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Dental trauma: prevalence and risk factors in schoolchildren

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Abstract – *Objectives:* This cross-sectional study aimed to determine the prevalence of traumatic injury to the permanent incisors in 8- to 12-year-old children and to test associations between dental trauma and nutritional status and physical activity level, with adjustment for demographic, behavioral, and psychosocial variables. Differences in risk factors between sexes were also assessed. *Methods:* Two-stage cluster sampling was used to select 1210 children in 20 public and private schools in Pelotas, Brazil, for study participation. Dental trauma was assessed using the O'Brien criteria. Parents provided information about socioeconomic characteristics and their children's history of trauma in early childhood *via* questionnaire. Children were interviewed to obtain demographic and psychosocial information and to assess physical activity level. Anthropometric measures were collected for body mass index calculation. Hierarchical Poisson regression was used for data analyses. *Results:* The prevalence of dental trauma was 12.6% [95% confidence interval (CI), 10.8–14.7%] in the entire sample; it increased with age from 7.2% at 8 years to 21.5% at 12 years. In the adjusted analysis, dental trauma was more prevalent in boys [prevalence ratio (PR) = 0.71; 95% CI, 0.50–0.99], older children (PR = 3.57; 95% CI, 1.73–7.34), those with inadequate lip coverage (PR = 2.03; 95% CI, 1.22–3.38), and those with histories of trauma in the primary dentition (PR = 2.60; 95% CI, 1.80–3.75). In a sex-stratified analysis, dental trauma was more prevalent in overweight/obese boys (PR = 1.65; 95% CI, 1.10–2.92). No significant association was found with socioeconomic variables, psychosocial characteristics, physical activity level, or school retention among boys or girls. *Conclusions:* The pronounced increase in the prevalence of dental trauma with age highlights the need to establish preventive strategies among schoolchildren. The risk of dental injury was increased in overweight/obese boys and children with histories of dental trauma in early childhood, confirming the existence of accident-prone children.

Key words: body mass index; children; dental trauma; epidemiology; physical activity

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Traumatic dental injuries (TDIs) may be accidental or intentional and can occur at any age. Dental trauma in infancy and childhood is particularly relevant because of the economic costs of treatment, long-term esthetic and/or functional impacts on oral health, and possibility of prevention (1). Given these factors and its high prevalence, dental trauma in children has been recognized as a public health problem.

This irreversible pathology has deservedly gained more attention, especially in the last decade (2). Studies conducted in nearly 30 countries have reported TDI prevalences ranging from 2.4% (3, 4) to 58.6% (5). This wide difference in prevalence is attributable to study population characteristics, including age range, as well as the criteria used to diagnose TDI.

Variables potentially associated with dental trauma have been investigated extensively worldwide (2, 4, 6), and some are commonly mentioned as known risk factors. Most studies have found a persistent sex-based difference in the occurrence of dental trauma, with boys being significantly more prone, despite the diminution of this difference

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over time (7). Occlusal traits, including accentuated overjet and incompetent lip coverage, have also been shown to predispose children to TDI (8). On the other hand, conflicting results regarding the influences of socioeconomic conditions (5, 9), biological characteristics (10, 11), and behavioral variables (12) highlight the need for further research.

Obesity is one of the several independent risk factors for fracture. It has been associated consistently with decreased mobility in children, and the risk of falling during daily activities is reportedly higher in overweight and obese children due to difficulties with balance (13). Although it has been linked to an elevated risk of nonfatal unintentional injury (14), the effect of obesity on the occurrence of TDI remains to be examined (7). Whereas obese subjects could be less exposed to traumatic injury because they tend to be sedentary (15), they have been suggested to be more prone to falls, collision, and related injury (12). The effect of physical activity habits on falls and collisions that cause TDI is also controversial (16, 17), similar to what occurs with nutritional status. Regardless of weight, some children have shown to be accident prone and suffer multiple episodes of dental trauma (18), but the association of trauma in the primary dentition with injury recurrence in the permanent teeth has not been investigated.

Knowledge about the prevalence and risk factors of dental injury is important to help establish preventive strategies and identify treatment needs in a given population, as well as for comparison with the results of other studies conducted throughout the world. Thus, this cross-sectional study aimed to determine the prevalence of traumatic injury in the permanent incisors of 8- to 12-year-olds in Pelotas, southern Brazil, and to test associations between dental trauma and nutritional status, as well as other potentially related factors (e.g., sex, age, occlusal traits, physical activity level, sports practice, parental education level, and family income and structure). Differences in risk factors between sexes were also assessed.

