Associations between School Environments and Childhood Traumatic Dental Injuries

Peerasak Malikaew[a,b]/Richard Geddie Watt[a]/Aubrey Sheiham[a]

Purpose: To assess the associations between social and physical school environments and the prevalence of traumatic dental injuries (TDI) in 12-year-old children in Thailand.

Materials and Methods: A cross-sectional study in 52 urban schools in Thailand was carried out from a sample of 2,725 12-year-old children that were clinically examined for TDI and interviewed. Cluster analyses were performed to classify the schools into supportive and non-supportive schools by social and physical environmental characteristics. Analyses of the associations were performed using multilevel analyses, accounting for school variations and controlling for confounding factors at the child level.

Results: 35.0% of children had TDI. Prevalence was twice as high amongst boys than girls. The prevalence of TDI was significantly lower in the schools with a supportive social environment (Crude OR = 0.6 (95% CI = 0.4 to 0.8, p = 0.004)). The adjusted OR was 0.7 (95% CI = 0.5 to 0.9, p = 0.02). This statistically significant association existed in boys but there was only an insignificant tendency of association in girls. There was no statistically significant association between TDI and the physical environment of the schools. But there was an insignificant tendency of association with the physical environment in girls.

Conclusion: TDI were much more common in boys than girls. TDI were significantly less prevalent in male children in schools with supportive, compared to less supportive social environments. In boys, there was a tendency for the more socially supportive environment to be more protective rather than the effect of any type of physical environment. In girls, this protective tendency was only apparent when school environments were both more socially supportive, and physically favourable.

Key words: dental, injuries, determinants, schools, sex

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The prevalence of traumatic dental injuries (TDI) to permanent teeth is relatively high among schoolchildren (Cortes, et al 2001). The major causes of TDI are: falls, pushing and fighting, collision during play and violence. However, studies on TDI fail to analyse the underlying determinants of the injuries. Haddon's matrix can be used for analysing underlying determinants of injuries (Haddon, 1968, 1972, 1980). None of the studies on TDI have used Haddon's matrix. Instead, they have used various categorisations of the causes of TDI. Only a few dental studies give details of specific causes of falls (Garcia-Godoy et al, 1986; Burton et al, 1985; Häyrinen-Immonen et al, 1990; Zerman and Cavalleri, 1993).

Environmental factors are obviously important aetiological factors for TDI. These include environ-

[a] *Department of Epidemiology and Public Health, University College London, London, UK.*

[b] *Department of Community Dentistry, Faculty of Dentistry, Chiang Mai University, Chiang Mai, Thailand.*

Reprint requests: *Prof. Aubrey Sheiham, University College London, The Royal Free and University College Medical School, Department of Epidemiology and Public Health, 1-19 Torrington Place, London WC1E 6BT, UK. Tel: +44 207 679 1700 Fax: +44 207 813 0242 E-mail: a.sheiham@ucl.ac.uk*

mental hazards, the nature and density of housing and physical/environmental characteristics of settings such as schools and neighbourhoods (Hargreaves et al, 1995).

The role of school environments as determinants of injuries has been well established (Bremberg and Gerber, 1988; Boyce et al, 1989; Bergström and Björnstig, 1991; Coppens and Krehel-Gentry, 1991; Rudd and Walsh, 1993; Sosin et al, 1993; Petridou et al, 1994; Stark et al, 1996; Maitra, 1997; Moysés, 2000; Moysés et al, 2003). According to Rudd and Walsh (1993), schools that are small, safe, engaging, and intimate communities are the most healthy environments. Although the roles of teachers involved with health promotion and safety at school, as well as the advantages of school-parent links, have been explored, there was little evidence of their impact on children (Young, 1992; Carter et al, 1994; Denman, 1998; Leger, 1998). Low levels of injuries are associated with the level of teachers' commitment and parental and community participation (Moysés et al, 2003).

