

Original Article

Prevalence of Traumatic Dental Injuries and Associated Factors Among 8 to 12-years-old Schoolchildren in Diyarbakir, Turkey

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INTRODUCTION

Traumatic dental injuries (TDI) is an important public health problem because of its frequency, occurrence at a young age and the high cost treatment follow-up procedures reason for continuing forward in the life of the patient's.^[1] Most dental injuries involve the anterior teeth, which may lead to restriction in biting, difficulty in speaking clearly, and embarrassment while showing teeth.^[2]

On the other hand, the public is unaware of the risks and does not have enough information to avoid traumatic injuries. However, some health professionals, including dentists, underestimate the incidence of dental trauma and concentrate on the treatment rather than prevention of traumatic injuries.^[3]

ABSTRACT

Background and objectives: This study aimed to assess the prevalence of traumatic injuries of the permanent incisors in public primary schoolchildren from 8 to 12 years old in South-Eastern Anatolia, Turkey. Additionally, the relationship between traumatic dental injuries, parents' education level, family income, size of incisal overjet and the presence of anterior open bite were examined.

Materials and Methods: Data were collected through oral examinations and structured interviews, and included socio-economic indicators. A total of 2907 children of both genders (1498 boys, 1409 girls) were included in the study. The response rate was 97%. **Results:** The prevalence of dental injuries was 4.6% (n = 135). The highest frequency of trauma in permanent teeth was observed at the age of 12 (8%). Boys experienced more dental injuries than girls, 5.9% and 3.3% (p = 0.001), respectively. The most commonly reported cause of injuries to the permanent incisors was falls (71.8%), followed by collision with objects or people (17.8%). Maxillary central incisors were the most affected by dental injuries (154, 84.6%). The most common crown fracture was in enamel only (67.58%) followed by crown fracture of enamel and dentin (22.52%). **Conclusion:** Socio-economic indicators and parents' level of education were not statistically significantly associated with the occurrence of traumatic dental injuries. Factors associated with increased risk of dental injuries in permanent teeth were age, gender, having an incisal overjet greater than 5mm and anterior open bite.

KEYWORDS: Traumatic dental injury, permanent teeth, socio-economic indicators, overjet, anterior open bite

Epidemiological data provide a basis for evaluating the concepts of effective treatment, resource allocation and planning within any health environment.^[4] The prevalence of dental trauma in various epidemiological studies differs considerably.^[4,5] This variation has been related to several factors such as type of study, trauma classification, differences in methodology, limited age groups and geographic and behavioral differences between study locations and countries.^[6] Nevertheless, there are few studies of the prevalence of traumatic

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injury to permanent dentition in children in Turkey; [7,8] 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 public primary schools.

Traumatic dental injuries are associated with biological, socio-economic, psychological and behavioural factors and predisposing factors which include increased incisal overjet, open bite, protrusion and lip incompetence. [9] As accidents are the main cause of dental injuries, one might expect a similar association between dental injuries and socio-economic background. However, very few studies have included socio-economic status in their reports and, among those that have, there are conflicting results. These discrepancies are likely due to methodological differences among studies and the few papers published on this issue, which underline the need for further investigation into the association between socioeconomic status and TDI. [10] Therefore, studies aiming to investigate the social determinants of trauma are needed to inform health promotion strategies to prevent its occurrence.

This study was carried out to assess the prevalence of traumatic injuries to the permanent incisors in public primary school children from both genders and aged between 8-12 years in Diyarbakir, Turkey. In addition, the study aims to confirm whether dental injuries are related to the age and gender of the child, the size of incisal overjet, the presence of anterior open bite, and also, to test the association between parents' level of education and socio-economic status with dental injuries.

MATERIALS AND METHODS

A cross-sectional survey was carried out on 2907 children (1498 boys, 1409 girls) aged between 8-12 years, attending public primary schools in South-Eastern Anatolia, Turkey, with 95% confidence interval level and a standard error of 5%. These children were randomly selected to represent the population of schoolchildren living in Diyarbakir.

Ethical clearance was obtained from the Ethical Committee of the Faculty of Dentistry, University of Dicle. A pilot study was carried out to test the feasibility of the study, the dental examination and the interview procedures. The questionnaire was also piloted and proved to be applicable to the Turkish population and appropriate for their reading levels. There was no need to change the previously proposed methodology.