Materials and methods

Population and sample selection

This cross-sectional study was conducted in 2010 with schoolchildren in Pelotas, a southern Brazilian city near the borders with Uruguay and Argentina. The city has an estimated population of 330 000 inhabitants (19), with 25 628 children aged 8–12 years enrolled in 25 private and 91 public schools.

The minimum sample size needed for this study was calculated using the following parameters and estimates: estimated 10% occurrence rate of dental trauma (9), 3% margin of error, 95% confidence level, and 20% overenrollment to cover nonresponse. As cluster sample selection was used, the estimated design effect was 2. These calculations indicated that the minimum sample size was 922 children.

Study participants were recruited from 20 private and public elementary schools, selected randomly with consideration of the number of children per school and proportional to school type in the city. In each school, all children aged 8–12 years in grades 2–6 were invited to participate. Detailed information on the methodology of this survey has been reported elsewhere (20).

Data collection

The following data were collected:

- questionnaire for parents: A questionnaire and informed consent form for parents were sent *via* the children at the beginning of the study. The questionnaire solicited information about family income (collected in continuous levels, categorized in quartiles) and maternal education (≥8 or <8 years). Parents were also asked whether their child had sustained dental trauma in early childhood (yes or no).
- Interview with children: Children were interviewed to obtain information about demographic (age, sex, and school grade) and psychosocial [e.g., family structure (nonnuclear or nuclear, if the child lived with both parents), household crowding (2–4, 5, or ≥6 occupants)] characteristics. Retention in school was considered to be present when the relationship between a student's age and grade did not meet Brazilian school standards. Physical activity level was assessed using a specific questionnaire that has been used previously with children to assess sports practice (type, duration, and frequency per week) and time to dislocate from home to school/work. Insufficient physical activity was defined as <300 min/week (21), and sports practice was defined as engagement in sporting activity at least once per week.
- Oral health examination of children: The presence of dental trauma in the permanent incisors was assessed using the O'Brien criteria from the UK Children's Dental Health Survey (22).

Overjet was measured to the nearest half millimeter as the distance parallel to the occlusal plane between the incisal edges of the most labial maxillary and mandibular central incisors and was considered to be increased when >3 mm. Lip competence was evaluated with the lips in a resting position and scored as present when they could be closed without noticeable strain, even in subjects who kept them apart during the examination. Evident strain upon lip closure was scored as incompetence.

- Anthropometric measurements: Trained and standardized (within National Center for Health Statistics margins of error) examiners measured children's height (in meters) and weight (in kilograms) for the calculation of body mass indices (BMIs; kg/m^2). Cole's criteria were used to classify children as normal, overweight, and obese, with consideration of age and sex (23).

Prior to data collection, a pilot study was conducted with mothers and children at Federal University of Pelotas Dental School. The findings led to some modification of the instruments and provided an estimate of the time needed for data collection.

To ensure study reliability, a training and calibration process was performed with the examiners ($n = 6$) and interviewers ($n = 9$) prior to carrying out fieldwork. During this stage, team members received a manual containing information regarding the instruments used and instructions about data collection for use during data collection. Initially, the examiners received 4 hours of initial theoretical training where the study supervisors explained the indexes used. The calibration process for dental trauma was performed *in lux*, with projection of 30 images. The degree of agreement among examiners was assessed using kappa statistics. A mean kappa value of 0.92 (range, 0.89–0.95) was achieved for dental trauma assessment. To assess the consistency of interview responses, 10 children in each school were re-asked 10 questions 1 week after the initial interviews.

Data analysis

Data were entered into a database (Epidata 3.1) in duplicate, and the 'validate' tool was used to identify discrepancies between entries. Data were then transferred to Stata software (version 10.0; Stata Corporation, College Station, TX, USA). Standard descriptive techniques and chi-squared tests (standard and for linear trend) were used to compare the frequency of dental trauma according to independent variables, and Poisson regression (24) with robust variance was used to identify and assess factors associated with dental trauma. Multivariable analysis employed a conceptual hierarchical model based on that described by Nicolau et al. (25), which determined the order of variable entry into the model to control for potential confounding factors. The first through fifth levels included the following: (i) socioeconomic variables (family income, maternal education, and school type), (ii) children's demographic characteristics (sex and age), (iii) biological variables (BMI, overjet, and lip coverage), (iv) psychosocial characteristics (family structure and household crowding), and (v) behavioral variables (physical activity, school retention, and previous dental trauma). Variables were adjusted for those in the same or higher levels. Analyses were also stratified by sex to explore the independent effects of dental trauma predictors in boys and girls. The level of significance was set at $P \leq 0.05$.

