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Factors associated with traumatic dental injuries among 12-year-old schoolchildren in South India

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Correspondence to: Jamil David, Centre for International Health, University of Bergen, P.O. Box 7804, N-5020 Bergen, Norway Tel.: +47 55588372 Fax: +47 55588561 e-mail: jamildavid@hotmail.com Accepted 17 April, 2009 Abstract – Aims: To assess the prevalence of, and correlates of traumatic dental injuries among 12-year-old schoolchildren in Kerala. Material and Methods: A cross-sectional, two-stage cluster sampling technique was used. The sample size included 838 12-year-old school children. Traumatic dental injuries to the anterior teeth were evaluated clinically by one examiner. Teeth examined were maxillary and mandibular incisors and canines. The children answered a structured questionnaire on sociodemographics, subjective oral health assessments and behavioural aspects. Results: Six per cent of the 12-year-old school children had traumatic dental injuries to the anterior teeth. The right central incisors were most frequently affected. Multiple logistic regression analysis showed that boys (Adjusted Odds Ratio (Adj OR) = 2.2, 95% Confidence Interval (CI) = 1.1-4.1) and children who disagreed that good marks in school were important to them (Adj OR = 2.3, 95% CI = 1.2-4.3) had a higher probability of having traumatized teeth than other children. Conclusions: The prevalence of traumatized anterior teeth among 12-year-olds in Kerala was low compared with other studies. Being male and negative about future career were associated with a higher probability of having a traumatized tooth.

The last decades have observed a dramatic increase in the number of research articles related to dental trauma among adolescents. This may indicate that traumatic dental injury (TDI) has evolved into a major public health problem. Studies indicate that in industrialized countries, about one in five children have had a TDI to permanent teeth before leaving school (1). Insight into some of the factors associated with dental trauma will help to formulate strategies to prevent the burden of the injury.

The majority of the studies of TDIs to permanent teeth in adolescents were conducted in Europe or the Americas. However, there are too few studies from Asia and Africa. The prevalence of TDIs among adolescents in the Americas and Europe ranged from 15% to 23% and 23% to 35%, respectively (2–9). Corresponding prevalence rates among adolescents in Asia and Africa ranged from 4% to 35% and 15% to 21% (10–14). Trauma to anterior teeth in the Asia-Pacific region ranged from 6% to 19% (15, 16). Published and unpublished reports from India have found prevalence of trauma to permanent anterior teeth among adolescents between 3% and 14% (17–20).

Of the few studies conducted regarding TDIs and socioeconomic status, the majority confirmed that traumatic injuries were significantly more common in children of high socioeconomic status than in those of low socioeconomic status (13, 21, 22), a few found the opposite trend (2, 6) and some have concluded that no association existed between socioeconomic status and TDIs (11, 23).

Dental aesthetics is considered to be influential in shaping people's identity and this association has attracted the attention of psychologists and oral epidemiologists (24, 25). Empirical studies show that children with an untreated TDI lose time from school for treatment (26) and the injury impacts on their quality of life (24, 26, 27). This problem is further exacerbated by high costs of treatment (26–28) resulting in most TDIs being untreated. Locker (4) revealed that an association existed between dental trauma and caries and postulated the cause due to risky behaviours within certain deprived populations.

TDIs among adolescents are of particular interest as reports show that injuries peak during adolescence (9, 23, 29, 30). Adolescence is a period in life when many healthrelated behaviours such as crime, smoking, drug use and reckless behaviours occur more frequently (31) and this may lead to repercussions, for e.g. physical or mental trauma (32). Furthermore, Delaney-Black et al. (32) suggested that children exposed to some form of violence early in life are subject to negative intellectual development.

Globally dental injuries to permanent anterior teeth are more common among boys than in girls (4, 8, 9, 11–13, 17). The high occurrence of TDIs in boys is

generally due to unintentional accidents, violence and outdoor activities like sports and games (3, 9, 12, 13, 17, 23). There are a few reports showing that TDIs are more common among girls (5, 33), whereas, no differences by sex has been found in other studies (34, 35).

