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Traumatic dental injuries among 8- to 12-year-old schoolchildren in Pinggu District, Beijing, China, during 2012

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Abstract – *Background*: Although traumatic dental injuries are most common during childhood and can cause significant health problems, the literature contains few reports of the prevalence of traumatic dental injuries in children in China. *Aim*: To study the prevalence of and factors related to traumatic dental injuries among 8- to 12-year-old schoolchildren in Pinggu District, Beijing during 2012. *Material and Methods*: An epidemiological survey of traumatic dental injuries was performed in all nine primary schools of Pinggu District, Beijing, China. Andreasen criteria as the diagnostic criteria were used in the study. A sample of 5165 students aged from 8 to 12 years old were examined, consisting of 2711 boys and 2454 girls. - *Results*: A total of 367 students (7.1%), 251 boys and 116 girls, were found to have traumatic dental injuries, and 442 permanent teeth were involved. Maxillary central incisors were the most affected by dental injuries (378, 85.5%). Among the 52 traumatized teeth (11.8%) that were treated, endodontic treatment (55.8%) was the most common method. *Conclusions*: The study showed a relatively low prevalence of dental injuries in Pinggu District. The treatment rate of traumatized teeth was relatively low. Schoolchildren need more medical assistance when they face accidents. Policymakers should develop a strategy for the prevention of traumatic dental injuries. Educational programs to increase the knowledge of traumatic dental injuries and prevent them should be initiated for teachers and schoolchildren.

Dental injuries in the front teeth can cause therapeutic, functional, social, esthetic and psychological problems that directly or indirectly influence the daily lives of patients and their families (1–4). The prevalence of dental injuries is reported from 12.6% to 24.2% (5–7) among 8- to 12-year-old schoolchildren, depending on factors such as geographical location, socio-economic status, methods of study, and the criteria for trauma classification. With the remarkable decline in dental caries among children in some countries (8, 9), the prevalence of traumatic dental injuries may exceed that of dental caries (10, 11), and such injuries may have a more negative effect on dental health (12, 13). The greatest risk age of dental injuries is in children 8–10 years old (14) or 0–3 years old (15). The prevalence of traumatic dental injuries increases with age among children 9–12 or 14 years old (16, 17). In adolescents, the main causes of traumatic injuries are falls and collisions (18, 19).

Despite the importance of the above problems of traumatic dental injuries, the literature contains few reports of the prevalence of traumatic dental injuries in children in China (20–22); the data of these reports were all gained from stomatology hospitals. To gain more accurate data, this study investigates the prevalence of traumatic dental injuries directly in primary schools. The size of the population was 1.37 billion in 2010 [2010 Sixth National population census data Gazette (No. 1), National Bureau of Statistics of China, April 28, 2011] in China, and 0.22 billion (16.60%) were under 14-year-olds. To understand the prevalence and risk factors associated with dental injuries, the current survey studied the prevalence, causes, types, treatments, gender, and age distribution of dental injuries in primary school students aged from 8 to 12 years in Pinggu District, Beijing.

Materials and methods

A prevalence survey was carried out including schoolchildren aged 8–12 years, of both sexes, living in Pinggu District, Beijing, with 95% confidence interval level and a standard error of 5%.

The sample consisted of 5165 students, 2711 boys and 2454 girls, from 8 to 12 years old (from grade 3 to

grade 6) in all nine primary schools of Pinggu District, Beijing, China. The study represented the whole population of children living in Pinggu District, Beijing, because under the law, every child in Pinggu District is enrolled in school. As the capital of China, Beijing is one of the most populous cities in the world, with a population of 19.61 million as of 2010. The city is country's political, cultural, and educational center and the second largest city of China.

According to the preliminary study and some reports, we hypothesized that the prevalence of traumatic dental injuries of children was 10% (16, 18) in Pinggu District. Using the formula $n = \left(u_\alpha^2 pq\right) / \delta^2$, where n is the number, p is the estimates of prevalence rate, δ is the admissible error, and $q = 1 - p$, in this study, we hypothesized that δ was no more than 10%, $\alpha = 0.05$, $u_\alpha = 1.96$. We could calculate the minimum sample size as 3458. The sample size was bigger than the requirement of the primary estimated minimum sample size.

