Dental Traumatology

Dental Traumatology 2009; **25**: 589–593; doi: 10.1111/j.1600-9657.2009.00827.x

Social and behavioral risk factors for maxillary incisor trauma in an adolescent Arab population

Jon Årtun, Rashed Al-Azemi

Department of Developmental and Preventive Sciences, Faculty of Dentistry, Kuwait University, Jabriya, Kuwait

Abstract – *Background/Aim*: The majority of dental traumas are due to falls or blows during regular activity, personal interaction and play inside or outside the home, suggesting that behaviors associated with certain social conditions are risk factors. Our purpose was to explore that hypothesis. *Materials and Methods*: We examined a population-based sample of 1583 13–14-year-old subjects in a classroom setting. Incisor trauma was scored according to the National Institute of Dental Research index, and overjet was measured to the nearest 0.5 mm. Presence of mesial migration and/or loss of first molars and/or open caries in permanent teeth were recorded and categorized as increased caries experience. Body mass index (BMI) was calculated from standardized measurements of height and weight, as weight in kg height^{-1} in m^2. Obesity was scored if BMI exceeded 30. Information on participation in physical activities, family income, and number of siblings was collected through subject and family interview. *Results and Conclusions*: Univariate logistic regression detected reduced trauma risk among subjects of high income families ($P = 0.009$) and among subjects attending private schools ($P = 0.026$). Sports and physical activities were more prevalent in boys than in girls ($P = 0.000$) and associated with trauma in the sample as a whole ($P = 0.001$), but not separately in boys and girls. No effect was detected of obesity, number of siblings and increased caries experience. Univariate analyzes also detected increased trauma risk in boys ($P = 0.000$) and in subjects with increasing intervals of overjet ($P = 0.000$). Following use of multiple regressions with forward selection, only male gender, increasing overjet, and high family income were included in the final prediction model. Our findings suggest that behaviors associated with high family income and private school attendance reduce the risk of incisor trauma among adolescents in Kuwait, and that the gender difference in sports activities is an unlikely explanation for the gender difference in trauma.

Correspondence to: Jon Årtun,
Nicolas and Asp College of Postgraduate Dentistry,
Dubai Healthcare City,
PO Box 53382, Dubai, UAE
Tel.: +971 4 3624787
Fax: +971 4 3624793
e-mail: jon.artun@gmail.com

Accepted 24 July, 2009

National surveys (1, 2) and examinations of population-based samples (3, 4) conclude that about 15% of young adolescent subjects demonstrate clinical signs of traumatic injuries to the permanent incisors. Similar prevalence in representative groups of schoolchildren has been found to vary between 10% and 25% (5–14). The extreme prevalence of 35% in a population of Thai school children (15) may be attributed to abnormal habits of dental misuse and accidental biting of hard material (15). The costs associated with meeting the annual need for treatment in a given trauma population has been estimated as considerable (16).

There is agreement that injuries occur more frequently to the maxillary than the mandibular incisors (1, 2, 4, 5, 7, 12, 14), and that the central incisors are affected more often than the lateral incisors (2, 4–7, 12, 14). A likely explanation is the low prevalence of Class III malocclusions (17), implying natural protection of the mandibular incisors, combined with the relative prominence of the maxillary central incisors. The agreement that overjet is a risk factor, due to a larger mean overjet (4, 6, 7) or a higher proportion of the largest overjet category following dichotomization (3, 8, 9, 11–13, 15) in the subsamples with trauma experience, or due to increased prevalence of trauma experience with increasing intervals of overjet (3, 4, 6, 18, 19), may therefore not be unexpected. However, some studies have failed to detect lip incompetence as a risk factor (6, 7, 13), and results differ regarding the relative importance of overjet and lip incompetence (3, 4, 8, 11).