Local authorities (Health Council and The Education Council) provided the necessary information for the construction of a sample frame. The following information was obtained: the names of public primary

schools in Diyarbakir, their addresses and total number of children in each public primary school by age. A letter was sent to the parents of all children explaining the aim, characteristics and importance of the study, and asking for their consent. Negative consent was accepted without any prejudice being attached to the children who had opted not to participate. Of these 3000 children, public primary schools; 93 were excluded because of their parents' unwillingness to participate in the study. Socio-demographic data included age, gender, parents' level of education and income. A questionnaire was sent to the parents of children to assess level of education of parents and income. Family income was calculated based on monthly wages of economically active members of the family and divided according to the current Turkish Minimum Wage (TMW = €350).

All dental examinations were carried out by two dentists (ECT, İY) who participated in a training and calibration exercise for the criteria used to identify dental injuries. The criteria used to assess traumatic dental injuries were derived from a modified version of Children's Dental Health Survey in the UK. [11] It included enamel fracture, enamel and dentin fracture, enamel and dentin fracture with pulp exposure, missing tooth due to injury, discoloration and fistulous tract alone.

The children were examined in a chair during class hours in predetermined order in a private school room under natural light. Gauze squares, cotton buds and sterile sets of plane mouth mirrors, periodontal probes were packed in sufficient quantities for each day. The examiners wore new gloves for each clinical examination. The dental examination for traumatic dental injuries included only maxillary and mandibular permanent incisors. Registration of the original overjet was repeated on 50 children within a 4 week interval by the same observer. The measurement error was found to be 0.21mm. Furthermore; the examiners recorded the size of incisal overjet and the presence of anterior open bite. Incisal overjet was measured, using periodontal probes, from the buccal surface of the most protrusive permanent mandibular incisor to the buccal surface of the most protrusive permanent maxillary central incisor on the children. Overjet was considered to be a risk factor when it presented values higher than 5mm, and the presence of anterior open bite was assessed based on the criterion of lack of vertical overlap of the incisors in the occlusal position. [12] Data were collected through oral examinations and structured interviews, and all recording forms were numbered, but not named.

STATISTICAL ANALYSIS

All results were analyzed using the Statistical Package for R version 3.2.3 (2015-12-10) copyright © 2015, the

R foundation for statistical computing. Data analysis included descriptive statistics (frequency distribution and cross-tabulation). Statistical significance for the association between occurrence of traumatic dental injuries and distribution of dental injuries by age and gender, parents' level of education, family income, children's incisal overjet size and the presence of anterior open bite were determined using the Pearson Chi-square test and binary logistic regression analysis. The level of significance was set at $p < 0.05$.

RESULTS

Some 2907 children (1498 boys, 1409 girls) aged 8-12 years attending public primary schools in Diyarbakır, Turkey during 2012 were included in this study. A total of 2907 out of 3000 children were present at the school on the days of the examination and interview (The response rate 97%). Table 1 presents their distribution by

age and gender. The prevalence of traumatized children was found to be 4.6% and it was highly significantly associated with age and gender ($p < 0.001$) [Table 1].

The prevalence of dental injuries increased with age. It rose from 1.8% at the age of 8 years to 8.0% at 12 years. Significant differences were found between children 10 and 11 years old (3.8% vs 7.2%, $p < 0.01$). There was a significant correlation between dental injuries and gender. Boys experienced more dental injuries than girls (5.9% cf 3.3%, $p = 0.001$), respectively [Table 1].

The most commonly reported cause of injuries to the permanent incisors was falls (71.8%), followed by collision with objects or people (17.8%), fight (3%), traffic accidents (0.7%), and unknown causes accounted for 6.7% ($\chi^2 = 4.052$, $p > 0.05$) [Table 2].

The study showed that maxillary central incisors (154, 84.6%) were the most affected by dental injuries,

Table 1. Prevalence and distribution of dental injuries in the permanent dentition by age and gender

Age Years	Gender	Number with dental injuries	Number examined	%	<i>p</i>	Pearson Chi-Square test
8	Boys	10	424	2.3	0.252	1.310
	Girls	5	395	1.3		
	All	15	819	1.8		
9	Boys	7	200	3.4	0.297	1.089
	Girls	9	151	5.6		
	All	16	351	4.4		
10	Boys	18	282	6.0	0.007	7.331
	Girls	6	320	1.8		
	All	24	602	3.8		
11	Boys	40	357	10.1	0.002	9.814
	Girls	17	377	4.3		
	All	57	734	7.2		
12	Boys	14	146	8.8	0.580	0.307
	Girls	9	120	7.0		
	All	23	266	8.0		
8-12*	Boys	89	1409	5.9	0.001	11.746
	Girls	46	1363	3.3		
	All	135	2772	4.6		