Ethical considerations

The Human Research Ethics Committee of the Federal University of Pelotas approved the study protocol. All parents provided written informed consent prior to data collection. All schools received information about the study protocol and agreed to participate. Children requiring dental treatment were referred to the Dental School of the Federal University of Pelotas.

Results

Of 1744 children who were eligible for the study, 419 (24.0%) lacked parental informed consent, 114 (6.7%) were absent from school during data collection, and one subject did not undergo dental trauma examination. Thus, the final sample comprised 1210 children. This sample size achieved 80% power to detect prevalence ratios ≥ 1.56 as significant, with a confidence level of 95%.

The majority of participants were female (52.6%), white-skinned (72.9%), and from public schools (79.1%). The mean age was 9.92 (±1.27) years. Dental trauma in permanent incisors was detected in 12.6% [95% confidence interval (CI), 10.8–14.7%] of children (Table 1); it was more prevalent in boys than girls in all age groups (female/male ratio, 1:1.10), and its prevalence increased with age in both sexes.

Table 1. Distribution and prevalence of dental trauma according to sociodemographic, biological, psychosocial, and behavioral variables among schoolchildren in Pelotas, Brazil, 2010 (n = 1210)

		Total		Dental trauma		
Variable	Categories	N	%	N	%	*P*
Sex	Male	574	47.4	82	14.3	0.104[a]
	Female	636	52.6	71	11.2	
Age	8	181	15.0	13	7.2	<0.001[b]
	9	312	25.8	36	11.5	
	10	295	24.4	35	11.9	
	11	259	21.4	34	13.1	
	12	163	13.5	35	21.5	
School type	Private	253	20.9	34	13.4	0.669[a]
	Public	957	79.1	119	12.7	
Maternal schooling	>8	750	63.8	94	12.5	0.882[a]
	<8	425	36.2	52	12.2	
Family income (R$) quartiles	0–510	246	23.8	32	13.0	0.869[b]
	511–740	271	26.1	39	14.4	
	741–1230	241	23.2	22	9.1	
	1231–12000	279	26.9	42	15.1	
Family structure	Nuclear	739	61.2	94	12.7	0.954[a]
	Nonnuclear	468	38.8	59	12.6	
Household crowding	2–4	737	61.7	100	13.6	0.098[b]
	5	231	19.3	29	12.5	
	≥6	227	19.0	21	9.3	
School retention	No	861	71.5	103	12.0	0.226[a]
	Yes	344	28.5	50	14.5	
Overjet (mm)	0–3	919	76.0	11	12.1	0.281[a]
	>3	290	24.0	42	14.5	
Lip coverage	Adequate	1099	91.2	132	12.0	0.042[a]
	Inadequate	106	8.9	20	18.9	
Body mass index	Not overweight	786	65.3	93	11.8	0.250[a]
	Overweight/obese	417	34.7	59	14.2	
Physical activity (min/week)	≥300	342	30.9	46	13.5	0.629[a]
	<300	766	69.1	95	12.4	
Trauma in early childhood	No	917	78.9	87	9.5	<0.001[a]
	Yes	256	21.8	59	23.1	
Total		1210	100	153	12.6	

[a]Chi-square.
[b]Chi-squared test for linear trend.
1R$ = 0.54 US$.

Table 2 presents the results of crude and adjusted Poisson regression analyses to identify factors associated with dental trauma in the whole sample. The crude analysis indicated that the presence of dental trauma in the permanent incisors was associated with older age, inadequate lip coverage, and the presence of trauma in the primary dentition. These variables remained associated with the outcome in the adjusted model, and sex was also associated, with boys more affected.

Poisson regression analysis showed that the prevalence of dental trauma tended to be higher in overweight/obese boys, and in those with inadequate lip coverage and who sustained trauma in early childhood than in normal-weight boys and those lacking these conditions (Table 3). Among girls, the presence of dental trauma was associated with older age and trauma in the primary dentition (Table 4).

