Community Dent Oral Epidemiol 2005; 33: 174–80

Community Dentistry and Oral Epidemiology

Dental trauma and its association with anatomic, behavioral, and social variables among fifth and sixth grade schoolchildren in Jerusalem

Harold D. Sgan-Cohen, Guy Megnagi and Yael Jacobi

Department of Community Dentistry, Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel

Sgan-Cohen HD, Megnagi G, Jacobi Y. Dental trauma and its association with anatomic, behavioral, and social variables among fifth and sixth grade schoolchildren in Jerusalem. Community Dent Oral Epidemiol 2005; 33: 174–80.

Abstract – With the decrease in dental caries prevalence, public health should place emphasis on other dental diseases. Dental trauma is an irreversible pathology which after occurrence is characterized by life-long debilitating effects. *Objectives:* To measure the prevalence of trauma in anterior permanent teeth among children, and to assess the associations with social, behavioral, and orthodontic variables. *Methods:* A total of 1195 fifth and sixth grade schoolchildren participated, representing the general Jewish population of Jerusalem. Trauma, incisal overjet and lip competence were measured by two calibrated examiners in the schools. Reasons and location of trauma were assessed according to telephone interviews with the parents of the children with severe trauma. *Results:* The total prevalence of dental trauma was 29.6%. Severe trauma, at least involving the dentine, was found among 13.5% of the children. Severe dental trauma was more prevalent among children with an incisal overjet of 4–6 mm (adjusted OR = 1.50, $P = 0.049$) or more than 7 mm (adjusted OR = 2.51, $P = 0.018$); with incompetent lips (adjusted OR = 2.31, $P < 0.001$), who learned in public religious schools (adjusted OR = 1.59, $P = 0.048$) and were males (adjusted OR = 1.45, $P = 0.041$). The main reason for dental trauma in all surroundings was falling, but sports and violence (not at orthodox private schools) were also important reasons. *Conclusions:* Based upon these findings a community effort is being planned and initiated with the aim of educating sports teachers, teachers, health personnel, and schoolchildren regarding awareness of dental trauma prevention, with emphasis on utilizing mouth guards and early orthodontic intervention, when financially possible.

Key words: dental epidemiology; dental trauma; health behavior; orthodontics

Harold D. Sgan-Cohen, Department of Community Dentistry, Hebrew University-Hadassah School of Dental Medicine, PO Box 12272, Jerusalem 91120, Israel
e-mail: harolds@cc.huji.ac.il

Submitted 20 January 2004; accepted 25 August 2004

The predominant concern of pediatric dentistry has traditionally been the treatment and prevention of dental caries. With the decrease in prevalence of this disease, dental public health for children has become more aware and concerned with other oral health issues. Dental trauma, an irreversible pathology, has now achieved more deserved attention by the profession. The primary requisite before actively dealing with a public health problem is to describe the extent, distribution, and associated variables with the specific disease.

Dental trauma among children has been described in the literature in many countries. A wide range of prevalence levels has been reported. As is illustrated in a selection of some recent studies presented in Table 1, the prevalence levels range from 1.8% in Norway to 34% in Saudi Arabia (1–11). These surveys have not always employed

Table 1. Dental trauma prevalence among children of various countries

Country	Age	Prevalence (%)	Authors (reference)
India	3–16	5.3	Rai et al. (1)
Syria	12	11.7	Marcenes et al. (2)
USA	'School'	2.4	Alonge et al. (3)
Saudi Arabia	12–14	34	Al-Majed et al. (4)
Tanzania	4–15	21	Kahabuka et al. (5)
UK	14	23.7	Marcenes and Murray (6)
Malaysia	16	4.1	Nik-Hussein (7)
Brazil	12	18.9	Traebert et al. (8)
Spain	'School'	17.4	Tapias et al. (9)
Jordan	12	13.8	Hamdan and Rajab (10)
Norway	7–18	1.8	Skaare and Jacobsen (11)

similar epidemiological methodologies, but most describe young teenagers and trauma of anterior permanent teeth.

Previous epidemiological surveys of dental trauma have reported relations with gender, orthodontic factors, and sport activities (12–14). A recent Israeli study has reported that 9% of young adults experienced dental injuries due to sports (14). Recent research has indicated an association between dental trauma and adverse psychosocial environments (15).

