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Traumatic dental injuries of permanent incisors in 11- to 13-year-old South African schoolchildren

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Abstract – Traumatic dental injuries (TDI) are common in children. There are few data on prevalence of TDI in South African populations. We assessed the prevalence and causes of TDI to anterior teeth in 11- to 13-year-old South African schoolchildren through a cross-sectional study, using a random cluster sampling method. Oral examinations were performed by calibrated examiners following training for TDI to anterior permanent incisor teeth (eight teeth) using a modified version of Ellis's classification. Of the study population of 2610 children aged 11-13 years old from 26 primary schools, 1665 children participated. The response rate was 64%. More than two-thirds (64.4%) were 12 years old. One hundred and six children had a TDI (6.4%). After adjusting for the effect of age and socio-economic status, boys had an almost 2.5 (95% CI: 1.59, 3.69) times higher probability of having a traumatic dental injury than girls. The highest prevalence was in 12 year olds and in the high socio-economic status group. Most of the children had trauma to one tooth. Enamel fracture was the main type of TDI (69.1%). The majority of the TDIs were untreated (85.4%). Homes and schools were the most common places where TDIs occurred, while only 5.7% occurred on a street, road or pavement. Falls were the main cause of TDIs. Sport was the second most common cause and the third most common cause was collision with objects. The present study indicates that the prevalence of TDIs in schoolchildren is not as high as has been reported in other countries. The prevalence of TDIs in this population was relatively low.

Childhood injuries, both intentional and unintentional, are a global public health problem. By the year 2020, the World Health Organization predicts that injuries will become the foremost reason for human life years lost (1). It has been estimated that injuries accounted for 9% of deaths and 12% of the burden of disease worldwide in 2000 (2). Many of these injuries result in varying degrees of disability, and, depending on the cause, severity and circumstances may result in serious physical, psychological, educational, social and economic consequences for the affected individuals and their families. There is a paucity of data on the prevalence of traumatic dental injuries (TDI) from Africa. A few studies in 11- to 13year-old Africans have been reported with the prevalence ranging between 9.8% and 19.1% (3-7). As the classification of the causes of TDI varies greatly between studies, it is difficult to compare them. Variations in prevalence of TDI have been attributed to the environment, the study sites, examination methods, type of dentition and the TDI classification used (8). Adekoya-Sofowara (9) reported that boys sustained injuries to the permanent dentition almost twice as often as girls.

South Africa has a high proportion of deaths from injuries. The burden from injuries, both intentional and

unintentional, is extremely high, especially for males (10). TDI are often associated with other injuries (11). TDI are relatively common in children. They affect about one in five children (12-14). Having untreated fractured teeth was directly related to impacts on appearance of the children and affected their emotional state (15). Children with fractured teeth also experienced more difficulties with 'eating and enjoying food' and were more frequently teased than those without traumatic injury (15). There is only one previous reported South African study on anterior TDIs in 11-year-old children (6). The lack of reliable statistics has largely hidden the health and development impacts of TDIs in South Africa. The objective of this study was to assess the prevalence and causes of TDI to anterior teeth in 11to 13-year-old South African schoolchildren. Strategies for prevention and policy are also suggested.

Methods

The Ugu Health District in Kwazulu Natal (KZN), South Africa, was selected for this study because it had socio-economic problems typical of many areas of South Africa; high levels of poverty, poor infrastructure, high illiteracy and innumeracy levels (16). The study was cross-sectional, using a random cluster sampling method. The estimated sample size was based on a TDI prevalence rate of 20% (95% CI), with a minimum required sample size of 1500.

A random cluster sample of all the primary schools (n = 210) in the Ugu district was done and 26 schools were included and agreed to participate in the study. The study population was all 2610 schoolchildren aged between 11 and 13 years in the 26 selected schools. As many of the schools were located in small communities, principals and class teachers were requested to fill in the socio-economic category (low, medium, high) of the child.

Oral examinations were performed by calibrated examiners following training and calibration for TDI to anterior permanent incisor teeth (eight teeth) using a modified version of Ellis's classification (17). The study was limited to the anterior teeth as other teeth are seldom traumatized. Discoloured teeth were recorded as injured when there was homogenous discoloration and a positive history of traumatic dental injury. The criteria and scoring for TDI is shown in Table 1. Type of treatment provided (Table 3) and type of treatment needed (Table 4) were also recorded.

Children were seated and examined using plane mouth mirrors and explorers under a portable headlight. No radiographs were used. Ten per cent of the children were re-examined by each examiner. High intra- and interexaminer Kappa scores ranging from 0.85 to 0.95 were obtained. All children who had clinical evidence of TDI were interviewed regarding the cause of the injury.