Previous studies report that maxillary central incisors were mainly affected by TDIs (10, 11, 17, 18, 36–38). The majority of individuals had only one tooth injured (17, 36). No preponderance in injury to teeth on right and left sides of the mouth was observed (10, 36, 37), but some authors reported a slight predominance of traumatic injuries to the left central incisor compared with the right (39, 40).

The objectives of the present study were to ascertain the prevalence of anterior tooth trauma among 12-yearold school children in Kerala and to study associations between traumatic dental injuries and sociodemographics, self-reported appearance of teeth, attitude toward future career and caries status.

Materials and methods

Study area and population

The study was carried out in Thiruvananthapuram, Kerala, India. The sample consisted of 12-year-old school children studying in the 7th grade (upper primary school) of government and private schools. Approximately, 95% of the adolescents attend schools in the district.

Sampling and procedure

The study subjects were mainly recruited for a former study on dental caries (41). A stratified, two-stage random cluster sample design was applied, using schools as the primary sampling unit. The sample size was estimated allowing for a design factor of 2, caries prevalence of 60% and absolute precision of 0.05. The required sample size calculated was 738. Fifteen percent was added in order to counter non-response. At stage 1, 30 schools (8 urban from a total of 39 and 22 rural from a total of 177) were selected with probability proportional to size from the list of schools in the areas. At stage 2, 28 schoolchildren were randomly selected from each school selected at stage 1 on the day of the examination. In total, 838 school children participated in the study and they were subjected to an oral examination and a structured self-reported questionnaire.

Structured questionnaire

A structured questionnaire consisting of questions pertaining to sociodemographic factors, satisfaction with appearance of teeth and the subjective importance of good grades in school was completed by the school children. Prior to the main survey the questionnaire was piloted and changes made when required. The pilot questionnaire was translated to the local language (Malayalam). In order to check for validation, the questionnaire was translated back into English. Issues related to cultural sensitivity and inclusion of appropriate words were given due consideration. Questions were read out to children in classrooms in an orderly manner giving children adequate time to ask questions if needed. A post-test of the questionnaire was conducted in seven schools (n = 108, approx 10%) and the days between the pre-and-post-test ranged from 7 to19 days. In order to avoid any form of bias teachers were excluded from managing any sort of activity when students answered the questionnaire.

Measures used

Independent variables: Gender was coded as 0 = female and 1 = male, and area coded as 0 = urban and 1 = rural. Social economic status was constructed from information of durable household assets (bicycle, television, fridge, motorcycle and car, 0 = no, 1 = yes). In order to classify individuals into different social classes each household asset was given a score (cycle = 1, television = 2, fridge = 3, motorcycle = $\frac{1}{2}$ 4, car = 7). The socioeconomic status summation index ranged from 0-17 and was categorized as (0) $0 = \text{poor class}, (1) \quad 1-10 = \text{middle class and} (2)$ 11-17 = high class. Self-reported mother's level of education was registered: (i) lower primary or upper primary school, (ii) high school, (iii) secondary school, (iv) degree or master degree, (v) no education (vi) don't know. One dummy variable was constructed yielding the categories (0) have not gone to school/do not know, (1) lower/upper primary and high school (2) secondary school/degree and master degree. Satisfaction with appearance of teeth was assessed with a four-point Likert scale ranging from (1) very satisfied to (4) very dissatisfied. The scores were then dichotomized as (0) satisfied with appearance of teeth (combining 1 and 2) and (1) dissatisfied with appearance of teeth (combining 3 and 4). A variable investigated future educational orientation by asking whether good grades were important to the child. The question had four-point Likert scale ranging from (1) strongly disagrees to (4) strongly agree. A dichotomized variable was constructed with (0) agree (combining 3 and 4) and (1) disagree (combining 1 and 2).

