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Traumatic dental injuries and related factors among sixth grade schoolchildren in four Palestinian towns

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Abstract – *Background*: Traumatic dental injuries (TDI) are recognized as an important dental public health issue among children. The West Bank, a part of the Palestinian Authority, is in immediate neighborhood to Israel. There are inadequate epidemiologic data among the Palestinian people, on dental health issues. *Aim*: To determine the occurrence of TDI to permanent teeth among sixth grade Palestinian schoolchildren living in four large towns of the West Bank and to investigate associations with anatomic and demographic factors. *Material and Methods*: Eight hundred and four children were sampled and examined in Ramallah, Bethlehem, Hebron and Jericho. Data collection included clinical examinations in schools and questionnaires for demographic and socio-economic background. *Results*: The prevalence of traumatic dental injuries was 17.7%. Enamel fractures and injuries involving dentine accounted for 41% and 42.5% of all injuries, respectively. The most affected teeth (89%) were upper central incisors. Only 5% of the injured teeth were treated. Results of multiple logistic regression confirmed that TDI were significantly ($P < 0.001$) more prevalent among boys, children presenting incisal overjet larger than 5 mm, and incompetent lip coverage. *Conclusions*: The relative high prevalence and very low levels of treated TDI identified in this study suggested that both prevention and treatment of TDI in the West Bank were inadequate.

Traumatic dental injuries (TDI) are recognized as a dental public health issue among children. These injuries often occur at a young age and are characterized by irreversibility, pain, high costs, and treatment burden (1). Traumatic dental injury has been also demonstrated to have psychological and social impacts on the affected children (2, 3). Epidemiologic research has reported that about one-third of all preschool children have suffered trauma involving the primary dentition and about a quarter of school children have suffered trauma to the permanent dentition (1).

A wide range of prevalence levels have been shown for permanent teeth trauma among a wide range of countries. Recent surveys among 11- to 13-year-old children have reported prevalence levels of 6.4% in South Africa, 11.2% in Malaysia, 12.8% in Nigeria, 13.1% in Turkey, 35% in Thailand, and 36% in Brazil. (4–9). Research has demonstrated strong associations with gender, incisal overjet, lip coverage, and sport activities (10).

A previous epidemiologic survey, conducted in Jerusalem, among 10- to 11-year-old Jewish primary schoolchildren, demonstrated a total TDI prevalence of 29.6%. Trauma, which at least involved the dentin, was found among 13.5% of the children. The main reason for TDI in all surroundings was falling, but sports and violence were also important reasons (11). In a similar survey, conducted among 10- to 11-year-old Arab primary schoolchildren in East Jerusalem, trauma prevalence, involving dentin, was 12.6%. The main reported causes for TDI, again, were falling, sports, violence and playing (12).

The Palestinian territory, under the Palestinian Authority, is in immediate neighborhood to Israel, and comprises two geographically separated regions: the West Bank and the Gaza strip. There are inadequate epidemiologic data concerning health issues in general and dentistry in particular, among the Palestinian people.

The aim of this study was to gather information about TDI to permanent teeth among Palestinian schoolchildren living in four cities of the West Bank. Specific objectives were to assess the prevalence of trauma to permanent incisors among sixth graders, and to investigate associations between TDI and independent variables: anatomic and demographic.

Methods

Population and sample

According to official figures, there are 96 700 children studying in 6th grade in the entire West bank. They study in 1827 schools, belonging to one of three different administrative categories. The majority (approximately

70%) study in government schools and the rest are divided between schools operated by the UN Relief and Work Agency (UNRWA) and private schools owned by several Non Governmental Organizations (NGO's).

It was estimated that a minimum sample size of 625 children was required to achieve a level of precision with a standard error of 2% or less. The 95% confidence interval level and a prevalence of TDI of 50% were used for the calculation. The decision to use a prevalence of 50% was due to lack of information of the actual prevalence figures. However, any calculation using a different figure than 50% would require a smaller sample size to achieve the same precision.

A stratified sampling technique was adopted. Four large towns were selected by convenience, and a random sample of children was selected in each town. The sample selection process took into account proportional representation, and the number of schools selected was proportional to the size of the town. All types of schools were included. They were state, NGO, and UNRWA schools, as well as schools for boys only, for girls only, and mixed. A 6th grade class was randomly selected in each school.

Data collection included clinical dental examination and an interview using a structured questionnaire. All data were collected by the same researcher (S.J.), after receiving informed consent from the local education authorities, school principals and parents. The examiner was previously trained. The training and calibration exercise included examining ten children under the supervision of an experienced dental epidemiologist (A.L.). Following this, a group of 50 children were independently examined by the trainee and the trainer. Satisfactory agreement was achieved (Kappa > 0.85), and the training was considered successful. Duplicate examinations were not carried out during the field work to assess intra-examiner agreement due to constraint of returning to previously visited schools.