Some aspects of the social environment of schools are related to general injuries and TDI. For example, school policies are associated with TDI (Moysés et al, 2003). The commitment towards health and safety, which is a component of school's health promotion, was associated with TDI. 9.7% fewer children had TDI in schools with a demonstratable commitment towards health and safety (Moysés et al, 2003). Schools with better teacher supervision of children and student-to-staff ratios had lower injury rates (Boyce et al, 1984a). The presence of teachers in playgrounds was associated with lower injury rates (Feldman et al, 1983; Bell, 1986; Coppens and Krehel-Gentry, 1991). Stark et al (1996) reported that injury rates in 'uncontrolled areas' (unsupervised) of elementary schools were higher compared with 'controlled areas'.

Social relationships in schools contribute to healthy environments (Rudd and Walsh, 1993). At the individual level, a study by Bremberg and Gerber (1988) revealed that injured children were significantly more likely to have unsatisfactory relationships with schoolmates than non-injured children. However, social relationships at school in terms of a school's characteristic, such as school/home and school/community relationships, need to be explored.

A child's educational performance is related to risk of injury. A poor performance at school is strongly correlated with school injuries (Petridou et al, 1994). However, performance of a group of children (e.g. a school) may vary across groups. It is interesting to assess if other group performances, such as violence and dropout rates, absenteeism and punishment rates, are associated with the occurrence of TDI.

Generally, poor physical environment contributes to poor health (Towner et al, 1993; Wilkinson and Marmot, 1999). The school buildings and surrounding areas can have an impact on children's academic achievement and learning (Moore and Lackney, 1993); and there is some evidence of the relationships between physical environment at school and injuries (Boyce et al, 1984b; Boyce et al, 1989; Coppens and Krehel-Gentry, 1991; Lenaway et al, 1992; Rudd and Walsh, 1993; Sosin et al, 1993; Stark et al, 1996; Maitra, 1997). Injuries sustained by children in school accidents are related to a lack of safe playgrounds, sport facilities, and stairways (Lenaway et al, 1992; Stark et al, 1996; Maitra, 1997).

In fall-related injuries, the ground-surface of the playground is an injury determinant, that particularly affects the severity of injuries (Boyce et al, 1984b; Coppens and Krehel-Gentry, 1991; Sosin et al, 1993). Impact-absorbing surfaces reduce the consequences of fall injuries (Sosin et al, 1993). Moreover, the incidence of fall injuries was lowest on sand surfaces, and slightly higher for grass, gravel and matting. The rate for asphalt was six times that of sand (Sosin et al, 1993).

Overall, since there was evidence that the rate and severity of injuries tended to vary considerably from school to school (Boyce et al, 1984a; Bergström and Björnstig, 1991), it could be hypothesised that a school's social and physical environment might be associated with the occurrence of general injuries and TDI.

Moysés et al (2003) found that children attending supportive schools had better oral health and lower rates of TDI than children attending non-supportive schools. As most previous studies on the prevalence and causes of TDI have not fully analysed the determinants of the injuries, a study was planned to investigate the effect of the school environments on TDI. The study uses Haddon's concepts and concentrates on the 'environment' in Haddon's second dimension.

The hypothesis is that the prevalence of TDI in Thai children attending schools with more socially supportive and physically favourable environments

is significantly lower than in those attending schools with less socially supportive and physically favourable environments. The objective was to assess the association between social and physical environments of schools and the prevalence of TDI in Thai children in Class Level 6.

MATERIALS AND METHODS

The study populations were all from primary schools in Muang District, Chiang Mai Province in northern Thailand. At the time of the study there were 58 primary schools in Muang District: 32 public, 11 municipal, and 15 private. Three public and 2 private schools were excluded because they had children whose culture and lifestyle are very different from the majority of Muang residents. Two new private schools were excluded, as they had no children in Class Level 6.

There were 4,720 Class Level 6 children in the 53 primary schools in the study population. To obtain a representative sample, a random selection of school children in Class Level 6 aged about 12 years was assessed for TDI.

The measures for school social environments comprised: school policies, supervision, and safety information, social relationships, as well as children's performance (Table 1). The social environment of schools included: school policies on safety, including safety plans and strategies, strategies on alcohol, drugs and first aid. The other factors were: safety policies implemented, and how long these had been in place. Supervision practice was based on the number of teachers responsible for supervising children in a school. There were two requirements for measuring social relationships between school and community: levels of parental participation in meetings between teachers and parents, and frequency that people in the community used the school for meetings, sports activities, or parties. Indicators of children's performance were based on: the results of health education examinations, violence, dropout, absenteeism and punishment rates of Class Level 6 children. The information on social environment was collected by interviewing the head teachers or directors of the schools using a questionnaire and by extracting data from the records of the schools.