The examination was carried out by two dentists who were trained at the beginning of the survey to be familiar with criteria for dental injuries. Ethical approval was given by the medical ethics committee of Peking University School and Hospital of Stomatology in Beijing. The authorities of those schools were visited to ensure full cooperation before the study was carried out. The oral examination was performed in classrooms to identify the type of dental injuries. Cotton buds and disposable plane mouth mirrors were the main examinational appliances. Students were examined in their seats during class hours while sitting in straight-backed chairs. The light source was normal daylight. If we need some details, for example, to distinguish the type of dental injuries, portable lighting device would be used.

The examiner recorded the following data: (i) school and gender, (ii) site of dental injury, (iii) type of dental injury, and (iv) treatment of dental injury. When we identified a tooth that had been treated, we would look for the medical histories of patients and ask students and their teachers or school doctors about the treatment procedures. If it was possible, we would have students bring the X-ray images to us to judge the types of treatments. Schools provided information on students' gender, age, and grade; the information could be found in school doctors' computers. Children provided information on time of the injury, cause of the injury, where the injury occurred, whether protective equipment was being used, and whether they were taught how to prevent dental injury. We ask students and get the information in classrooms.

To classify traumatic dental injuries, we used the 2007 criteria of the International Association of Dental Traumatology (23–25). We separated uncomplicated crown fracture into enamel fracture and enamel–dentin fracture in this study.

Kappa values were calculated for clinical measures on a tooth-by-tooth basis, and the score of intra-/inter-agreement ranged from 0.89 to 1.0 and from 0.83 to 0.94, indicating a very good intra-examiner agreement.

Root fracture was examined only partially because radiographs were not taken. Concussion, subluxation, lateral luxation, intrusion, and extrusion cannot be found if dental injuries occurred several months ago or longer.

Enamel fracture and concussion were less serious than other types of dental injuries, and generally, most of them did not require treatment, so we classified the enamel fracture and concussion into one group and all other types of dental injuries into another group. We used this classification as a proxy for the seriousness of traumatic dental injuries.

Data were analyzed using the SPSS 19.0 (SPSS Inc., Chicago, IL, USA) software program for Windows. The cumulative nature of most types of dental injuries influenced the choices of statistical analysis. The chi-squared test and Fisher's exact test were used to determine significant differences, with a two-sided significance level of $P < 0.05$. Differences in frequency distribution of degree of traumatic dental injuries according to gender were tested with Fisher's exact test, and differences in frequency distribution of traumatic dental injuries according to gender, age, and site of dental injury were tested with chi-squared test.

Results

A total of 5165 schoolchildren aged 8–12 years living in Pinggu District, Beijing, were examined in this cross-sectional survey: 52.5% boys and 47.5% girls. The frequency distribution of age and gender in different grades is shown in Table 1.

The examination rate was 100%, because all children in primary schools and their parents agreed to participate in the study. Most students were examined in the first examination, while the remaining students were examined in the second examination a week later.

The prevalence of traumatic dental injuries was found to be 7.1%; 367 affected students were found, 251 boys and 116 girls. A total of 442 permanent teeth were involved in the traumatic injuries: 299 children (81.5%) had one traumatized tooth, 61 children (16.6%) had two traumatized teeth, and seven children (1.9%) had three traumatized teeth.

The prevalence of dental injuries increased with age. It rose from 3.0% at the age of 8 years to 10.0% at 12 years. Significant differences were found between children 9 and 10 years old (4.4% vs 8.7%, $P < 0.001$). There was a significant correlation between dental injuries and gender. Overall, boys were 1.96 times more likely than girls to experience dental injuries ($P < 0.001$). Significant differences between boys and girls were found from 10 to 12 years old ($P < 0.05$; Table 2).