All clinical dental examinations and interviews were conducted within the schools. All permanent incisors (eight teeth) were examined, with the child seated in a regular chair and the examiner standing, using plane surface reflecting mouth mirrors, CPI periodontal probes and a source of artificial light. Each examined tooth was recorded for the type of injury present; type of treatment provided (when applicable), and type of treatment needed. The criteria for diagnosis were adopted from previously used protocols (2, 13), and based upon the same criteria defined for the Children's Dental Health Survey in the UK 1993 (14): no signs of TDI, treated TDI, enamel fracture, fracture involving dentin, pulp involvement (one of the following: visible pulp exposure, sinus-tract, swelling or tooth discoloration), missing tooth due to TDI. Clinical examination also included assessing incisal overjet and lip competence. Incisal overjet was measured in millimeters as the horizontal distance between upper and lower central incisors, and was recorded as either normal (up to 5 mm) or enlarged (more than 5 mm). Lip competence was observed and recorded when the child first entered the examination room, as suggested in the examination protocol and employed in previous studies (12, 13). Before the subject is aware of being examined, the lip coverage is observed and recorded as either adequate or inadequate (lips not touching each other during the rest position).

A structured questionnaire was applied to participants by the interviewer (S.J.) before each dental examination. A questionnaire previously used in a similar study (2) was translated from English to Arabic, and validated by back translation. It included demographic and socio-economic background (family structure, parents' occupation, employment status, and education level).

Data analysis

All data were entered into a computerized data worksheet (Microsoft Excel 2003), and were later analyzed using statistical package, SPSS version 15.0 (SPSS Inc., Chicago, IL, USA). State schools were under represented in the sample therefore a weighting procedure was employed before calculating the prevalence of TDI, and carrying out the data analysis.

Traumatic dental injuries data are presented descriptively, as distributions of the different levels by proportion of children and by type of teeth affected. Analyses of association included univariate associations of TDI (dichotomized by 'no trauma' or 'any trauma') with clinical and demographic explanatory variables. In most reported variables, the original scales were dichotomized for simplification of analyses. Multivariate analyses were performed using a binary regression model for TDI against all variables that had a minimal tendency ($P < 0.2$) towards statistical significance in the univariate analysis (15). The significance level was set at 5%.

Results

The sample of this survey consisted of 804 sixth grade children of ages 11 and 12 years. Frequency distributions of demographic and socio-economic characteristics of the sample were presented in Tables 1 and 2, respectively.

The prevalence of TDI was 17.7% (95% CI 15.1–20.5%). Table 3 shows the prevalence of different types of TDI. Ninety four children experienced TDI in one tooth and 59 children in two teeth. Altogether, there were 212 injured teeth. Enamel fractures and injuries involving also dentin occurred almost in the same frequency: 87 (41%) and 90 (42.5%), respectively (of all 212 injured teeth. Most of the injuries were in upper central incisors (188/212, 89%).

Only 11 TDI in upper central incisors were treated with composite resin restorations. All other TDI were untreated. Among the 201 untreated injured teeth, only 30 (15%) did not need treatment. Treatment needs included simple composite resin restorations (68%); root canal treatment (11%), internal bleaching due to discoloration (2%); needed fixed or removable prosthetic replacement for missing teeth (5.5%).

Only 48 (6%) children had inadequate lip coverage, whereas 756 (94%) presented competent lips. Enlarged incisal overjet was recorded in 109 children (13.9%). Among the children with inadequate lip coverage ($n = 48$), the majority (94%) also had enlarged overjet.

Table 1. Frequency distribution of the study population by town, school types, and gender

	Children				By school sectors[1]			By gender mix[1]		
Town	Boys	Girls	Total	%	Gov	NGO	UNRWA	Boys	Girls	Mixed
Bethlehem	123	117	240	30	95 (3)	104 (3)	41 (1)	103 (3)	96 (3)	41 (1)
Hebron	111	130	241	30	94 (3)	67 (3)	80 (2)	63 (2)	106 (4)	72 (2)
Jericho	91	71	162	20	81 (2)	40 (1)	41 (1)	40 (1)	41 (1)	81 (2)
Ramallah	72	89	161	20	68 (2)	19 (1)	74 (2)	62 (2)	80 (2)	19 (1)
Total	397	407	804	100	338 (10)	230 (8)	236 (6)	268 (8)	323 (10)	213 (6)

NGO, Non Governmental Organizations; Gov, Government; UNRWA, UN Relief and Work Agency.
[1]Numbers in parentheses are of schools (classes) in each sector.