Clinical examination

The examiner was calibrated at the Faculty of Dentistry, Bergen, Norway. Oral examination was conducted by one examiner (JD). Two students (total = 108) in each school were examined twice to check for intra-examiner reliability.

Teeth registered as traumatized were teeth with fractures. A tooth crown was scored as fractured when some of its surface was missing as a result of trauma and there was no evidence of caries (42). Teeth which exhibited both trauma and caries were included in the caries category. Teeth with dark discolouration, presence of swelling or fistula adjacent to an otherwise healthy tooth and teeth missing due to trauma were also registered as traumatized. Teeth were examined by direct vision. Neither vitality tests nor radiographs were used to assess the extent of the fractured teeth. In the analyses the children were categorized as having no anterior tooth trauma (0) or one or more teeth with traumatic injury (1). In addition, traumatic injury were categorized using O'Brien's classification (1) (Code 1 – discoloration, Code 2 - fracture involving enamel, Code 3 - Fracture involving enamel and dentine, Code 4 - Fracture involving enamel, dentine and pulp, Code – 5 – Missing to trauma, Code 6 - Acid-etch composite restoration, Code 7 – Permanent replacement including crown, denture, bridge pontic, Code 8 - Temporary restorations, Code 9 – Assessment cannot be made. Dental caries was registered using the WHO criteria (42). During the tooth examination children were questioned regarding the location of where the traumatic incidence occurred.

Statistical analyses

The data were analysed using the sPSS version 14.0 (SPSS Inc, Chicago IL, USA). Chi-square test was used for bivariate analyses. An entry method of multivariate logistic regression was performed. In Block 1 sociode-mographic variables were entered while the remaining variables were included in Block 2. All variables were forced into the final model irrespective of their significance. Interactions between variables were examined. The 95% confidence intervals (CI) and odds ratios (OR) were estimated. The significance level was set at 5%.

Ethical approval

Before the commencement of the study the proposal was approved by the ethical committees (Ethical Committee at Thiruvananthapuram Medical College and Norwegian Ethical Committee) in India and Norway. To participate in the survey, all principals of schools and selected students were required to give a letter of consent. Children diagnosed with anterior teeth injury were referred to a local dentist if warranted.

Results

The prevalence of TDIs in the study population was 6.1%. Trauma was most frequently seen in maxillary central incisors (92%, n = 57). Forty children had one traumatized anterior teeth, while two teeth were traumatized in 11 children. None of the anterior teeth fractures involved the pulp and the majority required two surface restorations. Most of the traumatic episodes occurred outside school hours (60%).

Table 1 presents the distribution of the study population according sociodemographic characteristics, satisfaction with appearance of teeth, the reported importance of good marks, and the prevalence of TDI and dental caries. The Kappa values for the test-retest of the questionnaire (n = 108) ranged from 0.41 (satisfied or dissatisfied with appearance of teeth) to 0.97 (socioeconomic status). The Kappa values for fractured anterior teeth was excellent ($\kappa = 1$).

Table 1. 1	Distributio	on of	12-year-old	children	acco	rding	to
sociodemo	ographic	factors,	subjective	assessme	ents,	attituo	des
and clinic	al features	N =	838)				

	% (<i>n</i>)
Gender	
Girls	42.8 (359)
Boys	57.2 (479)
Area	
Urban	26.5 (222)
Rural	73.5 (616)
Socioeconomic status	
High class	4.8 (40)
Middle class	69.9 (585)
Poor class	25.3 (212)
Mother's education	
Secondary school/masters	20.3 (170)
Lower/Upper primary school	67.1 (562)
Haven't gone to school	12.6 (106)
Appearance of teeth	
Satisfied	62.8 (526)
Dissatisfied	37.2 (312)
Good marks in school are important to me	
Agree	81.6 (684)
Disagree	18.4 (154)
Trauma	
No traumatic experience	93.9 (787)
Traumatic experience	6.1 (51)
Caries experience	
DMFT = 0	73.0 (612)
DMFT > 0	27.0 (226)
The number of cases in socioeconomic status does n of missing cases.	ot add up to 838 because