The prevalence of trauma did not differ significantly according to the practice of any sport assessed, although TDI tended to be more prevalent in children practicing any sport at least once per week than in those practicing less frequently (Table 5).

Discussion

This study examined general and behavioral variables potentially related to dental trauma in boys and girls. Dental trauma prevalence was associated with older age, presence of inadequate lip coverage, and history of dental trauma in early childhood. A

Table 2. Results of crude and adjusted Poisson regression analyses of dental trauma prevalence among schoolchildren in Pelotas, Brazil, 2010 (n = 1210)

Independent Variables	PR[c] (95% CI)	P value	PR[a] (95% CI)	P value
Socioeconomic variables				
Family income (quartiles)				
4th (R$ 0–510)	1	0.872	1	0.567
3rd (R$ 511–740)	1.11 (0.72–1.71)		1.20 (0.71–2.04)	
2nd (R$ 741–1230)	0.70 (0.42–1.17)		0.80 (0.42–1.51)	
1st (R$ 1231–12 000)	1.16 (0.76–1.77)		1.26 (0.51–1.47)	
Maternal schooling (years)				
≥8	1	0.882	1	0.638
<8	0.98 (0.71–1.34)		0.91 (0.62–1.35)	
School type				
Private	1	0.669	1	0.520
Public	0.93 (0.65–1.32)		0.85 (0.51–1.40)	
Demographic characteristics				
Sex				
Male	1	0.104	1	0.049
Female	0.78 (0.58–1.05)		0.71 (0.50–0.99)	
Age				
8	1	<0.001	1	<0.001
9	1.61 (0.88–2.95)		1.68 (0.82–3.43)	
10	1.65 (0.90–3.04)		1.94 (0.95–3.97)	
11	1.83 (0.99–3.37)		1.84 (0.89–3.83)	
12	2.99 (1.64–5.45)		3.57 (1.73–7.34)	
Biological characteristics				
Body mass index (BMI)				
Normal	1	0.250	1	0.187
Overweight/obese	1.20 (0.88–1.62)		1.37 (0.96–1.92)	
Overjet				
≤3 mm	1	0.281	1	0.710
>3 mm	1.20 (0.86–1.67)		1.08 (0.73–1.59)	
Lip coverage				
Adequate	1	0.038	1	0.006
Inadequate	1.57 (1.03–2.41)		2.03 (1.22–3.38)	
Psychosocial characteristics				
Family structure				
Nuclear	1	0.954	1	0.784
Nonnuclear	0.99 (0.73–1.34)		0.95 (0.66–1.37)	
Household crowding				
2–4	1	0.098	1	0.250
5	0.93 (0.63–1.36)		0.90 (0.57–1.43)	
≥6	0.68 (0.44–1.07)		0.69 (0.41–1.17)	
Behavioral characteristics				
Physical activity (min/week)				
≥300	1	0.629	1	0.815
<300	0.92 (0.66–1.28)		1.05 (0.71–1.55)	
School retention				
No	1	0.226	1	0.926
Yes	1.22 (0.89–1.66)		0.98 (0.59–1.61)	
Trauma in early childhood				
No	1	<0.001	1	<0.001
Yes	2.43 (1.80–3.28)		2.60 (1.80–3.75)	

PR[c]: crude prevalence ratio; PR[a]: adjusted prevalence ratio; 1R$ = 0.54US$.

sex-stratified analysis showed that the prevalence of dental trauma was greater in overweight/obese boys than in normal-weight boys.

Petti et al. (12) and Nicolau et al. (26) found that childhood obesity significantly increased the risk of traumatic injury, but subsequent studies showed no association between dental trauma and height/weight proportions (16, 25, 27, 28). The association of obesity with dental trauma may be explained by obese children's reduced agility and greater likelihood of accidents, whereas normal weight may improve motor skills, thereby reducing the risk of

Table 3. Results of crude and adjusted Poisson regression analyses of dental trauma prevalence among boys in Pelotas, Brazil, 2010 (n = 574)