Table 2. Socio economic profile of participants' parents ($N = 804$)

	Fathers[1]		Mothers[1]	
	N	%	*N*	%
Employment				
Employed	709	88.2	137	17
Unemployed	85	10.6	658	81.8
Occupation				
Manual	530	65.9	32	4.0
Non-manual	174	21.6	110	13.7
Education level				
Primary to high school	464	57.7	479	59.6
University	181	22.5	110	13.7

[1]Numbers and percentage excluding missing data or 'don't know' answers and therefore not summing to total

The majority (58.7%) of children with enlarged overjet had normal lip competence.

Traumatic dental injuries were associated with gender and geographic area of residence. The odds for experiencing TDI were 1.6 times higher ($P < 0.01$) for boys, compared with girls (Table 4). Children living in Bethlehem, Hebron, and Jericho were 1.7 times more likely to experience TDI than their counterparts living in Ramallah ($P < 0.05$) (Table 4).

There were no statistically significant associations between TDI levels and parents' occupation, employment or education level (not presented in the tables). There were also no statistically significant associations between TDI levels and administrative sectors or gender-mix of schools. TDI occurrence was slightly lower in the government administered schools, but the differences were not statistically significant (Table 4).

There were significant ($P < 0.001$) associations between TDI and inadequate lip coverage and incisal overjet larger than 5 mm. While the general TDI occurrence among all study sample children was 19%, among those with incompetent lips the level was 81.3%, and among those with enlarged incisal overjet the level was 69.7%. The odds for experiencing TDI were therefore 18.5 times higher among children with enlarged incisal overjet, and 24.4 times higher among those with incompetent lips.

As some of the variables associated with TDI are related to each other, there might have been a bias of their independent effects. A model of binary logistic regression was conducted to allow adjustment for these potential confounding and modifying effects. The results confirmed that all variables remained statistically significantly associated after adjustment for the other variables. The odds ratio of 'town' and 'gender' on TDI increased. Boys had twice the chance of experiencing TDI compared with girls ($P < 0.001$). Children from Bethlehem, Hebron or Jericho had almost twice (1.9) the chance of experiencing TDI compared with those from Ramallah ($P = 0.04$). In contrast, the odds ratio of incisal overjet and lips coverage on TDI decreased (Table 4). The effect of incompetent lips, after adjustment, demonstrated an OR of only 4.2 (compared to 24.4 unadjusted). This may be due to the known high correlation between these two variables. When two explanatory variables are highly correlated (more than 0.9), problems may arise and it may be advised to exclude one variable in the multivariate model (15). However, in this study, the Spearman correlation

Table 3. Distribution of traumatic dental injuries (TDI) by affected teeth and type of TDI

	By children		By teeth				
	N	%	Upper central	Upper lateral	Lower central	Lower lateral	Total
No trauma	651	81.0	–	–	–	–	–
Enamel fractures only	65	8.0	80	4	3	0	87
Dentin fractures	63	7.8	77	7	6	0	90
Pulp involvement	9	1.2	11	0	0	2	13
Missing tooth due to TDI	10	1.2	9	1	1	0	11
Treated teeth due to TDI	6	0.8	11	0	0	0	11
Total TDI	153	19.0	188	12	10	2	212
Total	804	100					

Table 4. Association of TDI with gender, town, size of incisal overjet, lip coverage, and schools' categories: frequency distribution and logistic regression analyses

Variables	No TDI (%)	TDI (%)	All (%)	Unadjusted OR (95% CI)	Adjusted OR[1] (95% CI)
Gender					
Girls	344 (84.5)	63 (15.5)	407 (50.6)	1.0	1.0
Boys	307 (77.3)	90 (22.7)	397 (49.4)	1.6 (1.1–2.3)*	2.0 (1.3–3.1)**
Town					
Ramallah	140 (87.0)	21 (13.0)	161 (20.0)	1.0	1.0
Bethlehem	193 (80.4)	47 (19.6)	240 (30.0)	1.7[2] (1.0–2.8)*	1.9[2] (1.0–3.4)*
Jericho	126 (77.8)	36 (22.2)	162 (20.0)		
Hebron	192 (79.7)	49 (20.3)	241 (30.0)		
Incisal overjet					
≤5 mm	618 (88.9)	77 (11.1)	695 (86.4)	1.0	1.0
>5 mm	33 (30.3)	76 (69.7)	109 (13.6)	18.5 (11.5–29.6)**	12.7 (7.3–22.3)**
Lip coverage					
Normal	642 (84.9)	114 (15.1)	756 (94.0)	1.0	1.0
Incompetent	9 (18.8)	39 (81.3)	48 (6.0)	24.4 (11.5–51.7)**	4.2 (1.7–10.4)**
School category					
Government	283 (83.7)	55 (16.3)	338 (42.0)	1.0	
NGO's	180 (78.3)	50 (21.7)	230 (28.6)	1.4 (0.9–2.2)[ns]	
UNRWA	188 (79.7)	48 (20.3)	236 (29.4)	1.3 (0.9–2.1)[ns]	
Gender mix					
Mixed	169 (79.3)	44 (20.7)	213 (26.5)	1.0	
Boys only	208 (77.6)	60 (22.4)	268 (33.3)	1.1 (0.7–1.7)[ns]	
Girls only	274 (84.8)	49 (15.2)	323 (40.2)	0.7 (0.4–1.1)[ns]	
Total	651 (81.0)	153 (19.0)	804 (100)		