Bivariate analyses

Table 2 shows the percentages of children having at least one traumatized anterior tooth according to sociodemographics, satisfaction of appearance of teeth, selfreported importance of good grades and dental caries. A higher proportion of boys than girls experienced TDIs to their anterior teeth (8% versus 4%, $\chi^2 = 6.6$, P = 0.010). Children who reported that good marks in school were not important to them had a higher proportion of traumatized anterior teeth than those who reported that good marks were important to them (10% versus 5%, $\chi^2 = 6.1$, P = 0.013).

Multivariate analyses

Table 2 illustrates the results of the bivariate and multivariate logistic regression analyses. The two independent variables that were significantly associated with having TDI in the multivariate analyses were gender and the self-reported importance of good marks. Boys had twice the probability (Adj OR = 2.2, 95% CI 1.1–4.1) of having an anterior tooth traumatized compared with girls. Those who considered that good marks in school were unimportant to them had twice the odds of having a TDI to anterior teeth (Adj OR = 2.3, 95% CI 1.2–4.3). The total explained variance in the model was 6% when using the set of variables (Nagelkerke's $R^2 = 0.06$).

	No traumatic	Traumatized anterior	Unadjusted	Adjusted	
Factor	experience % (n)	teeth % (<i>n</i>)	OR (95% CI)	OR (95% CI)	Nagelkerke's R ²
Block 1					
Gender					
Girls	96.4 (346)	3.6 (13)	Ref	Ref	
Boys	92.1 (441)	7.9 (38)	2.2 (1.2-4.3)*	2.2 (1.1-4.1)*	
Area		. ,		. ,	
Urban	91.4 (203)	8.6 (19)	Ref	Ref	
Rural	94.8 (584)	5.2 (32)	0.5 (0.3-1.1)	0.5 (0.3-1.1)	
Socioeconomic status					
High class	92.5 (37)	7.5 (3)	Ref	Ref	
Middle class	93.7 (548)	6.3 (37)	0.8 (0.2-2.8)	0.8 (0.2-2.9)	
Poor class	94.8 (201)	5.2 (11)	0.6 (0.1-2.5)	0.7 (0.2-3.1)	
Mother's education					
Secondary school/masters	93.5 (159)	6.5 (11)	Ref	Ref	
Lower/Upper primary school	94.0 (528)	6.0 (34)	0.9 (0.4-1.8)	1.0 (0.4-2.2)	
Haven't gone to school	94.3 (100)	5.7 (6)	0.8 (0.3-2.4)	0.9 (0.3-2.6)	
Total					0.032
Block 2					
Appearance of teeth					
Satisfied	95.1 (500)	4.9 (26)	Ref	Ref	
Dissatisfied	92.0 (287)	8.0 (25)	1.7 (0.9-2.9)	1.7 (0.9-2.9)	
Good marks in school are					
important to me					
Agree	95.9 (649)	5.1 (35)	Ref	Ref	
Disagree	89.6 (138)	10.4 (16)	2.2 (1.2-4.0)*	2.3 (1.2-4.3)*	
Caries experience					
DMFT = 0	94.3 (577)	5.7 (35)	Ref	Ref	
DMFT > 0	92.9 (210)	7.1 (16)	1.2 (0.6-2.3)	1.1 (0.6-2.2)	
Total					0.060

Table 2. Bivariate and multivariate logistic regression

Traumatized permanent anterior teeth according to various correlates. Unadjusted and adjusted odds ratios (OR) and 95% confidence interval (CI)*P < 0.05, Ref – Reference category.