The most common type of traumatic dental injuries was enamel fracture (340, 76.9%), followed by enamel–dentin fracture (58, 13.1%), enamel–dentin fracture with pulp exposure (complicated crown fracture; 28, 6.3%), and other types of injuries (16, 3.6%).

The study showed that maxillary central incisors (378, 85.5%) were the most affected by dental injuries, followed by maxillary lateral incisors (31, 7.0%) and lower central incisors (18, 4.1%). There was no significant difference between the right and left maxillary central incisors (199 vs 179, $P > 0.05$).

Table 1. Distribution of a population of 5165 schoolchildren aged 8 to 12 years regarding age and gender in different grades

Age and gender	Grade 3 *n*	Grade 4 *n*	Grade 5 *n*	Grade 6 *n*	All grades *n*	Relative (%)
8 years						
Boy	308	7	1		316	6.0
Girl	318	3		1	322	6.2
All	626	10	1	1	638	12.2
9 years						
Boy	221	407			628	12.0
Girl	200	404	6	1	611	11.7
All	421	811	6	1	1239	23.7
10 years						
Boy	15	224	434	4	677	13.0
Girl	7	138	454	2	601	11.5
All	22	362	888	6	1278	24.5
11 years						
Boy	3	13	261	570	847	16.2
Girl	4	7	179	543	733	14.0
All	7	20	440	1113	1580	30.2
12 years						
Boy	4	8	20	211	243	4.7
Girl			4	183	187	3.6
All	4	8	24	394	430	8.3
8–12 years						
Boy	551	659	716	785	2711	53.0
Girl	529	552	643	730	2454	47.0
All	1080	1211	1359	1515	5165	100.0
Relative frequency (%)	20.9	23.4	26.9	30.0	100	

Table 2. Frequency distribution of traumatic dental injuries according to gender

Age and gender	Dental injury *n* (%)	No dental injury *n* (%)	*P*-value for chi-squared test according to gender
8 years			
Boy	10 (3.2)	306 (96.8)	0.784
Girl	9 (2.8)	313 (97.2)	
9 years			
Boy	32 (5.1)	596 (94.9)	0.255
Girl	23 (3.8)	588 (96.2)	
10 years			
Boy	78 (11.5)	599 (88.5)	<0.001
Girl	33 (5.5)	568 (94.5)	
11 years			
Boy	100 (11.8)	747 (88.2)	<0.001
Girl	39 (5.3)	694 (94.7)	
12 years			
Boy	31 (12.8)	212 (87.2)	0.030
Girl	12 (6.4)	175 (93.6)	
8–12 years			
Boy	251 (9.3)	2460 (90.7)	<0.001
Girl	116 (4.7)	2338 (95.3)	

We found that the proportion of injuries classified as enamel fracture and concussion was lower in girls than in boys ($P = 0.027$; Table 3). What we meant is that dental injuries of girls tended to be more serious than those of boys.

Table 3. Frequency distribution of degree of dental injuries according to gender

Age and gender	Enamel fracture and concussion *n* (%)	Other types of dental injuries *n* (%)	*P*-value for Fisher's exact test according to gender
8 years			
Boy	11 (91.7)	1 (8.3)	>0.999
Girl	9 (90.0)	1 (10.0)	
9 years			
Boy	29 (85.3)	5 (14.7)	>0.999
Girl	24 (85.7)	4 (14.3)	
10 years			
Boy	76 (76.0)	24 (24.0)	0.066
Girl	24 (60.0)	16 (40.0)	
11 years			
Boy	95 (79.8)	24 (20.2)	0.151
Girl	31 (68.9)	14 (31.1)	
12 years			
Boy	32 (88.9)	4 (11.1)	0.067
Girl	12 (66.7)	6 (33.3)	
8–12 years			
Boy	243 (80.7)	58 (19.3)	0.027
Girl	100 (70.9)	41 (29.1)	

Reported reasons for dental injuries were daily activities (140 children, 38.2%), sports (97, 26.4%), traffic accidents (8, 2.2%), conflicts (2, 0.5%), and unknown reasons (120, 32.7%).