Very few studies disagree with the common finding that boys are at increased risk of dental traumas prior to adolescence (3, 8). One suggested unusually high frequency of participation in sports among the girls in the sample as a possible reason (3). The majority of the injuries are due to falls or blows during regular activity,

personal interaction or play inside (24–49%) or outside (18–42%) the home (4, 8, 10, 13, 15). Sports activities account for about 2–9% (4, 8, 10, 15) and traffic accidents for about 1–10% (4, 8, 10, 15) of the injuries. The injury prevalence may exceed population averages among subjects engaging in impact-prone sports activities (20). However, while one study reported that most traumas occurred among boys at school because of falls while playing sports (14), increased physical activities including sports participation has also been found to be preventive in adolescents (8). The gender difference in incisor trauma is therefore more likely to reflect behavioral differences during regular social interactions than differences in sports participation.

There are indications that dental traumas may be more frequent among adolescents residing in socially deprived areas (11), living in overcrowded households (11), or growing up with a single parent or a step parent (10, 21, 22). A few recent reports also suggest that emotionally stressed children (23) with conduct disorder (22) and peer relationship problems (24) are at increased risk, and that an association exists between increased caries experience and dental injuries (14). However, results differ regarding the effect of parent education (10, 21, 24) and socioeconomic background (9, 10, 12, 14, 21, 22). Similarly, while some studies have detected obesity or overweight as a risk factor (8, 10) others conclude that children with normal height/weight proportions are equally likely to experience dental trauma (21).

Taken together, existing information may indicate that behaviors associated with certain conditions are risk factors for incisor traumas. Our purpose was to explore that hypothesis in a large, representative sample of young adolescents.

Materials and methods

Sample

The subjects were selected from 13- to 14-year-old school children in Kuwait following approval by the Ethics Committee of Faculty of Dentistry, Kuwait University. A stratified cluster sampling method was utilized (25), defining the students in the government schools of each of the six administrative areas of Kuwait as six strata, and the students in the various private schools as the 7th stratum. The number of students to be examined from each stratum was estimated according to the proportions, following random sampling procedures when selecting the schools (clusters) from each stratum and the students from each school. A total of 1583 subjects (788 boys and 795 girls) of mean age 13.24 $\pm$ 0.42 years were examined, representing about 6.7% of the target population.

Data collection

Permission was obtained from the Research Department of the Kuwaiti Ministry of Education to perform the examinations during school hours. A well lit room was provided by the school principal, and the students were informed about their rights to participate.

Interviews

An Arabic speaking research assistant interviewed the students and recorded their answers to standardized questions regarding number of siblings, and amount and type of physical activities. Those physically active, were asked whether they participated in organized sports, in football, or in other types of activities such as running, bicycling, etc. They were also asked how many days per week they were active, and whether or not they used protective gear. The information on income was collected through phone interview with the parents and recorded as KD $<$ 500, 500 $<$ KD $<$ 1000, 1000 $<$ KD $<$ 2000, and KD $>$ 2000.

Height and weight examinations

An Arabic speaking research assistant recorded height and weight. The subjects were asked to remove their shoes before a bathroom scale was used to record their weight to the nearest 0.5 kg. Similarly, their height was measured to the nearest 0.5 cm using a cm band taped to the wall and a rectangular wood block placed on top of their skull, touching the band at a 90° angle.

Clinical examinations

Each of four orthodontists examined 25 subjects 1 day per week for 16 weeks. The examinations were performed in a regular room in each individual school, without special lighting. Each maxillary incisor was scored for presence and type of traumatic injury according to the National Institute of Dental Research (NIDR) index, which is based on clinical non-radiographic evidence of tooth injury and treatment received, including a positive history of injury obtained from the subject (2). Care was made not to score enamel defects attributed to abrasion during functional jaw movements and small enamel chips caused by biting objects as dental trauma (Fig. 1). Overjet (OJ) was measured to the nearest half mm as the distance parallel to the occlusal plane from the incisal edge of the most labial maxillary central incisor to the most labial mandibular central incisor using a ruler. Lip competence was evaluated with the lips in rest position and scored as competent even in subjects keeping them apart during the examination, provided they could close the lips without noticeable strain. If lip strain was evident upon closure, the lips were scored as incompetent. The measurements for OJ and lip competence were not made in subjects with a history of orthodontic treatment (N = 66). Instead, OJ was measured on pretreatment study models if available (N = 56), or otherwise recorded as missing. Mesial tipping and/or rotation of maxillary first molars and mesial tipping of mandibular first molars concomitant with reduced space mesial to the first molar in question was scored as mesial migration. Missing first molars and presence of permanent teeth with visible active caries were also recorded.