The orthodontic literature has traditionally demonstrated the association between trauma and incisal overjet, thereby indicating early orthodontic treatment as the preventive treatment of choice. This rationale has been verified, but the public health costs are often beyond the reach of most of the population. Mouth guards are a cheaper and potentially more accessible option, but demand much health education and promotion prior to public acceptance and adequate awareness (13, 16). In Israel, only 27% of sportspeople were found to be aware of this protective device and only 3% actually used mouth guards (14).

An Israeli study published in 1972 found 8.7% of 6–14-year-old children with traumatized permanent anterior teeth, and a second study in 1976 found 11.1% of 5-year-old children with traumatized anterior primary teeth (17, 18). The scarcity of Israeli data indicated the first objective of the present survey: to establish the prevalence of dental trauma among 10–11-year-old schoolchildren in Jerusalem. The second objective was to investigate possibly related general and behavioral variables. The overall aim was to prepare background data, diagnosis, and rationale, for a public health program in Jerusalem.

Material and methods

Population

There are 78 primary schools in Western Jerusalem. According to the Israeli Central Statistical Institute, about 24,500 Jewish children study in these schools with about 14,000 in the fifth and sixth grades.

A statistical program was utilized for the calculation of sample size (19). With a known total population of 14,000 children, confidence level of 95%, estimated true proportion of 25% trauma prevalence (based on world data as presented in Table 1), and a maximal acceptable difference of 2.5%, a sample size of 1065 was calculated. The 1195 children who were eventually included, therefore exceeded this number, and allowed for a potential 90% response rate.

Three different geographic regions (south, west, and north; the eastern, Arab section of Jerusalem will be studied in a future study) were included in the study. In the first stage, a purposive stratified sample was chosen in the following way: in the northern region, one 'low middle class' neighborhood was included; in the western region, one 'upper middle class' neighborhood was included; in the southern region, one 'average middle class' neighborhood was included. These social class definitions were according to the registry of the municipal authorities, and according to size of home and number of children. In the second stage, from the list of schools in each previously selected neighborhood, one public secular (PubS) school, one public religious school (PubR) and three private orthodox schools (PrivO) were randomly chosen (PrivO schools are smaller). These are the three typical educational 'sectors' in Jerusalem. The combination of geographic, socioeconomic, and 'religious orientation' provided optimal representation of the city's socioeconomic nature. One school's principal (PrivO) refused to participate (with the reason given that the survey would disrupt the studies), and thereafter it was replaced in the same region, randomly, by another. The final study population consisted of 15 schools: 418 children (35%) in PubS, 244 (20.4%) in PubR, and 533 (44.6%) in PrivO schools. This distribution was very similar to the general distribution in the city: 39.7% PubS, 17.2% PubR, 43.1% PrivO.

All dental examinations were conducted in the schools with the child seated in a regular chair and the examiner standing. A standard dental mirror, small flashlight, and a small millimeter ruler were employed. All children were given a tooth brush and paste as a gift after examinations.

Two examiners [a dentist undergoing an internship in orthodontics (YJ) and a senior dental student (GM)] participated and were supervised by the first author (HDSC). Ten children were examined under supervision of the first author, in order to train the other examiners and achieve optimally similar diagnoses. Thereafter, the first 105 children were independently examined individually by both examiners and results were compared. Of the 840 incisors examined, complete agreement was reached for 809 teeth (96.3%). For the remaining teeth there was disagreement, regarding either the existence or the severity of trauma. The κ statistic was calculated according to a statistical program (19). Overall κ was 0.93 ($P < 0.001$; 95% CI = 0.90–0.95). This level of agreement was regarded as satisfactory for continuation of the study. The two examiners worked side-by-side in the same room and when any doubt was evident they consulted each other.