Data analysis

Prevalence figures are reported for TDI by sex, age and socio-economic status strata. Chi-squared statistics were used for differences in TDI prevalence between sexes and chi-squared for trend for differences between different age and socio-economic status groups. Furthermore,

Table 1. The modified Ellis classification and criteria and scoring for TDI (9)

	Code	Criteria	Description							
1	0	No trauma								
	1	Enamel fracture	Simple fracture of crown, enamel only; involving little or no dentine							
1	2	Enamel and dentine fracture	Extensive fracture of the crown involving considerable dentine but with no pulp							
;	3	Enamel and dentine fracture with pulp	Extensive fracture of the crown involving considerable dentine and exposing dental pulp							
	4	Non-vital tooth with discoloration	Traumatized tooth that is no vital, and is discoloured, with or without loss of crown structure							
	5	Displacement	Extrusion, intrusion or lateral displacement							
1	6	Total tooth loss	Absence of tooth due to complete ex-articulation							
	7	Fracture and restoration	Restored tooth with composite or crown following fracture of crown							
	TDI. traumatic dental iniury.									

logistic regression analysis allowed for the assessment of the relationship between TDI and sex, adjusted for the effect of age and socio-economic status.

Informed consent was obtained from the parents. Ethical approval for the study was obtained from the Research Ethics Committee of the University of the Western Cape (ref. 2006/C023). Signed informed consent was received for each child. Each participant received an individual oral health report after the survey, with appropriate advice.

Results

Of the 2610 children in the Ugu Health District schools aged 11–13 years from the 26 primary schools, 1665 children participated. The response rate was 64%. There were more girls (n = 883, 54%) than boys (n = 782, 47%). More than two-thirds (64.4%) were 12 years old. One hundred and six children had a TDI (6.4%). The highest prevalence of TDI was in 12 year olds and in the high socio-economic status group; however, there was no significant variation in TDI between age groups or by socio-economic status. There were significant sex differences in the prevalence of TDI. Twice as many males (9.1%) than females (4.0%) had a TDI (Table 2). After adjusting for the effect of age and socio-economic status, boys were 2.43 (95% CI: 1.59, 3.69) times more likely to have a traumatic dental injury than girls (P < 0.001).

Most of the children had trauma to one tooth (5.4%) and 1% to two teeth. Each child was examined for TDI to the eight upper and lower incisor teeth. There was evidence of TDI to a total of 123 teeth (6.4%). The majority (n = 116) were of the upper teeth and only seven in the mandible. The upper central incisors were the most common teeth with TDI. 48.1% were the upper right central incisor and 40.7% the upper left central incisor.

Enamel fracture was the main type of TDI (69.1%); 22.8% involved only enamel and dentine and in 5.7% there was involvement of enamel, dentine and pulp. The

Table 2. Prevalence of traumatic dental injuries, by sex, age and socio-economic status

	TDI p	resent	No TDI		
Variables	n	%	п	%	<i>P</i> -value
Sex ¹					
Boys	71	9.1	711	90.9	< 0.001
Girls	35	4.0	848	96.0	
Age in years ²					
11	19	7.5	233	92.5	0.368
12	57	5.3	1015	94.7	
13	30	8.8	311	91.2	
Socio-economic status ²					
Low	20	5.2	366	94.8	0.342
Medium	67	6.7	935	93.3	
High	19	6.9	258	93.1	
TDI, traumatic der ¹ Chi-squared test. ² Chi-squared test	ntal injur for trend	y. 1.			

	Untreated trauma		Acid reste	etch pration	Perma- nent crown		Total	
Affected tooth	п	%	п	%	п	%	п	%
12	5	4.0	1	0.8			6	4.8
11	42	34.2	7	5.7	1	0.8	50	40.7
21	53	43.2	5	4.1	1	0.8	59	48.1
22					1	0.8	1	0.8
32	1	0.8					1	0.8
31	1	0.8	1	0.8			2	1.6
41	1	0.8	1	0.8			2	1.6
42	2	1.6					2	1.6
Total	105	85.4	15	12.2	3	2.4	123	100.0

Table 3. Distribution of affected tooth by type of treatment provided

majority of the TDIs were untreated (85.4%) (Table 3), 12.2% had an acid-etch composite restoration and three teeth had a permanent crown. More than two-thirds needed treatment in the form of an acid etch restoration (Table 4).

Homes (46.3%) and schools (35.8%) were the most common places where TDIs occurred. 5.7% occurred on a street, road or pavement. Falls were the main cause of TDI (43.4%). Sport was the second most common cause (13.2%) and the third most common cause was collision with objects (9.4%). 8.5% reported that they did not know what had caused the TDI.

Discussion

The prevalence of TDIs in this population of South African schoolchildren is not as high as in other countries. A prevalence of 6.4% for 11- to 13-year olds is similar to some reports from Nigeria (3, 5, 14), but much lower than in other reported studies (14). As the classification of the causes of TDI varies greatly between studies, it is difficult to compare them. Variations in prevalence of TDI have been attributed to the environment, the study sites, examination methods, type of dentition and the TDI classification used (8).