Method error

Two sets of calibrations were performed prior to the actual examinations. At the first set each examiner examined the same 40 subjects. Following comparison of the scores and adjustments of the criteria (Fig. 1),

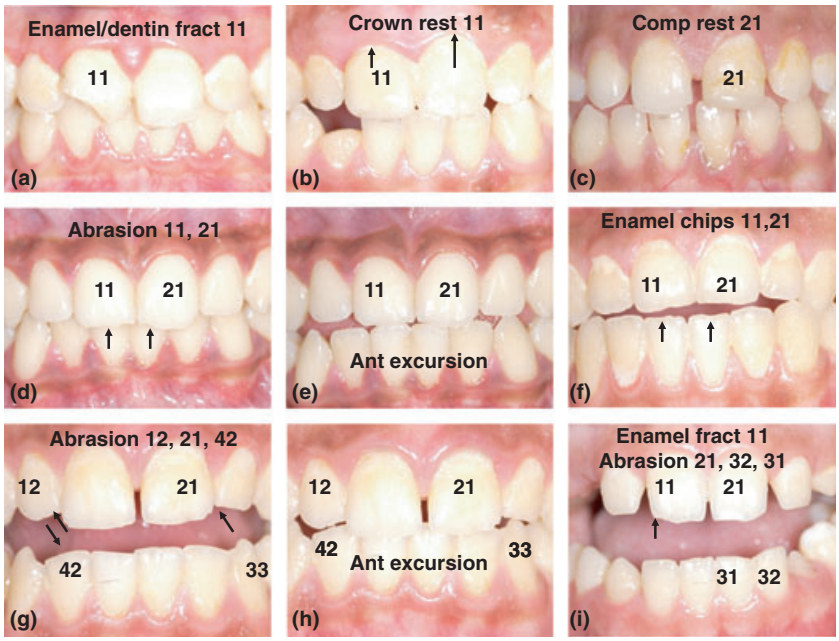

Fig. 1. Scoring of incisor trauma according to the NIDR index incorporated into the NHANES III US Survey. (a) Enamel/dentin fracture due to trauma of 11; (b) crown restoration following crown fracture due to trauma of 11; (c) composite restoration following crown fracture due to trauma of 21; (d & e) enamel defects of 11, 21 not due to trauma but tooth abrasion during function; (f) enamel defects of 11, 21 not due to trauma but chipping during function; (g & h) enamel defects of 12, 21, 33, 42 not due to trauma but tooth abrasion during function; (i) enamel defect on 11 due to trauma, on 21, 32, 31 due to abrasion during function.

another 40 subjects were examined twice about 2 weeks apart by all four examiners. The intraclass correlation coefficients between the first and second scores of the four examiners were 0.97 for OJ, 0.90 for lip competence, ranged from 0.97 to complete agreement for the trauma scores of the eight incisors, and ranged from 0.75 to complete agreement for mesial migration and loss of first molars as well as for presence of visible caries ($P = 0.000$). Using ANOVA structure, the pooled between examiner intra class correlation coefficients were 0.97 for OJ ($P = 0.000$), 0.90 for lip competence ($P = 0.124$), varied from 0.98 to complete agreement for the trauma scores ($P = 0.183$ and 0.098 for tooth 11 and 41), and varied from 0.92 to complete agreement for mesial migration and loss of first molars as well as for the presence of visible caries ($P = 0.000$).

Data analyzes

Presence of traumatic injury was defined as positive trauma score on any incisor. Increased caries experience was defined as presence of mesial migration and/or loss of any first molar and/or presence of open caries on any permanent tooth. Body mass index (BMI) was calculated according to the formula kg m^{-2} (26). Subjects were categorized as thin with BMI < 18.5 and obese with BMI > 30 (27). Number of siblings was categorized as ≤4, as ≥5 but ≤8, and as ≥9, and number of days with participation in physical activity as ≤3 and as ≥4. Chi-square tests and univariate logistic regression analyzes were administered to test the differences between subjects with and without incisor trauma. Finally, stepwise multiple logistic regressions were employed to develop a prediction model. Variables were successively entered into the models if their effects were significant at $P < 0.05$. At each step the variable with the lowest P-value was included. Previously entered variables were excluded if their effects were no longer significant ($P > 0.05$) upon inclusion of a new variable. The final model was determined when no remaining variables had a significant effect ($P > 0.05$).