Independent variables	PR[c] (95% CI)	P	PR[a] (95% CI)	P value
Socioeconomic variables				
Family income (quartiles)				
4th (R$ 0–510)	1	0.967	1	0.736
3rd (R$ 511–740)	0.95 (0.55–1.66)		1.11 (0.56–2.19)	
2nd (R$ 741–1230)	0.56 (0.28–1.12)		0.68 (0.29–1.58)	
1st (R$ 1231–12 000)	1.11 (0.65–1.92)		1.25 (0.59–2.67)	
Maternal schooling (Years)				
≥8	1	0.815	1	0.818
<8	0.95 (0.61–1.47)		0.94 (0.55–1.61)	
School type				
Private	1	0.304	1	0.275
Public	0.79 (0.50–1.25)		0.70 (0.37–1.33)	
Biological characteristics				
Age				
8	1	0.010	1	0.009
9	2.25 (0.95–5.31)		2.31 (0.92–5.78)	
10	1.75 (0.71–4.31)		1.86 (0.70–4.92)	
11	2.10 (0.87–5.07)		1.99 (0.76–5.21)	
12	3.67 (1.54–8.71)		4.71 (1.80–12.33)	
Body mass index				
Normal	1	0.037	1	0.012
Overweight/obese	1.53 (1.03–2.29)		1.65 (1.14–2.92)	
Overjet				
≤3 mm	1	0.196	1	0.844
>3 mm	1.33 (0.86–2.06)		0.89 (0.62–1.79)	
Lip coverage				
Adequate	1	0.030	1	0.006
Inadequate	1.76 (1.06–2.93)		2.52 (1.31–4.87)	
Psychosocial characteristics				
Family structure				
Nuclear	1	0.445	1	0.518
Nonnuclear	0.85 (0.55–1.30)		0.85 (0.51–1.40)	
Household crowding				
2–4	1	0.158	1	0.439
5	0.83 (0.49–1.41)		0.79 (0.42–1.49)	
≥6	0.66 (0.36–1.22)		0.80 (0.39–1.64)	
Behavioral characteristics				
Physical activity (min/week)				
≥300	1	0.951	1	0.861
<300	1.01 (0.68–1.54)		1.05 (0.64–1.70)	
School retention				
No	1	0.719	1	0.697
Yes	1.08 (0.71–1.65)		0.88 (0.45–1.70)	
Trauma in early childhood				
No	1	<0.001	1	<0.001
Yes	2.35 (1.57–3.50)		2.68 (1.64–4.38)	

PR[c]: crude prevalence ratio; PR[a]: adjusted prevalence ratio; 1R$ = 0.54US$.

accidental falls or incidents during interaction and play with family and friends. Overweight/obesity was associated with a higher prevalence of dental trauma in boys, but not girls, in this sample. This finding may be related to the higher prevalence of the outcome among boys and the greater proportion of overweight boys who were physically active (39.3% versus 26.2% of overweight girls).

One of the most interesting findings of this study is the greater chance of having dental trauma in the permanent dentition among children who experienced dental trauma in the first years of their lives, as reported by parents. Although previous studies have suggested that some children are accident prone and suffer from multiple episodes of dental trauma, the results of the present study suggest that these children may be identified even earlier: when they sustain trauma in the primary dentition, in early years of life. Glendor et al. (18) assessed the risk of multiple trauma episodes

Table 4. Results of crude and adjusted Poisson regression analyses of dental trauma prevalence among girls in Pelotas, Brazil, 2010 (n = 636)