The measures of the physical environment of schools included: conditions of buildings (75% fair, and 25% good); cleanliness of schools (63% fair, 33% good, and 4% poor); floor conditions (73% fair, 21% good, and 6% poor); floors of toilets (67% fair and 33% poor); playgrounds (6% good, 58% fair, and 36% poor); canteen lighting (89% good, 10% fair and 2% poor); toilets (54% good, 42% fair and 4% poor); crowding and amount of playground area (34% high, 33% average and 33% low). The condition of the floors and surfaces were separately assessed in five areas of the school. Hard surfaces on playgrounds were defined as: surfaces covered with concrete, asphalt, stone, wood, gravel, brick, ceramic, marble and metal. Sand, soil, and grass were considered as soft surfaces. Seventeen of the schools were classified as having above average, 17 average and 18 below average hard surfaces in their playgrounds. Crowding was assessed by the number of children per 100 square metres of total school area and separately for the playground area. This information on physical environment was collected and recorded by direct observation using set criteria. Other data collected included age, sex, and socio-economic status of parents. Anterior tooth overjet and Body Mass Index was also assessed.

The estimated sample size for the study was based on a TDI prevalence rate of 20%. At the confidence level of 99% (1-α), the required minimal sample size was 1,699 children. The children were randomly selected from the 52 schools.

Three trained dentists examined children for TDI to the anterior 12 teeth according to a classification developed by Cortes et al (2001). This classification includes: no trauma, discoloration due to trauma, enamel crack, enamel fracture, enamel and dentine fracture, fracture with pulp exposure, missing tooth due to trauma, composite restoration, bonded fragment, permanent crown provided, semi-permanent crown provided, denture or bridge provided (pontic), fistulous tract and/or presence of swelling, and assessment cannot be made. The children were seated on portable dental chairs, and examined with plane mouth mirror and explorer under light from portable halogen lamps. Participants were asked about the history of any questionable lesion to confirm diagnosis. No tooth vitality test or radiographs were used. The anterior tooth overjet was measured in millimetres. Each examiner examined about 900 children. Approximately 16% of the children were reexamined by each examiner. The interexaminer Kappa scores ranged from 0.85 to 0.96. The Kappa scores for interexaminer reliability ranged from 0.83 to 0.87 indicating almost perfect agreement (Landis and Koch, 1977) between the

Table 1 The final variables included in the cluster analyses of social environment and their distributions

Variables	Number of schools	%
Supervision (Number of supervisors per 100 children) (Tertile)		
– Few (< 0.83)	18	34.6
– Average (0.83 – 1.14)	17	32.7
– More (> 1.14)	17	32.7
Children received safety information (outside sources)		
– Fewer than 1 a term	16	30.8
– 1 a term or more but fewer than 1 a month	12	23.1
– 1 a month or more	24	46.1
Provided safety topic through school curriculum (Bullying)		
– Fewer than 3 times a week	3	5.8
– 3 times a week	19	36.5
– More than 3 times a week	30	57.7
School and home relationships (Participation of parents in each meeting)		
– Less than 50%	5	9.6
– 50 to 74%	24	46.2
– 75 to 100%	23	44.2
School and community relationships (School has been used for community activities)		
– Fewer than 1a term	9	17.3
– 1 a term or more but fewer than 1 a week	10	19.2
– 1 a week or more	33	63.5
The result of health education examination (Total 40 marks) (Tertile)		
– Low (< 19.8)	18	34.6
– Average (19.8 – 21.5)	17	32.7
– High (> 21.5)	17	32.7
Violence rate (cases per 100 children per year) (Tertile)		
– High (> 1.20)	17	32.7
– Average (0.04 – 1.20)	12	23.1
– Low (< 0.04)	23	44.2
Dropout rate (cases per 100 children per year) (Tertile)		
– High (> 3.80)	17	32.7
– Average (0.96 – 3.80)	17	32.7
– Low (< 0.96)	18	34.6
Absentee rate (days per Class Level 6 child per year) (Tertile)		
– High (> 3.0)	17	32.7
– Average (1.5 – 3.0)	17	32.7
– Low (< 1.5)	18	34.6
Punishment rate (cases per 100 Class Level 6 children per week) (Tertile)		
– High (> 16.7)	15	28.8
– Average (7.8 – 16.7)	19	36.5
– Low (< 7.8)	18	34.6

examiners. After the clinical examinations, participants who had evidence of TDI were interviewed for details of the injury event. A trained interviewer using a questionnaire interviewed the children with TDI.

