence,[32,33] while others have failed to establish this association using different socioeconomic indicators.[26,11] Two SES indicators that suggest higher SES position was associated with increased TDI risk were observed, which is consistent with Fakhruddin et al.,[11] Odoi et al.[31] and Damé et al.[33] Due to ambivalent results from population-based studies on TDI risk factors in adolescents, an unequivocal description of the association between individual factors and context with TDI is still unclear.[34]

Sociodemographic variables are risk indicators associated with different diseases and events. In the present study it was observed that older age of parents was correlated with increase in TDI risk; however, no prior reports along the same line were found in the literature. While older parents could be assumed to exert a different level of supervision of children, it may simply be that older children have older parents. Future studies should better characterize such relationship, even if it is to verify the value of schooling level or older age as a proxy variable that may be measuring other aspect or intermediate variables in the association of parental features with TDI. Similarly, child age was associated with TDI; older children had higher likelihood of TDI. The trends seem to indicate a higher prevalence in preschoolers, decrease in school-age children, then increase in adolescence, and decrease generally with age into adulthood, until TDI events become rare after age 30.[4,6,8] Those findings can be explained by any combination of children's psychomotor development, adherence to more violent games, or being engaged in contact sports – perhaps similar to factors associated with maxillofacial injuries in children.[35] The main reasons for TDI were found to be recreational activities followed by sports, misuse of teeth [such as onychophagy, removing bottle caps with teeth, biting pencil or pen], and falls. Although not in the same order, these reasons have been previously reported.[24,36] Falls and automobile accidents had more severe sequels than recreational activity and violence, which is in agreement with previous literature reports.

Limitations in the study do exist, mainly related to its design. In the first place, the study was cross-sectional and thus causal relationships cannot be established; only statistical associations. Second, data collected were derived from surveys completed by parents, so the information may not be accurate, and open to some degree of recall bias. In addition, only public schools and in some cities in Mexico were evaluated; the number of dental injuries could be an underestimation or an overestimation of the situation at the national level.

Conclusion

Dental trauma prevalence was 18.2% in this multicentric study. This study provided important information regarding the association of different sociodemographic (age, sex and father's age), socioeconomic (father's educational level and having health insurance), and clinical (overjet) variables in Mexican schoolchildren with TDI. No socioeconomic inequalities were observed in this schoolchildren sample. Identifying and fully characterizing factors associated with TDI may help prevention or early intervention to improve the prognosis of injured teeth.

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