Dependent dental variable

Previously employed classifications of dental trauma have included extensive lists of criteria. Two of the more commonly employed methods are those of Andreasen et al. (20) and Garcia-Godoy (21). Andreasen's classification contains 19 groups, whereas Garcia-Godoy's system defines 13 categories. The present study was conducted in field circumstances without optimal conditions for diagnosis (dental records, optical transillumination, radiographs, etc.). The criteria which were employed were based upon published classifications, but inclusion was limited to those categories pragmatically appropriate to the in-school field conditions. Categories were therefore diagnosed according to simple and brief visual inspection and clear answers to interview (e.g. if a tooth was missing and the examiner suspected the reason to be trauma, this was verified by interview of the child and later the parent). Based upon this rationale, we were unable to include diagnosis of root fracture, luxation, intrusion, or extrusion. Trauma was scored as:

- 0 = no evidence of trauma
- 1 = trauma limited to the enamel
- 2 = trauma involving dentine
- 3 = trauma involving the pulp
- 4 = treated trauma, which had clearly involved (at the least) the dentine (usually with composite restoration)
- 5 = discoloration due to trauma (verified by interview)
- 6 = avulsed tooth due to trauma (verified by interview).

In order to further the simplification of subsequent data analysis, we operatively redefined and combined these categories into three groups. The basic rationale was whether teeth were healthy, had experienced mild trauma limited to the enamel, which did not imperatively demand immediate treatment (and which in practice often had not been treated), or teeth which had experienced trauma involving at least the dentine and which medically (not only due to esthetic reasons) demanded treatment. Thus, the following categories were employed:

- 1 = no trauma (score 0)
- 2 = mild trauma (score 1)
- 3 = severe trauma (scores 2–6).

Dental independent variables

1. Lips were recorded as 'competent' if the child entered the room (before being aware of the pending examination) and presented with closed lips, or 'incompetent' if the lips were naturally apart.
2. Overjet was measured (in millimeters), employing a small ruler and measuring the horizontal distance between upper and lower central incisors.

Social and behavioral independent variables

1. School sector was defined according to the municipality into three sectors: public secular (PubS), public religious (PubR), and private orthodox (PrivO). PubR schools are characterized by regular conventional schooling requirements in addition to traditional religious tuition. Both PubS and PubR schooling include organized classes in physical training as part of the curriculum. PrivO schools have a very different curriculum which is predominantly based on orthodox religious rabbinical studies. Classes are segregated by gender and tuition is very regimental and emphasize theoretical studying (with hardly no organized physical training).
2. Socioeconomic level of the children's families was defined according to the fathers' occupations. This was applied using the index previously adapted for Israel and often employed, based originally upon criteria of the British Registrar

General (22). This index supplies a list of most occupations divided into six qualitatively different groupings: social class 1 = higher professions, large employers; social class 2 = lower professions, medium employers; social class 3 = skilled manual workers (white collar); social class 4 = semi-skilled workers (blue collar); social class 5 = unskilled workers; social class 6 = unemployed. Nonworking single mothers are classified as class 6 and working single mothers according to their occupation.

3. Dental injury event was evaluated according to a telephone interview with parents of children with 'severe' trauma. This included the location of the traumatic incident (home, school, 'outside', other); reason for trauma (fall, sport, violence, play, blow from object, bicycle or skates, other).

For univariate statistical analysis, Pearson's chi-square test was employed, when no trauma, mild, and severe trauma were included, and simple logistic regression when only severe trauma was analyzed. In multiple variable analysis, for severe trauma, a multiple logistic regression model was employed. Significance levels were chosen at $P < 0.05$.

Results

The ages of the fifth and sixth grade children ranged from 9 to 13. About 95% ranged between 10 and 12 years. Of these, 50.1% were boys and 49.9% girls. All children present at school on the days of examination were requested to participate. None of the children refused (100% response rate). Less than 5% of the children were absent from the schools due to illness, holiday, or other reasons.

Figure 1 demonstrates the distribution of trauma which was found. Among 70.5% of the children no trauma were detected. Mild trauma was found among 16.1% and severe trauma among 13.5% of the examinees.

In this study no significant association was found between dental trauma and socioeconomic level, according to parent's occupation.