Results

Effect of social parameters

The proportion of subjects with trauma differed among the four income categories ($P = 0.051$). The lowest proportion was detected in the highest category (9.0%), with 11.8%, 15.2%, and 16.2% of the subjects in the remaining categories being affected. Following dichotomization, univariate logistic regression detected a significant relationship between family income of KD > 2000 and trauma (Table 1). The proportion of trauma was similar among the subjects in the three sibling categories ($P = 0.442$). However, trauma was less prevalent among subjects attending private (8.9%) than public (15.2%) schools ($P = 0.026$), and univariate logistic regression detected a significant relationship between private school attendance and trauma (Table 1).

Effect of behavioral parameters

No difference was detected in injury rate among the subjects in the three BMI categories or between subjects with and without increased caries experience. Physical activity was more prevalent among boys than girls (68.4% vs. 28.8%, $P = 0.000$). The injury rate was similar among the boys who were (20.2%) and were not (17.3%) physically active as well as among the girls who were (11.4%) and were not (9.0%) physically active, and no effect was detected of the different types of activity in the boys and the girls. For the sample as a whole; however, 17.6% of those reporting themselves as physically active were injured, as opposed to 11.5% of those who said they were not ($P = 0.001$). Univariate logistic

Table 1. Social & behavioral parameters with significant effect on incisor trauma in a population-based sample of 1583 adolescents. Results according to univariate logistic regression

Variable	Effect (SE)	Sign.	Odds ratio (conf int)
Family income[1]	0.61 (0.24)	$P = 0.009$	1.84 (1.16–2.93)
School attendance[2]	0.61 (0.27)	$P = 0.026$	1.84 (1.08–3.13)
Participation sports[3]	0.49 (0.15)	$P = 0.001$	1.64 (1.23–2.17)

SE, standard error.
[1]KD > 2000 vs. KD < 2000.
[2]Private vs. public.
[3]Yes vs. no.

regression detected a significant relationship between physical activity and trauma for the whole sample (Table 1), and a higher effect of participation in football than of the two other categories ($P = 0.000$). However, the effect was similar among those that were active ≤3 and ≥4 days per week. The use of protective gear was very low, with 14 subjects reporting use of helmet and three reporting use of mouth guard, and not accounted for in the analyzes.

Prediction model

As previously documented (4), male gender ($P = 0.000$) and increasing intervals of OJ ($P = 0.000$) were detected as risk factors. The multivariate regression analyzes showed that only gender, family income and increased OJ were included in the final prediction model (Table 2).

Discussion

Our findings suggest that high family income is a protective factor for dental traumas in children prior to adolescence. One mechanism might be a possibly higher level of parent education and socioeconomic status among the high income families, which in turn might have been conducive to improved parent education on the significance of proper child behavior during leisure activities and peer interactions. Another mechanism might be that the children from the high income families were more socially secure, and at less risk of reacting violently in stress related situations. Very few studies have found that higher parent education and socioeconomic status are preventive factors (15). On the contrary, several studies have failed to detect any effect of increased parent education or the chosen socioeconomic indicators (10, 12–14, 21, 23), and one study concluded that high socioeconomic background (9) and higher level of education (24) are risk factors. However, our finding may indirectly support the common finding that traumatic injuries are more prevalent among children from socially deprived areas and disadvantaged families (10, 11, 15, 21, 22). The same explanations may be offered for the protective effect of private school attendance on traumatic injuries to the teeth of the adolescents in our sample. The reason for inclusion only of family income in the final prediction model may be co-variation between the two parameters, with high family income being most important (Table 2).