In this study, 112 children's dental injuries happened at home, followed by 46 at school, 33 in the road, 33 in the sports grounds, 28 in some other places, and 115 in an unknown place.

A total of 58 children were injured in the morning, 111 children in the afternoon, and 51 children at night, while 147 children cannot remember the time of being injured.

Among 442 traumatized teeth, 52 teeth (11.8%) had received treatment, while 390 teeth (88.2%) were not dealt with (Table 4). Endodontic treatment (55.8%) was the most common type of treatment for traumatized teeth, followed by dental fillings (38.5%). Complicated crown fracture received the highest rate of treatment (85.71%).

Among the 367 children with traumatized teeth, only seven children (1.9%) were using protective equipment when the trauma happened an 10 children (2.7%) had been taught how to prevent traumatic dental injuries before the tooth was damaged, such as use of mouthguards or knowledge of first aid for dental trauma. Sixty children (16.4%) were taught after the damage occurred, and six children (1.6%) were taught both before and after.

Discussion

The prevalence of traumatic dental injuries to the permanent teeth among 8- to 12-year-old schoolchildren in Pinggu District was on the lower end of the reported prevalence (6, 8, 9, 16, 17, 26–30). Behavioral and cultural diversity between countries may explain the differences. Children are treated strictly by parents and teachers in most cities of China: Almost all day, they

Table 4. Frequency distribution of different kinds of treatments according to types of dental injuries

Type	Type of treatment				
	Endodontic treatment *n*	Dental fillings *n*	Other kinds of treatments *n*	Dental injuries *n*	Frequency of treatment *n* (%)
Enamel fracture	1	11		340	12 (3.5)
Enamel–dentin fracture		9		58	9 (15.5)
Complicated crown fracture	24			28	24 (85.7)
Other type injuries	4		3	16	7 (43.8)
Total *n*	29	20	3	442	52 (11.8)
Relative frequency	55.8%	38.5%	5.8%		100%

must sit in houses or classrooms to study from Monday to Friday, even on winter and summer vacation, therefore having less time to play than children of other countries. Quarreling and fighting are forbidden between classes, so few children take part in rough activities at school except in physical education classes.

In this study, root fracture could not be found because of the lack of radiographs. This suggests that the actual prevalence rate of dental injuries must be higher. Also concussion, subluxation, extrusion, lateral luxation, and intrusion may not be found if they received effective treatment. Some children also could not remember the experience of injuries. If the data were gained from dental clinics or hospitals, more root fracture would be found by radiographs (21), some minor injuries might be missed at the same time, for the reason of inadequate knowledge about traumatic dental injuries among Chinese people (22), and some patients would not visit doctors after their teeth were damaged.

Boys were more affected (9.3%) by tooth injuries than girls (4.7%; $P < 0.001$). This finding was similar to other reports (21, 28, 29).

Most children (81.5%) suffering from dental injuries had one tooth damaged. Enamel fracture (76.9%) was the most common form of dental injuries, as in many previous studies (20, 27, 31). Maxillary central upper incisors were the most commonly damaged, in agreement with most studies (7, 32).

This study showed that the prevalence of dental injuries increased with age from 8 to 12 years old, in agreement with other reports (30). Because most types of dental injuries were cumulative, the fact that the prevalence of dental injuries increased with age did not mean that the oldest were the most vulnerable. Granted that the comparison was made between different cohorts instead of between different ages for members of any one cohort, the differences between each consecutive age may serve as a rough estimate of the incidence of dental injuries.