Discussion

The prevalence of TDIs among 12-year-old school children in Thiruvananthapuram was low (6%) compared with majority of the studies on TDIs. Although the study sample size was calculated based on the anticipated proportion of dental caries in the district (60%), this figure suffices the possible upper limit of individuals with TDIs required for this study. Sixty percent clearly overestimates the prevalence of dental trauma reported in the literature (2, 3). The cross-sectional study design of the present survey may be a contributory factor to low prevalence of TDI, because it is considered that several features related to a traumatic incident may not be visible by direct vision (36, 38). However, the results of this study may be comparable to other studies as few researchers use radiographs in field surveys (2, 11, 12, 43). Nevertheless, care should be taken when comparing results with other studies as differences exist in sampling techniques, diagnostic criteria, teeth involved and patterns of behaviour among the population (3, 35, 38). Because students within each school are likely to be more similar than students in different schools, a cluster (school) sample design, as employed in the presents study, tends to inflate the standard errors and thus provides less precise estimates as compared with a simple random sample. This was partly taken care of by doubling the sample size from that required for a simple random sample design (44).

The present finding showed that the prevalence of TDIs was higher in urban than in rural children (Table 2). Moreover, the prevalence in urban areas reported here (8.6%) suggest an increase in prevalence in urban areas (3%) when compared with another study carried out in a similar setting of the same district (18). In contrast to prevalence rates reported from other countries (2, 4, 8, 13), the proportion of adolescents with TDIs was lower among Indians (17–20). The overall low prevalence in TDIs among the study sample may be due to the relative lack of outdoor activities and emphasis on education (18).

Boys were twice as likely as girls to have a TDI to the anterior teeth. There is general consensus that boys have higher risk of TDIs than girls during adolescence (2, 4, 8, 11, 13, 17) because boys tend to engage more in sports and outdoor activities (9, 11, 13, 43). Violence and misusing teeth have also been suggested to be causes of anterior teeth injury among boys (3, 19). On the other hand, a few earlier studies have reported that TDIs are more common among girls than boys (5, 33). Burden (34) indicated that with girls more involved in outdoor activities nowadays, there is no significant sex difference in TDIs (9, 35). When compared with many other societies, the majority of girls in Kerala are culturally more engaged in indoor activities (18). Similar findings have been highlighted by Hamdan and Rajab (11).

The other variable which showed significant association with TDI was whether good marks in school were important to the children. Twelve-year-old schoolchildren who considered that good marks at school were not important experienced twice the risk of TDIs compared with those who considered it important. This attitude may reflect that negative outlook among adolescents is important for risk taking (31) and this in turn may be one of the causes of dental injury. Injuries may in turn affect academic performance. A USA study revealed that exposure to violence has a negative impact on academic progression (32). However, as the present study was cross-sectional, it does not permit conclusions as to whether it was risky behaviour that caused TDIs or vice versa. Further longitudinal studies are required to disentangle the complex relationship of poor academic achievement, violent behaviours and TDIs.

Previous researchers identified that injury to the teeth had a negative impact on the individual (26, 27). This however was not indicated in this study were no significant difference in the level of satisfaction with the appearance of teeth was noticed if children experienced traumatized teeth.

The maxillary central incisors were most commonly affected by TDI. This corroborates well with other studies (10-12, 43). While this study showed a slight predilection in the number of maxillary right central teeth injured compared with maxillary left central teeth (43), another study found the opposite trend (10).

The majority of TDIs occurred at home (60%). Several researchers have indicated that more TDIs occurred at home than in other areas, for example, school (5, 12, 35, 43) but no effort was made in the current study to identify the exact place of the traumatic episode. A few children mentioned 'can't remember' (1%) when asked about place of injury. Such responses may be provided as a result of negative experiences (3) or merely due to recall bias (38).

In conclusion, the prevalence of permanent anterior teeth trauma was low in Kerala. Twelve-year-old boys and those who considered that receiving good marks in school was not important had a higher prevalence of anterior traumatic dental injuries.

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