* $\chi^2 = 11.746$ $p = 0.001$

Table 2. Frequency distribution of the cause of traumatic dental trauma, in a sample of 135 schoolchildren, Diyarbakır, Turkey

Type of accidents	Boys	Girls	Total	%	Pearson Chi-Square test	<i>p</i>
Fall (All reasons)	63	34	97	71.9	4.052	0.399
Collision against objects or people	16	8	24	17.8		
Traffic accident*	-	1	1	0.7		
Fight	4	0	4	3.0		
Unknown	6	3	9	6.7		
Total	89	46	135	100		

* All traffic accidents were related to riding a bicycle.

Table 3. Rate per thousand permanent incisors with traumatic dental injuries in a sample of schoolchildren, Diyarbakır, Turkey (n = 23256 incisors)

Type of tooth	Frequency (%)	Relative frequency per thousand incisors
Maxilla		
Right lateral incisor	6 (3.3)	0.26
Right central incisor	80 (43.9)	3.44
Left central incisor	74 (40.7)	3.18
Left lateral incisor	4 (2.2)	0.17
Mandible		
Left lateral incisor	6 (3.3)	0.26
Left central incisor	8 (4.4)	0.34
Right central incisor	4 (2.2)	0.17
Right lateral incisor	-	-
Total	182 (100)	7.82

Table 4. Distribution of affected teeth in relation to different types of dental injuries

Type of dental injury	Boys	Girls	Total	%
Enamel fracture alone	82	41	123	67.58**
Enamel and dentin fracture	27	14	41	22.52***
Enamel and dentin fracture with pulp exposure	1	4	5	2.75
Missing tooth due to injury	-	1	1	0.55
Discoloration alone	5	1	6	3.30
Fistulous tract alone	5	1	6	3.30
Total	120	62	*182	100

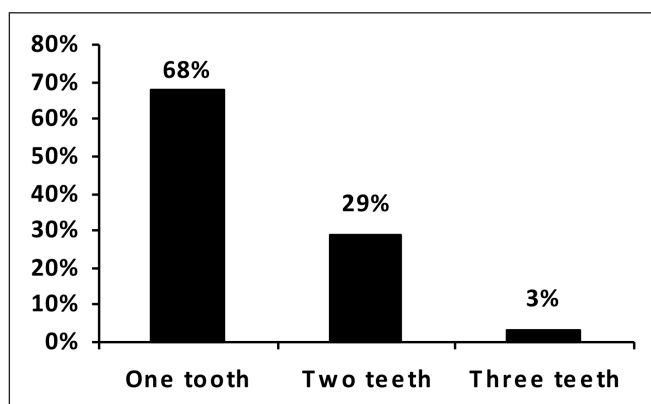
*There are a total of 182 affected teeth in 135 children with dental injuries. ** $\chi^2 = 23.927, p < 0.0001$ *** $\chi^2 = 7.166, p = 0.0074$

Table 5. Frequency distribution of traumatic injuries to the permanent incisors in a sample of public primary school children by gender, socio-economic indicators, size of the overjet and anterior open bite status

Subgroup	Number with dental injury		Number in subgroup		p	Pearson Chi-Square test
	n	(% in subgroup)	n	(% of all)		
Gender						
Boys	89	(5.9)	1498	(51.5)	0.001	11.746
Girls	46	(3.3)	1409	(48.5)		
Father's education						
≤8 years	41	(4.1)	995	(34.2)	0.333	0.936
>8 years	94	(4.9)	1912	(65.8)		
Mother's education						
≤8 years	67	(4.0)	1675	(57.6)	0.054	3.701
>8 years	68	(5.5)	1232	(42.4)		
Family income						
Low (≤€350)	40	(4.2)	953	(32.8)	0.424	0.639
High (>€350)	95	(4.9)	1954	(67.2)		
Overjet						
≤5mm	52	(2.4)	2135	(73.4)	0.000	88.538
>5mm	83	(10.8)	772	(26.6)		
Anterior open bite						
Yes	27	(0.1)	270	(9.3)	0.000	19.282
No	108	(4.1)	2637	(90.7)		
All	135	(4.6)	2907	(100)		

Table 6. Results of Binary logistic regression of explanatory variables on injuries to the anterior permanent teeth (n = 2907)