The prevalence of traumatic dental injuries among 10-year-old children was significantly higher than among 9-year-old children, whereas there was no significant difference in pairwise comparison between other adjacent years of age. In other words, children aged 10 years suffered from dental injuries at a greater incidence than at other ages. Children are physically weaker before 10 years of age, whether boys or girls, and take part in less vigorous exercise than older children, so they have less chance of being injured. Most 10-year-old children studied in grade 5 (69.4%; Table 1). In this grade, children are stronger than in lower grades. They have relatively more free time than children in grade 6, because they need not face graduation examinations in Beijing and have more time to play or exercise, but their gross motor coordination is less developed than in older children, so their chance of being injured is greater. Previous studies also identify the age of 9 to 10 years as the period of life when most of the recorded damage occur (33). For these reasons, efforts to prevent dental injuries can be targeted. By concentrating our work on children of grades 4 and 5 (9 and 10 years old), we can minimize the workload and expenses while gaining more favorable results.

Where the cause of trauma was known, daily activities, followed by sports, were the main causes of injuries, as reported elsewhere (34). In some studies, falls and collisions were the main causes (35–37). This difference can be explained. Children can fall not only in daily activities, such as walking and playing games, but also in sports activities such as playing basketball or football, swimming, skating, which also result in collisions. In other words, the same circumstances might be classified differently by different researchers.

Prevention of dental injuries can be based on causes. For sports, the use of mouthguards is strongly recommended (38). For daily activities, specific and appropriate public places that contain impact-absorbing surfaces should be provided (19, 39). To prevent injuries associated with other causes, such as traffic accidents or conflicts, health education programs should be initiated (16, 40). The percentage of injuries with unknown causes was higher than in some reports (19, 30, 41); this result may possibly be explained by a high prevalence of minor injuries, for which children and their parents, not being very concerned by the traumatic event, forgot its circumstances in a short time (33).

The majority of dental injuries occurred at home (30.5%) and school (12.5%), as in previous reports (19). As a result, the work of accident prevention should be mainly carried out by teachers and parents.

Only 11.8% of traumatized teeth were treated, while 88.2% teeth were not dealt with. The rate of treatment was as low, as in previous reports (42, 43). Because most dental injuries, such as enamel fracture, were minor and did not require treatment (7), some children and their parents also did not recognize the advisability of visiting dentists or doctors when dental injuries happened, and they would not seek dental care. Only when

children felt unwell, for example, with toothache, might they go to hospital or clinic and accept treatments (21). According to this result, we suggest that schoolchildren and their parents should receive information on the management of dental injuries. Dentists also have a responsibility to give schoolchildren first aid when they have dental injuries.

Only seven children (1.9%) were using protective equipment when the trauma happened; 10 children (2.7%) had been taught how to prevent traumatic dental injuries before the tooth was damaged. This illustrates an inadequate knowledge of prevention of traumatic dental injuries among Chinese people, as the inadequate knowledge of treatment in previous reports (22).

Although the study was carried out only in Beijing, the results could show the epidemiologic characteristics of traumatic dental injuries in major areas of China, because Beijing is a representative of most Chinese cities in education, living habit, and culture, etc. At same time, the uniform system of primary education in China has been implemented, so most schoolchildren living in cities developed the similar living and studying habits. This also made the epidemiologic characteristics of traumatic dental injuries among schoolchildren in Beijing in common with other cities. On the other hand, the results were difficult to represent the whole population in China, because of the unbalanced development between Beijing and some remote areas, so this study also had some limitations.

The results of this study would be useful for others countries in understanding the prevalence of traumatic dental injuries in China. The reasons of low prevalence of traumatic dental injuries in Beijing should be taken into consideration, and further study should be made; they may provide references for preventing traumatic dental injuries and reducing them in other countries.

In conclusion, the prevalence of traumatic dental injuries was relatively low in the present study. The knowledge of traumatic dental injuries among Chinese people was inadequate. Schoolchildren need more medical aid when they face dental injuries. Policymakers should develop a strategy for the prevention of traumatic dental injuries. Educational programs about dental injuries and their prevention should be initiated for teachers and schoolchildren. Attention to a susceptible population such as 9- and 10-year-old children is likely to be valuable.

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Conflict of interest

There is no conflict of interest.

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