Incisal overjet

No association was found with mild trauma. Table 2 shows the results for severe trauma. For an overjet of 0–3 mm the level of severe trauma was 9.4%, which increased to 17.0% for 4–6 mm, and 30.4% for an overjet of more than 7 mm. In simple regression analysis an overjet of 4–6 mm

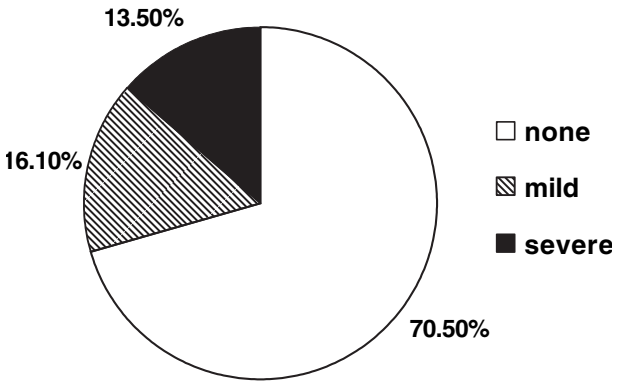

Fig. 1. Distribution of dental trauma among Jerusalem children, by severity.

increased the chances for severe trauma by almost double (unadjusted OR = 1.98, $P < 0.001$), and an overjet of over 7 mm increased the chances for severe trauma by more than fourfold (unadjusted OR = 4.24, $P < 0.001$). According to the multiple regression model, the adjusted odds ratio for overjet of 4–6 mm was 1.50 (95% CI = 1.00–2.24, $P = 0.049$); and the adjusted odds ratio for overjet of over 7 mm was 2.51 (95% CI = 1.17–5.37, $P = 0.018$).

Lip competence

No association was found with mild trauma. Table 2 shows the results for severe trauma. Among children with competent lips the level of severe trauma was 8.3% as compared with 20.6% among those with incompetent lips. In simple regression analysis incompetent lips increased the chance for severe trauma by almost threefold (unadjusted OR = 2.88, $P < 0.001$). According to the multiple regression model, the adjusted odds ratio for incompetent lips was 2.31 (95% CI = 1.55–3.42, $P < 0.001$).

School sector

The levels of mild trauma were highest in the public secular schools: 24.4%, as compared with the public religious (11.9%) and private orthodox (11.4%) schools. Levels of severe trauma were highest among public religious schools: 17.2%, as compared with public secular (12.4%) and private orthodox (12.6%) schools. When chi-square analysis was applied to the association of school sector with mild, severe or no trauma, differences were highly significant ($P < 0.001$). Table 2 shows the results and analysis for severe trauma. In simple regression analysis school sector was not significantly associated with severe trauma. According to

Table 2. Logistic regression analysis of severe trauma on: maxillary incisal overjet, lip competence, school sector, and gender

	n	% Severe trauma	Unadjusted OR	*P*	Adjusted OR[a]	*P*	95% CI adjusted OR
Overjet							
0–3	631	9.4	1		1		
4–6	518	17.0	1.98	<0.001	1.50	0.049	1.00–2.24
7+	46	30.4	4.24	<0.001	2.51	0.018	1.17–5.37
Lips							
Competent	713	8.3	1		1		
Incompetent	461	20.6	2.88	<0.001	2.31	<0.001	1.55–3.42
School sector							
Public secular	418	12.4	1		1		
Public religious	244	17.2	1.46	0.091[b]	1.59	0.048	1.00–2.52
Private orthodox	533	12.6	1.01	0.952[b]	0.92	0.691[b]	0.61–1.38
Gender							
Male	599	16.0	1		1		
Female	596	10.9	0.64	0.010	0.69	0.041	0.49–0.98

[a]Adjusted in a multiple logistic regression model.
[b]Not significant.

the multiple regression model, the chances for severe trauma among children learning in public religious schools were higher than among children in public secular schools (adjusted OR for public religious = 1.59, 95% CI = 1.00–2.52, $P = 0.048$).

Gender

No association was found for mild trauma: as shown in Table 2, boys demonstrated higher levels of severe trauma (16.0%) than girls (10.9%). These results were significant both at the simple regression and the multiple regression levels (unadjusted OR for girls = 0.64, $P = 0.010$; adjusted OR = 0.69, 95% CI = 0.49–0.98, $P = 0.041$).