Table 2. Variables included in the final prediction model for maxillary incisor trauma in a population-based sample of 1583 adolescents. Results according to multivariate logistic regression

Variable	Effect (SE)	Sign.	Odds ratio (conf int)
Gender	0.64 (0.24)	$P = 0.008$	1.90 (1.18–3.03)
Income	0.71 (0.29)	$P = 0.016$	2.03 (1.14–3.62)
OJ category	0.75 (0.32)	$P = 0.020$	2.11 (1.13–3.96)

SE, standard error; OJ, overjet.

A large follow-up evaluation of a population-based birth cohort in Finland (28) concluded the lifetime prevalence of dental trauma at 31 years of age was associated with overweight, mental distress, lack of physical activities, and low socioeconomic status. It may therefore not be unusual that some studies have detected overweight or obesity as a risk factor for traumatic injuries in adolescents (8, 10). In keeping with other studies (21) however, we did not detect such associations in our adolescent sample. One explanation might be minimal negative stigma of obesity in this adolescent Arab population, with minimal impact of obesity on the children's ability to form interpersonal contact and function well in society.

A previous study concludes that living in an overcrowded household increases the risk of dental trauma (11). However, very few studies have actually looked at the effect of increasing number of siblings as a risk factor. No such effect was detected in our sample. A large family size may therefore not be associated with increased sibling rivalry, domestic fighting, and a feeling of deprivation in the adolescent population we sampled from. We did not collect information on parent structure in our sample. We could therefore not test the finding that children from single parent household or from families with a step parent are at increased risk of trauma (10, 21, 22) in Arab populations.

The effect of increased physical activity and participation in sports as a risk factor for dental trauma is controversial (3, 8, 28). A large follow-up study in adults found that reduced physical activity was a risk factor (28), and a study in adolescent suggests that participation in sports actually may be a preventive factor (8). It may therefore be speculated that increased physical activity is conducive to improved motor skills and increased self confidence, which in turn may reduce the risk of accidental falls or violent incidents during interaction and play with family and friends. Although the regression analyzes did detect an effect of participation in sports and other physical activities in our sample as a whole, the number of days per week with activity had no effect, and increased physical activity was not included in the final prediction model (Table 2). Moreover, the difference in dental trauma among those who were and were not physically active (17.6% vs. 11.5%) could not explain the previously reported gender difference in injury rate of 19.3% vs. 9.7% (4) of the subjects in our sample, since no effect was detected of increased physical activities on dental trauma in each subsample of boys and girls, despite the large gender difference in physical activities.

We could not confirm the recent interesting finding that increased experience of untreated caries is associated

with dental traumas in adolescents (14), suggesting that the association between untreated caries and behaviors conducive to dental trauma is unclear. However, it may be criticized that this finding is based on inclusion of 85 subjects with mesial molar migration without concomitant scores for molar loss or untreated caries among the 330 subjects that met our definition for increased caries experience, since we cannot rule out premature deciduous molar extraction due to premolar agenesis. Only seven of the 66 subjects with a history of orthodontic treatment had experienced trauma. The injuries occurred prior to orthodontics, and availability of pretreatment study models allowed measurement of representative OJ. Our findings regarding effect of OJ on dental trauma are therefore likely to be valid.

Conclusions

Our findings suggest that behaviors associated with high family income and private school attendance reduce the risk of incisor trauma among adolescents in Kuwait, and that the gender difference in sports activities is an unlikely explanation for the gender difference in trauma.

Acknowledgements

This research was supported by Kuwait University Grant #DD07/00.