NGO, Non Governmental Organizations; TDI, traumatic dental injuries; UNRWA, UN Relief and Work Agency.
[1]Adjusted for the other three significant factors.
[2]Combined Odds Ratios for other three towns vs Ramallah.
[ns]Not statistically significant.
*Statistically significant at the level of $P < 0.05$.
**Statistically significant at the level of $P < 0.001$.

coefficient between these two variables was 0.59 (2 tailed $P < 0.001$). Both of these variables therefore remained in the model.

Discussion

This study is the first of its kind conducted within the Palestinian community.

The prevalence of TDI, in the four towns included in this study, was 17.7% (95% CI: 15.1–20.5%). This level was similar to the TDI occurrence levels of 17.3–21% reported among 12-year-old children in several Brazilian studies (16–18). Israeli surveys among Jewish and Arab children in Jerusalem reported higher prevalence of TDI, 29.6% and 33.8%, respectively (11, 12). Lower levels were reported among similar age groups in other middle-east countries: 11.5% in Iraq, 11.7% in Syria, 13.8% in Jordan, and 14.5% in Kuwait (7, 19–21). Prevalence levels are often not readily comparable due to differences in diagnostic criteria and methodologies.

The actual prevalence of TDI is likely to be higher than the figure reported in this study. The diagnostic criteria included only fractures to the teeth and excluded concussions, subluxations, vertical and horizontal luxations, or teeth out of position due to trauma. It should be noted that many luxation injuries may be clinically missed due to lack of radiology application and that luxation injuries are common in the permanent dentition and may give rise to complications. Tooth discoloration was included in the 'pulp involvement' category of TDI.

Only eleven injured teeth were restored (out of 212 = 5%), among six children of this study sample. This finding represents a very low level of treatment compared with data from most previous studies, which report a range of 14.6–30% of treated teeth following TDI (4, 18, 22, 23). This might reflect both a low availability of dental services within the Palestinian community, and potentially a low priority of this health issue relative to other daily problems. Low TDI treatment levels are of serious potential psychosocial impacts, as has been demonstrated in previous research (2).

According to multiple logistic binary regression analysis, higher risk ratios were found for boys (adjusted OR = 2.03), children with enlarged overjet (adjusted OR = 12.74), and incompetent lips (adjusted OR = 4.17). These factors are commonly mentioned as known risk factors, and the ratios found in this study resemble those of previous research (11, 12, 18, 24).

Some researchers have suggested that the risk of TDI may be associated with socio-economic status (SES) indicators such as material deprivation, overcrowded neighborhoods or parents' level of education (24–26). In our study, we did not identify a significant association of TDI and parents' education level, occupation or employment status. This is consistent with a recent literature review that examined associations between TDI and SES indicators (27).

Lower levels of TDI were found among children enrolled in government schools, but the difference was not of statistical significance. This may be a type 2 error. Moreover, this may have been due to higher proportions of girls in government schools (approximately 60% vs 40%) as compared with NGO schools (Table 1).

Children from the town of Ramallah were somehow more 'protected' from experiencing TDI compared with children from other towns, who were almost twice as likely to experience TDI. Further research should assess the reasons for this difference. Possible explanations included cultural issues. Potential effect of school categories, gender distribution, family structure, and other SES factors were all examined, but not found to be of significant influence.

Unfortunately, data concerning circumstances of TDI events were not recorded and thus, full understanding and interpretation of the data were not accomplished. This is a shortcoming of this study and further data collection is required to investigate the different causes for trauma. This is essential information especially for public health leaders and administrators, in their planning and implementation of preventive measures.

The sample in this study cannot be regarded as representative of the whole cohort of 11 and 12 year old Palestinian children in the West bank. Within the restraints of practical limitations, the convenience (albeit purposive) sample was limited to four of the larger towns and excluded small towns and rural populations.

Public health efforts need to highlight the importance of TDI and its potential psychosocial impact TDI on the daily life of children identified in other studies. The relative high prevalence and very low levels of treated TDI identified in this study suggested that both prevention and treatment of TDI in the West Bank demand special attention of dental care suppliers and the appropriate health care institutions.

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