Dental injury event

The predominant reason for severe dental trauma always was falling. There was no significant difference between levels of having experienced trauma at school (32.2%), home (31.4%), or 'outside' (36.4%). At school, the main reasons for severe trauma were falling ($n = 10$, 30.3%) and violence ($n = 10$, 30.3%), and sport ($n = 9$, 27.3%). At home the reasons were falling ($n = 24$, 66.7%), and thrusting of a 'hard object' in the mouth ($n = 8$, 22.2%). 'Outside' the main reasons were falling ($n = 14$, 36.8%), sport ($n = 13$, 34.2%), and playing ($n = 8$, 21.1%). The other listed reasons were very rarely cited by parents as reasons for trauma. Due to the low numbers these data are only described and were not statistically analyzed. It is interesting to note that at public secular and public religious schools the main reason was falling (25.0% and 36.1%, respectively) but also sport (25.0% and 27.8%, respectively). In the private orthodox schools falling accounted for 60.0% of the reasons given for severe trauma, and all other reasons were very rarely cited by parents.

As is exhibited in Table 2, the largest effect on trauma was an overjet of over 7 mm (unadjusted OR = 4.24, adjusted OR = 2.51), followed by incompetent lips (unadjusted OR = 2.88, adjusted OR = 2.31). In the multiple logistic regression analysis which combined the potential effects of incisal overjet, lip competence, school sector and gender on severe dental trauma, colinearity was examined but not detected between lip competence and overjet.

Discussion

Epidemiological surveys of dental trauma have reported a wide range of prevalence levels as seen in the selection presented in Table 1. The criteria for definition of dental trauma in many of the surveys are different, as are the age groups. Most indices usually differentiate according to level of dental tissue involved, i.e. enamel, dentine, pulpal exposure, extrusion, etc. (20, 21).

The present study demonstrated a general dental trauma prevalence of 29.6%. This included 'mild' trauma limited to the enamel. Severe trauma, at least involving the dentine was found among 13.5% of the fifth and sixth grade schoolchildren (Fig. 1).

Dental trauma was more prevalent among children with an incisal overjet of 4–6 mm (adjusted OR = 1.50) or more than 7 mm (adjusted OR = 2.51); with incompetent lips (adjusted OR = 2.31), who learned in public religious schools (adjusted OR = 1.59) and were males (adjusted OR = 1.45).

In general, children attending private orthodox schools revealed the lowest levels of dental trauma. The main reason for dental trauma in all surroundings was falling, but sports were an important reason at school and outside (not in the home). At private orthodox schools, falling accounted for 60% of the reasons for trauma, with sports and other activities demonstrating considerably less importance. The findings that trauma was lowest among children attending private orthodox schools, that falling was their predominant reason for trauma, and that physical activity was a rarely cited reason, were not unexpected. These children spend considerably more time studying and little time at play.

No differences were detected between trauma reportedly experienced at home, school, or 'outside'. Despite this finding, school teachers are important agents for public health interventions. Schools not only are one of the important locations of potential trauma, but children's physical behaviors are often shaped within this environment.

It should be noted that parents were the source for these reported reasons. A bias needs to be considered, for example, regarding the low levels of reported violence at home. Violence was an often reported reason at school, but less so at home and 'outside'. Despite the relatively low levels reported, this subject should not be ignored. This is specifically evident, according to the data, in schools, where violence was the most cited reason for trauma (together with falling).

Surveys of dental trauma in other countries have demonstrated associations with gender, lip competence, anterior incisal overjet, other orthodontic variables and sporting activities, similar to the results of the present survey (12, 13).

The only previous epidemiological survey conducted in Israel (also conducted among Jerusalem schoolchildren) on permanent teeth trauma was published in 1972 and reported a prevalence of 14.6% among 12–13-year-olds (17). It is inexpedient to attempt extrapolation of a possible trend by comparing these data with those of the present study. The methodologies which were employed were also unfortunately inadequately similar.

This study did not show an association between trauma and socioeconomic level, but did reveal differences between the social environments as are reflected in the different schooling sectors of Jerusalem. These environments influenced the occurrence of dental trauma.