Independent variables	PR[c] (95% CI)	*P*	PR[a] (95% CI)	*P* value
Socioeconomic variables				
Family income (quartiles)				
4th (R$ 0–510)	1	0.686	1	0.736
3rd (R$ 511–740)	1.34 (0.67–2.70)		1.37 (0.59–3.18)	
2nd (R$ 741–1230)	0.94 (0.43–2.05)		1.00 (0.38–2.66)	
1st (R$ 1231–12 000)	1.29 (0.65–2.56)		1.34 (0.53–3.39)	
Maternal schooling (Years)				
≥8	1	0.848	1	0.750
<8	1.05 (0.66–1.66)		0.91 (0.50–1.64)	
School type				
Private	1	0.693	1	0.982
Public	1.12 (0.64–1.94)		0.98 (0.45–2.25)	
Biological characteristics				
Age				
8	1	0.012	1	0.008
9	1.07 (0.44–2.58)		1.29 (0.41–4.11)	
10	1.57 (0.68–3.59)		2.34 (0.79–6.96)	
11	1.60 (0.68–3.73)		2.02 (0.65–6.30)	
12	2.44 (1.06–5.66)		3.72 (1.19–11.58)	
Body mass index (BMI)				
Normal	1	0.651	1	0.734
Overweight/obese	0.89 (0.54–1.47)		0.91 (0.52–1.58)	
Overjet				
≤3 mm	1	0.818	1	0.970
>3 mm	1.06 (0.64–1.75)		1.01 (0.56–1.83)	
Lip coverage				
Adequate	1	0.656	1	0.305
Inadequate	1.19 (0.55–2.61)		1.57 (0.66–3.70)	
Psychosocial characteristics				
Family structure				
Nuclear	1	0.419	1	0.691
Nonnuclear	1.20 (0.77–1.86)		1.12 (0.65–1.93)	
Household Crowding				
2–4	1	0.362	1	0.291
5	1.04 (0.59–1.82)		1.03 (0.53–2.00)	
≥6	0.71 (0.37–1.37)		0.62 (0.28–1.36)	
Behavioral characteristics				
Physical activity (min/week)				
≥300	1	0.770	1	0.941
<300	0.92 (0.53–1.59)		1.03 (0.53–1.99)	
School retention				
No	1	0.202	1	0.702
Yes	1.35 (0.85–2.15)		1.16 (0.54–2.53)	
Trauma in early childhood				
No	1	<0.001	1	0.002
Yes	2.48 (1.58–3.89)		2.55 (1.42–4.57)	

PR[c]: crude prevalence ratio; PR[a]: adjusted prevalence ratio; 1R$ = 0.54US$.

affecting the permanent teeth in children and adolescents over a 12-year period. They found that the risk of sustaining multiple injuries was 8.4 times higher when the first trauma episode occurred at 9 years of age than when it occurred at the age of 12. Survival analysis also showed that every new trauma episode was associated with a reduction of the interval between episodes. A cohort study of children in Brazil confirmed the hypothesis that individuals with previous trauma were more prone to recurrent TDI events (29). The presence of multiple trauma episodes was also related to increased risks of certain types of injury, complication, and treatment (30), and thus with greater treatment cost. However, these associations should be interpreted with caution due to the cross-sectional design of the study, which may have been affected by recall bias, and also, it is know that a

Table 5. Prevalence of traumatic dental injury (TDI) according to type of sports participation among schoolchildren in Pelotas, Brazil, 2010 (n = 1210)

Participation in sports[a]	TDI prevalence (%) Boys			TDI prevalence (%) Girls			TDI prevalence (%) Total sample		
	Play	Do not play	P^b	Play	Do not play	P^b	Play	Do not play	P^b
Soccer	15.1 (60)	12.8 (22)	0.48	11.1 (19)	11.2 (52)	0.96	13.9 (79)	11.6 (74)	0.25
Volleyball	13.0 (12)	14.6 (70)	0.69	14.4 (26)	9.9 (45)	0.10	13.9 (38)	12.3 (115)	0.49
Basketball	16.2 (11)	14.1 (71)	0.64	12.9 (8)	11.0 (63)	0.65	14.6 (19)	12.4 (134)	0.48
Handball	11.5 (3)	14.5 (79)	0.67	15.0 (3)	11.1 (68)	0.58	13.0 (6)	12.7 (147)	0.94
Bicycling	13.4 (13)	14.6 (69)	0.77	13.9 (14)	10.7 (57)	0.35	13.6 (27)	12.5 (126)	0.66
Taco	13.2 (9)	14.5 (73)	0.78	15.8 (3)	11.0 (68)	0.52	13.8 (12)	12.6 (141)	0.75
Sports fight	18.2 (8)	14.0 (74)	0.45	17.6 (3)	11.0 (68)	0.42	18.0 (11)	12.4 (142)	0.20

[a]At least once a week.
[b]Chi-squared test.

large portion of parents do not recognize the occurrence of dental trauma in their toddlers (31).