There was a significant variation in dental trauma between the sexes, with boys having a higher prevalence than girls. After adjusting for the effect of age and socioeconomic status, boys had almost 2.5 times higher probability of experiencing a traumatic dental injury than girls. In a review of the literature, it was reported that boys sustained injuries to the permanent dentition almost twice as often as girls (9). Our findings are in accordance with a previous review (9) and with other studies (14, 18–20). This difference by sex is attributed to greater participation of boys in contact sports, fights and car accidents (21–27).

There was no social class gradient in TDIs in our study. Twelve-year-old boys from a medium socioeconomic status background were most commonly affected with TDI. The few studies addressing dental trauma and socio-economic status have reported conflicting findings. Some authors (14, 28) reported a higher prevalence of TDI among the highest socio-economic group, whereas others (21, 29, 30) found that the lower socio-economic groups were more prone to TDIs. The conflicting findings may be related, to some extent, to the fact that the aforementioned studies refer to different countries, which do not necessarily share common socioeconomic status patterns. Furthermore, one limitation of our study relates to the nature of the socio-economic status data. For practical reasons, socio-economic status was indirectly assessed for each child by the principals and/or class teachers and, therefore, lacks objectivity.

Most of the TDIs occurred at home and at school. The levels of TDI at home were higher than that at school. The role of the school environment as a determinant of TDI is well established. In schools that have a supportive social and physical environment, TDI are less likely (31, 32). Older school boys need to be targeted for prevention activities. In view of our findings, it is also important to consider strategies for reducing TDI in the home environment, possibly by involving parents more closely in this approach.

Falls were the most common reason for the TDI. This finding is similar to that reported by previous studies (19, 30, 33). The next more common cause was sport. A study in 9- to 12-year olds reported that 9% sustained TDIs due to sport (24). Collision was the third most common reason. Other causes also reported 'ran into objects' or collision, as a cause of TDI (19, 34).

Table 4. Distribution of affected tooth by type of treatment needed

	No tre	eatment	Acid etch restoration		Crown		Acid etch restoration + root treatment		Permanent crown + root treatment		Other restoration		Total	
Affected tooth	п	%	п	%	п	%	п	%	п	%	п	%	п	%
12	1	0.8	4	3.2			1	0.8					6	4.8
11	18	14.6	31	25.2	1	0.8							50	40.7
21	13	10.6	40	32.6	1	0.8			2	1.6	3	2.4	59	48.1
22	1	0.8											1	0.8
32			1	0.8									1	0.8
31	1	0.8	1	0.8									2	1.6
41			2	1.6									2	1.6
42	1	0.8	1	0.8									2	1.6
Total	35	28.5	80	65.1	2	1.6	1	0.8	2	1.6	3	2.4	123	100.0

It was anticipated that due to the very high levels of interpersonal violence in South Africa that TDIs would be more common and mainly due to violence. Neither was true in this population. Most of the TDIs were untreated. However, in the present study, as in other studies, the majority of the TDIs affected only the enamel and did not require restorative treatment (21, 35, 36). On the other hand, almost a quarter of TDIs affected the dentine and 5.7% affected the enamel, dentine and pulp. The predominant concern of dentistry has traditionally been the treatment and prevention of caries. With decreasing prevalence of caries in some communities, dental public health for children is focusing on other oral health issues including the importance and impact of TDIs (28, 37).

Preventive strategies need to address the underlying determinants of oral conditions to achieve sustainable improvements in oral health and to reduce inequalities. A guiding concern for injury prevention practitioners and researchers is why and how childhood injuries occur. The two common aetiological models are the socioecological model and the Haddon matrix (38). The socioecological model has become well established over the last 3 decades and is useful in developing an understanding of the broader factors that impact on individual behaviour. This model provides a useful framework for injury prevention efforts, as various networks and institutions, including schools, communities and legislative bodies, should all play their role in creating a safer environment for children. The model may be applied for preventing both accidental and unintentional (for example, child abuse) injury events.

The Haddon matrix was initially developed with a focus on non-intentional traffic injuries but has been widely applied to understand the development of the phases of any injury event. The theoretical framework provides a guide that is generally used to establish actions for childhood injury prevention. It makes sense to accept the commonality of the intertwining of accidental and non-accidental injuries, rather than separate causes, as they overlap. Intentional and non-intentional injury events share many common risk and resilience factors. Strategies aimed at decreasing those will have a simultaneous positive impact on reduction of both types of injuries.

Conclusions

The prevalence of TDIs in this population was relatively low, but that the majority was untreated. TDI have been shown to have serious effects on the quality of life of children (39) and should not be neglected.

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