Variables	B	S.E.	Wald	p	Exp (B) (Odds ratio)	95% Confidence Interval	
Age	0.415	0.072	33.385	0.000	1.515	1.316	1.744
Gender (boys)	-0.617	0.192	10.297	0.001	0.539	0.370	0.786
Mother's education (≤ 8)	-0.332	0.189	3.080	0.079	0.717	0.495	1.040
Father's education (> 8)	-0.231	0.205	1.265	0.261	0.794	0.531	1.187
Family income ($> \text{€}350$)	-0.101	0.209	0.233	0.629	0.904	0.600	1.361
Overjet ($> 5\text{mm}$)	-1.964	0.200	94.040	0.000	0.140	0.095	0.208
Anterior open bite (yes)	-1.567	0.254	38.035	0.000	0.209	0.127	0.343
Constant	-4.200	0.794	27.942	0.000	0.015	-	-

**Figure 1:** Distribution of children with traumatized teeth according to the number of teeth involved.

followed by mandibular central incisors (12, 6.6%) and maxillary lateral incisors (10, 5.5%). There was no significant difference between the right and left maxillary central incisors (80 vs 74, $\chi^2 = 0.044$, $p > 0.05$) [Table 3].

The number of injured teeth per child was 1.34 (182 teeth in 135 children) and single tooth trauma was the most common type (92 children - 68%) followed by two teeth trauma (39 children - 29%) and three teeth trauma (4 children - 3%) [Figure 1].

The most common fracture was in enamel only (67.58%), followed by crown fracture of enamel and dentin (22.52%, [Table 4]). Significant differences by gender were observed in only enamel fracture alone and enamel and dentin fracture ($\chi^2 = 23.927$, $p < 0.0001$ and $\chi^2 = 7.166$, $p = 0.0074$) [Table 4]. Discoloration alone following trauma and presence of fistulous tract alone occurred in 3.3% of those with TDI.

Socio-economic indicators, namely father's and mother's levels of education and family income were not associated with the occurrence of traumatic dental injuries ($p = 0.333$, 0.054 and 0.424, [Table 5]). Children with incisal overjet greater than 5 mm experienced more dental injuries ($p = 0.000$, [Table 5]). Likewise, Children with anterior open bite also experienced more dental injuries

in anterior permanent teeth than their counterparts with normal occlusion ($p = 0.000$, [Table 5]).

In modelling including all independent variables ($\chi^2 = 163.985$, $p < 0.0001$), there was an increase in the agreement with the inclusion of independent variables. According to binary logistic regression analysis, TDI were not significantly related to level of mother's education ($p = 0.079$). Moreover, results of binary logistic regression analysis confirmed that age of the child ($p = 0.000$), gender of the child ($p = 0.001$), incisal overjet ($p = 0.000$) and anterior open bite ($p = 0.000$) were associated with the occurrence of TDI [Table 6].

Adjusted results showed that dental injuries were 1.515 times (95% CI = 1.316-1.744) more likely to occur with the increasing of age. Boys were 0.539 times (95% CI = 0.370-0.786) more likely to have dental injuries than girls. Besides, children with an overjet size greater than 5.0 mm were 0.14 times (95% CI = 0.095-0.208) more likely to present with a dental injury than children with an overjet size equal or lower than 5.0 mm. Finally, children with an anterior open bite were 0.209 times (95% CI = 0.127-0.343) more likely to have a traumatic dental injury [Table 6].

DISCUSSION

This cross-sectional survey has identified a prevalence of 4.6% of traumatic dental injuries to the permanent anterior teeth among schoolchildren the ages of 8-to-12- years in Diyarbakir, Turkey. According to previous studies reported in literature, the prevalence of traumatic injuries involving the permanent dentition ranged from 6.1% to 58.6%.^[13,14] The present study prevalence is very low compared to other studies that use the same methodology and diagnostic criteria in many countries.^[9,14] This difference depends on several factors, such as oral (increased overjet, anterior open bite) and environmental determinants (material deprivation), geographical location, socioeconomic, behavioural and cultural diversity between countries.

The present study showed that the prevalence of dental injuries increased with age from 8 to 12 years old (1.8% vs 8.0%, $p = 0.001$), in agreement with other reports.^[15,16] This may be attributed to the increasing mobility and activity with age. However, in a cross-sectional study, it was stated that more traumatic dental injuries had been recorded in older children probably because the register of injuries to hard tissues was usually cumulative.^[17] Because of that the prevalence of dental injuries increased with age, but did not mean that the oldest were the most vulnerable.