Whereas repeated trauma episodes may be connected to a child's behavior and ability during activities, physical activity level was not associated with the outcome in this study. According to Ranalli (32), physical activity is associated with injury risks, including orofacial soft- and hard-tissue trauma, despite its health benefits. The prevalence of TDI was also assessed by type of sport, which may be more important than activity level, in this study. TDI tended to be more prevalent in children participating in sports fight and other impact-prone sports activities, but this difference was not significant. Çetinbas et al. (17) found that crown fracture rates were significantly higher in association with bicycling than with other types of sport. Artun and Al-Azemi (16) found that the prevalence of trauma was 17.6% among active children and 11.5% among inactive children, but this difference was not confirmed in the multivariate analyses. One other study failed to detect an association between trauma and activity level (33), whereas others have suggested that the association of physical activity with improved motor skills may protect against injury when falls or collisions occur (12, 16, 34).

Very few studies have obtained results conflicting with the common finding that boys are at increased risk of dental trauma prior to adolescence (10, 11, 35). Researchers argue that the more frequent occurrence of dental trauma in boys than in girls is related to boys' tendencies to engage more frequently in vigorous outdoor activities and participate in sports (36). A large gender difference in physical activity level was detected in our sample, but this variable had no effect on dental trauma in separate analyses of boys and girls. Similar results were found in an Arabian population, which led the authors to conclude that the gender difference in sports activity was an unlikely explanation for the observed difference in dental trauma (16). The gender difference in trauma to the incisors observed in this study is thus more likely to reflect behavioral differences during regular social interactions and sports practice than differences in physical activity level.

The prevalence of dental trauma increased with age in our sample. This increase has been associated with the cumulative effect of injuries (36) and with age-related differences in risk. The age of 12 is very representative of the trauma problem in permanent teeth because it represents the end of the most trauma-active period of a person's life (37), after which the prevalence of dental trauma tends to stabilize (38). Schoolchildren in this age range are at a greater risk of developing lesions, and preventive strategies should be directed at this population. School is thus an appropriate environment for preventive interventions aiming to reduce the sharp increase in dental trauma with age.

Family characteristics, including household crowding (39) and family structure (25, 26), have been associated with an increased risk of dental trauma, but we failed to detect any such association in our sample. No socioeconomic variable affected dental trauma occurrence in the present study. Higher parental education level and socioeconomic status have been identified as potential preventive factors against dental trauma (6), as behaviors associated with high family income and private school attendance could reduce the risk of incisor trauma (16). A systematic review, however, found that traumatic injuries in the permanent teeth were correlated with socioeconomic indicators in few studies, with the majority detecting no such association (40).

The high degree of diagnostic reliability observed contributes to the internal validity of this study. External validity is accounted for by the sampling procedure used and the enrollment in school of nearly all children in this age range in Pelotas, according to Local Educational Services. One limitation of the present study is the cross-sectional design. BMI was assessed at the time of data collection and thus may have differed from that at the time of dental trauma. In addition, data on physical activity levels were collected with reference to the previous week, whereas dental injuries have a cumulative effect and may have occurred any time after tooth eruption. Recall bias may have affected parents' responses about dental trauma in early childhood. Thus, although the findings of this study add to the evidence base on determinants of dental trauma, prospective studies of correlated determinants are needed.

Promising interventions for preventing dental trauma in schoolchildren include systematic population-based programs, such as the World Health Organization's 'Health-Promoting Schools' program. This public health program offers a broad solution for dental trauma through a wide range of actions and policies, including personal and social education aimed at developing life skills, safe physical activity, school policies against bullying and violence, physical environment, school health and alcohol policies, provision of mouth guards, and links with health services (41, 42). The adoption of a common risk factor approach in public health policies is important; health promotion strategies aiming to reduce fat and sugar consumption can not only prevent dental trauma, but also reduce all types of injury, dental caries, diabetes, arteriosclerosis, and hypertension (26). Such strategies reduce costs and human resources requirements and have shown greater efficiency and effectiveness.

Professionals should also be attentive to opportunities to take measures at the individual level and adopt strategies for individuals with previous TDI in an effort to prevent further injury (29). The identification of children with occlusal characteristics predisposing them to TDI and the early provision of orthodontic treatment may also help prevent episodes of dental trauma (2).

Conclusion

The findings of this study indicate that the risk of TDI is greater in overweight/obese boys and children with histories of dental trauma in early childhood, confirming the existence of accident-prone children. The pronounced increase in the prevalence of dental trauma with age (from 8 to 12 years) highlights the need to establish preventive strategies among schoolchildren.

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Conflict of interest

The authors declare there are no conflict of interests.

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