The data derived from this study are currently being employed in an organized municipal effort to educate regular and especially sports teachers, public health nurses, family doctors and schoolchildren, regarding dental trauma. This includes the rationale for a program, etiology of trauma, the potential prevention (with emphasis on mouthguards and early orthodontic treatment where possible) and the treatment of teeth after traumatic experiences. This program, as all public health efforts, is based upon and adapted to the social characteristics of the individual communities.

References

1. Rai SB, Munshi AK. Traumatic injuries to the anterior teeth among South Kanara school children – a prevalence study. J Indian Soc Pedod Prev Dent 1998;16:44–51.
2. Marcenes W, Al-Beiruti N, Tayfour D, Issa S. Epidemiology of traumatic injuries to the permanent incisors of 9–12-year-old schoolchildren in Damascus, Syria. Endod Dent Traumatol 1999;15:117–23.
3. Alonge OK, Narendran S, Williamson DD. Prevalence of fractured incisal teeth among children in Harris County, Texas. Dent Traumatol 2001;17: 218–21.
4. Al-Majed I, Murray JJ, Maguire A. Prevalence of dental trauma in 5–6 and 12–4-year-old boys in Riyadh, Saudi Arabia. Dent Traumatol 2001;17:153–8.
5. Kahabuka FK, Plasschaert A, van't Hof M. Prevalence of teeth with untreated dental trauma among nursery and primary school pupils in Dar es Salaam, Tanzania. Dent Traumatol 2001;17:109–13.
6. Marcenes W, Murray S. Social deprivation and traumatic dental injuries among 14-year-old schoolchildren in Newham, London. Dent Traumatol 2001;17:17–21.
7. Nik-Hussein NN. Traumatic injuries to anterior teeth among schoolchildren in Malaysia. Dent Traumatol 2001;17:149–52.
8. Traebert J, Peres MA, Blank V, Boell Rda S, Pietruza JA. Prevalence of traumatic dental injury and associated factors among 12-year-old school children in Florianopolis, Brazil. Dent Traumatol 2003;19:15–8.
9. Tapias MA, Jimenez-Garcia R, Lamas F, Gil AA. Prevalence of traumatic crown fractures to permanent incisors in a childhood population: Mostoles, Spain. Dent Traumatol 2003;19:119–22.
10. Hamdan MA, Rajab LD. Traumatic injuries to permanent anterior teeth among 12-year- old schoolchildren in Jordan. Community Dent Health 2003;20:89–93.

11. Skaare AB, Jacobsen I. Dental injuries in Norwegians aged 7–18 years. Dent Traumatol 2003;19:67–71.
12. Kania MJ, Keeling SD, McGorray SP, Wheeler TT, King GJ. Risk factors associated with incisor injury in elementary school children. Angle Orthodont 1996;66:423–32.
13. McNutt T, Shannon SW, Wright JT, Feinstein RA. Oral trauma in adolescent athletes: a study of mouth protectors. Pediatr Dent 1989;11:209–13.
14. Levin L, Friedlander LD, Geiger SB. Dental and oral trauma and mouthguard use during sport activities in Israel. Dent Traumatol 2003;19:237–42.
15. Nicolau B, Marcenes W, Sheiham A. The relationship between traumatic dental injuries and adolescents' development along the life course. Community Dent Oral Epidemiol 2003;31:306–13.
16. Diab N, Mourino AP. Parental attitudes toward mouthguards. Pediatr Dent 1998;19:455–60.
17. Zadik D, Chosack A, Eidelman E. A survey of traumatized incisors in Jerusalem school children. J Dent Child 1972;39:185–8.
18. Zadik D. A survey of traumatized primary anterior teeth in Jerusalem preschool children. Community Dent Oral Epidemiol 1976;4:149–51.
19. Abramson JH, Gahlinger PM. Computer programs for epidemiologists. PEPI Version 4.0. Salt Lake City: Sagebrush Press; 2001.
20. Andreasen JO, Andreasen FM. Textbook and color atlas of traumatic injuries to the teeth. 3rd edn. Copenhagen: Munksgaard; 1994.
21. Garcia-Godoy F. A classification for traumatic injuries to primary and permanent teeth. J Pedodont 1981;5:295–7.
22. Kark SL. Epidemiology and community medicine. New York: Appleton-Century-Crofts; 1974. p. 117–8.