References

1. O'Brien M. Children's dental health in the United Kingdom 1993. In report of dental survey, Office of Population Censuses and Surveys. London: Her Majesty's Stationary Office; 1994.
2. Kaste LM, Gift HC, Bhat M, Swango PA. Prevalence of incisor trauma in persons 6–50 years of age: United States, 1981–1991. J Dent Res 1996;75(Spec iss):696–705.
3. Burden DJ. An investigation of the association between overjet size, lip coverage and traumatic injury to the maxillary incisors. Eur J Orthod 1995;17:513–7.
4. Årtun J, Behbehani F, Al-Jame B, Kerosuo H. Incisor trauma in an adolescent Arab population: prevalence, severity, and occlusal risk factors. Am J Orthod Dentofacial Orthop 2005;128:347–52.
5. Järvinen S. Fractured and avulsed permanent incisors in Finnish children. A retrospective study. Acta Odont Scand 1979;37:47–50.
6. Hunter ML, Hunter B, Kingdon A, Addy M, Dummer PMH, Shaw WC. Traumatic injury to maxillary incisor teeth in a group of South Wales school children. Endod Dent Traumatol 1990;6:260–4.
7. Kania MJ, Keeling SD, McGorray SP, Wheeler TT, King GJ. Risk factors associated with incisor injury in elementary school children. Angle Orthod 1996;66:423–32.
8. Petti S, Cairella G, Tarsitani G. Childhood obesity: a risk factor for traumatic injuries to anterior teeth. Endod Dent Traumatol 1997;13:285–8.
9. Cortes MI, Marcenes W, Sheiham A. Prevalence and correlates of traumatic injuries to the permanent teeth of schoolchildren aged 9–14 years in Belo Horizonte, Brazil. Dent Traumatol 2001;17:22–6.
10. Nicolau B, Marcenes W, Sheiham A. Prevalence, causes and correlates of traumatic dental injuries among 13-year-olds in Brazil. Dent Traumatol 2001;17:213–7.
11. Marcenes W, Murray S. Social deprivation and traumatic dental injuries among 14-year-old schoolchildren in Newham, London. Dent Traumatol 2001;17:17–21.
12. Hamdan MA, Rajab LD. Traumatic injuries to permanent anterior teeth among 12-year-old schoolchildren in Jordan. Community Dent Health 2003;20:89–93.
13. Traebert J, Almeida IC, Marcenes W. Etiology of traumatic dental injuries in 11–13 year-old schoolchildren. Oral Health Prev Dent 2003;1:317–23.
14. Fakhruddin KS, Lawrence HP, Kenny DJ, Locker D. Etiology and environment of dental injuries in 12- to 14-year-old Ontario schoolchildren. Dent Traumatol 2008;24:308–5.
15. Malikaew P, Watt RG, Sheiham A. Prevalence and factors associated with traumatic dental injuries (TDI) to anterior teeth of 11–13 year old Thai children. Community Dent Health 2006;23:222–7.
16. Borum MK, Andreasen JO. Therapeutic and economic implications of traumatic dental injuries in Denmark: en estimate based on 7549 patients treated at a major trauma center. Int J Paed Dent 2001;11:249–58.
17. Behbehani F, Årtun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract 2005;14:390–5.
18. Järvinen S. Incisal overjet and traumatic injuries to upper permanent incisors. A retrospective study. Acta Odont Scand 1978;36:359–62.
19. Shulman JD, Peterson J. The association between incisor trauma and occlusal characteristics in individuals 8–50 years of age. Dent Traumatol 2004;20:67–74.
20. Nysether S. Dental injuries among Norwegian soccer players. Community Dent Oral Epidemiol 1987;15:141–3.
21. 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.
22. Lalloo R. Risk factors for major injuries to the face and teeth. Dent Traumatol 2003;19:12–4.
23. Vanderas AP, Papagiannoulis L. Urinary catecholamine levels and incidence of dentofacial injuries in children: a 2-year prospective study. Endod Dent Traumatol 2000;16:222–8.
24. Odoi R, Croucher R, Wong F, Marcenes W. The relationship between problem behavior and traumatic dental injury amongst children aged 7–15 years old. Community Dent Oral Eidemiol 2002;30:392–6.
25. Cochran WG. Sampling techniques, 3rd edn. New York: John Wiley; 1977.
26. Kopelman P. Obesity as a medical problem. Nature 2000;404:635–43.
27. Neeley WW, Gonzales DA. Obesity in adolescence: implications in orthodontic treatment. Am J Orthod Dentofacial Orthop 2007;131:581–8.
28. Perheentupa U, Laukkanen P, Veijola J, Joukamaa M, Järvelin M-R, Laitinen J et al. Increased lifetime prevalence of dental trauma is associated with previous non-dental injuries, mental distress and high alcohol consumption. Dent Traumatol 2001;17:10–6.