The greatest risk age of dental injuries in children are 7-9 and 10-12 years olds.^[18] Our study indicated a significant differences between children of 10 and 11 years of age (3.8% vs 7.2%, $p < 0.01$). These results mainly corroborated the findings of previous studies.^[19,20] It is difficult to determine the differences between the children aged 7-9 and 10-12, possibly because, at these ages children have been practising a specific sport and they feel confident of their own abilities and venture into high-performance attempts, increasing the risk of accidents.

The gender difference in the number of cases with dental trauma of permanent teeth was statistically significant ($p = 0.001$). This difference may be explained by behavioral or even cultural factors. Moreover, the explanation for these findings could be due to the fact that boys tend to participate in more strenuous activities with higher dental trauma risk, such as contact sports and more aggressive types of games as compared to girls. This result is supported by previous studies, which indicate that boys are more prone to trauma.^[14,21] However, some studies have already indicated an increasing trend of dental trauma among girls, because of their increasing participation in sports or activities formerly practiced by boys only.^[22]

In this study, the main reported types of accidents that resulted in dental injuries were falls (71.8%) and collisions with objects and people (17.8%). The etiology of traumatic dental injuries observed in the present study is in accordance with the results found in several studies in literature that have demonstrated that falls and collisions are among the main causes of dental trauma.^[3,9,23] Although explicit violence was not reported by the school children in this study, it is important to note that falls and collisions from pushing, for example, are minor forms of violence.^[23] The researcher should be aware of the underlying causes of violence in dental injury studies.

There is agreement that injuries occur more frequently to the maxillary than the mandibular incisors,^[3,11,24,25] and

that the central incisors are affected more often than the lateral incisors.^[24,25] The importance of this finding lies in the fact that these incisors play an important role in esthetic, phonetic and functional activities. Moreover, because of their morphology and location, they are susceptible to traumatic injuries.^[25] The prominent and vulnerable position of the maxillary incisors in the face is responsible for their more frequent involvement in fractures than the lower teeth.^[26]

The number of traumatized teeth showed that single tooth trauma was the most common type (68%) followed by two teeth trauma (29%). This result is in agreement with other previous studies^[9,25] showing that when one tooth or two teeth is traumatized, the majority of the force of the impact is dispersed by the fractured tooth or teeth and thus, no more teeth will be injured.

Fractures involving only enamel (67.58%), and also enamel and dentine (22.52%), were the most frequent types of traumatic injuries observed in the present research, corroborating the findings of previous studies.^[8,9,23]

Some studies included income and measures of social status. The findings, however, were equivocal with associations between higher socio-economic status and increased trauma being identified as positive,^[27] nonexistent^[23] and negative.^[2,11] Further research needs to be carried out to elucidate the role of socio-economic indicators in the occurrence of traumatic injuries to the teeth. In the present research, neither mothers' education nor family income were associated with likelihood of dental injuries ($p = 0.054, 0.424$).

Most previous studies reported an association between the size of the incisal overjet and presence of dental injury.^[11,24] However, other studies showed no significant relation between incisal overjet and TDI.^[23] In relation to overjet, different authors have argued over which particular value should be regarded as an increased overjet. Thus, some recognize an increased overjet when the value is over 3 mm,^[24] and others when it is over 5 mm.^[9,23] In the present study, it was also found that children with incisal overjet greater than 5 mm experienced more dental injuries and the difference observed was highly statistically significant ($p = 0.000$). This relationship highlights the importance of the need in the future for co-operation between dentists and orthodontists in Turkey to facilitate early intervention as a preventive measure in cases with excessive overjet.

Children with dental malocclusion anterior open bite are reported to have a significantly increased risk for dental damage after a trauma to the facial area compared to other children.^[28] According to Nguyen and colleagues^[29]

children presenting with an anterior open bite are more prone to trauma and the maxillary incisors are the teeth most frequently involved. The present research also showed that children with an anterior open bite had experienced more dental injuries and the difference observed was highly statistically significant ($p = 0.000$). The results of this study also confirmed that in children, anterior open bite is an important predisposing factor of injuries to permanent incisors. These findings also highlight the need for prevention strategies and orthodontic correction at the onset of the permanent dentition.^[30]

CONCLUSION

The prevalence of dental injuries in permanent teeth in Turkish schoolchildren was very low and unaffected by parents' educational level or their socio-economic status. It was concluded that age, gender and presenting an overjet size > 5 mm, anterior open bite were more likely to have traumatic dental injuries in Diyarbakır, Turkey. As preventive orthodontic treatment is vital for such patients, it must be completed before the age of 10 which is in the middle of mixed dentition.

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Nil

Conflicts of interest

There are no conflicts of interest

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