All statistical analyses were carried out using statistical software such as the Stata Statistical Package Programme Version 6.0 (Stata Corporation, 2000), the Statistical Package for Social Science for Windows version 10 (SPSS/PC, 1999) and the MLwiN version 1.02.0002 (Rasbash et al, 1998).

Schools were classified into four groups according to school environments: two on the extent of social support in schools – less supportive and more supportive; and two groups based on the schools' physical environment – less favorable and more favorable. Certain variables of school characteristics were considered of greater importance in discriminating between groups. Since there is no clearly good information about the relevance of different variables of school characteristics, an equal weighting method was applied (Dunn and Everitt, 1982).

However, there were some variables of school characteristics that were significantly correlated with one another at a significance level of less than 0.05. This suggested that some of them, possibly described the same situation. Principal Component Analyses (PCA) was performed to reduce the number of variables (Bryman and Cramer, 1999). Then, the best representative (the highest score coefficient) for each obtained situation was selected for the final variables in cluster analysis.

The optimisation cluster analysis, or *k*-means cluster analysis (MacQueen, 1967), was used for classifying the schools because the method is not hierarchical or nested, and an appropriate choice of the final number is made at the end to classify the school. When an analysis was performed using a Statistical Package for Social Science for Windows version 10 (SPSS/PC, 1999), the computer randomly specified the initial cluster centres. The possible cluster centres of the given number of groups were repeatedly calculated until the clustering criterion was satisfied. Finally, the final cluster centres of the chosen number of groups were obtained.

The school environment is a context of particular characteristics of the school obtained from a classification of schools. Therefore, social and physical environments are school-level information. On the other hand, the TDI was measured at student level. To assess the relationship between school environments and TDI, the effects of school-level (group-level) variables on the student-level (individual-level) outcome were examined.

Multilevel analyses were performed to investigate the associations between TDI and the explanatory variables in the study by accounting for variations between schools (Goldstein et al, 1998). The statistical significance was considered at 95% confidence interval for associations between variables and at 90% confidence interval for interactions between variables.

This study was approved by the Human Experimentation Committee, Faculty of Dentistry, Chiang Mai University, Chiang Mai, Thailand. Informed consent was obtained from parents or guardians of every participant.

RESULTS

Of 53 primary schools in the study population, one private school did not respond. 2,725 children were examined for TDI. 51.2% were girls and 48.8% were boys. The mean age of the participants was 11.8 ± 0.7 years; 64.3% were 12 years old; 29.1% were younger than 12 and 6.6% older than 12 years old. The parents of 4.9% were unemployed and 42.3% educated at the compulsory level or lower. The family income of 61.5% of children was above 5,000 Baht.

Of the 2,725 children examined, 954 children (35.0%) had TDI. TDI was twice as prevalent in boys (45.3%) than girls (25.2%).

The schools were clustered into four groups: two according to the characteristics of the social environment, and two by the physical environments of schools. For the social environment, there were 30 schools in Social Environment Cluster 1, and 22 schools in Social Environment Cluster 2. The main differences between the two clusters of schools were the levels of supervision by staff, safety topics in the school curriculum, participation of parents in school meetings, community activities in school, violence, absenteeism and punishment rates.

When the 52 schools were clustered according to their physical environments, there were 24 schools in Physical Environments Cluster 1, and 28 schools in Cluster 2. Cluster 2 schools had an overall higher environment score. The main differences between the two clusters of schools were the levels of cleanliness of schools, condition of surfaces of playgrounds, and crowding.

Table 2 The distributions of traumatic dental injuries, by children's characteristics

Children's characteristics	Frequency of children with TDI (%)			P-values†
	Yes	No	Total	
Sex				
– Males	603 (45.3)	728 (54.7)	1,331	
– Female	351 (25.2)	1,043 (74.8)	1,394	< 0.001
Age				
– < 12 years old	262 (33.0)	531 (67.0)	181	
– 12 years old	613 (35.0)	1,138 (65.0)	1,751	
– > 12 years old	79 (43.6)	102 (56.4)	793 (100.0)	0.03
Marital status of parent				
– No or a single parent	240 (42.3)	327 (57.7)	567	
– Both parents	714 (33.1)	1,444 (66.9)	2,158	< 0.001
Employment status of parent				
– Unemployed	83 (61.9)	51 (38.1)	134	
– Employed	871 (33.6)	1,720 (66.4)	2,591	< 0.001
Educational status of parent				
– Compulsory level or lower	446 (38.7)	707 (61.3)	1,153	
– Above compulsory level	508 (32.3)	1,064 (67.7)	1,572	0.001
Family income				
– 5,000 Baht or less per month	424 (40.4)	625 (59.6)	1,049	
– Above 5,000 Baht per month	530 (31.6)	1,146 (68.4)	1,676	< 0.001
Anterior tooth protrusion (Overjet)				
– > 5 mm	99 (42.9)	132 (57.1)	231	
– < 5 mm	855 (34.3)	1,639 (65.7)	2,494	0.009
Body Mass Index (BMI, kg/m^2)				
– 1st tertile (< 16.92)	294 (32.3)	615 (67.7)	909	
– 2nd tertile (16.92 to 19.62)	338 (37.3)	569 (62.7)	907	
– 3rd tertile (>19.62)	322 (35.4)	587 (64.6)	909	0.09

† Chi-square test

Some characteristics of children such as sex, age, socio-economic factors, and anterior tooth protrusion were significantly associated with TDI (Table 2). Therefore, these variables could be alternative explanations for the occurrence of TDI, and were the potential confounding factors of the associations between school environments and TDI.

After accounting for variations in schools there was a highly significant association between TDI and social environments of schools (Table 3). The estimated crude odds ratio (OR) of the social environment was 0.59 for the schools with a more supportive social environment compared to those with a less supportive social environment ($p = 0.004$). On the other hand, the physical environment of schools was not significantly associated with TDI (Table 3). When analysing the association between TDI and social environment for each possible confounding factor, sex was the strongest confounder that reduced the strength of association, from 0.59

Table 3 Multilevel analyses for the unadjusted associations between traumatic dental injuries and school environment, accounting for school variations*

School environment	Numbers of schools/children	Crude OR (95% CI)	P-value†
Social environment			
– More supportive	30/1,399	1	
– Less supportive	22/1,326	0.59 (0.41, 0.84)	0.004
Physical environment			
– More favorable	24/1,733	1	
– Less favorable	28/992	0.88 (0.61, 1.28)	0.52

† Wald's test
* The school variations shown in terms of logit variances were 0.24 (SE = 0.08) for the association between traumatic dental injuries and social environment and 0.29 (SE = 0.09) for the association between traumatic dental injuries and physical environment.

to 0.65. Most of the other confounding factors only slightly changed the strength of associations. Adjusting for physical environment and educational status of parents did not change the strength of association.

When the association between TDI and physical environment of schools was adjusted for each possible confounding factor, the strength of the association was only slightly changed. Sex was the strongest confounder. The strength of the association changed from 0.88 to 0.95 after adjusting for sex.

In the multivariate analysis of the association between TDI and social environment, the model was adjusted firstly for physical environment. After that, the model was adjusted for demographic factors, since the sex variable was the strongest confounder. The next group of variables inserted in the model were socio-economic factors starting from parents' marital status, employment status, family income, and educational status. The strength of the association between TDI and social environment was very similar (0.59 to 0.57) when controlling for physical environment. The strength of the association slightly decreased to 0.64 after adding and controlling for demographic factors, particularly for sex.

Since all potential confounding factors slightly altered the strength of association between TDI, they were sequentially inserted into the multivariate model for the physical environment in the same order as the model of the association between TDI and social environment. The strength of association between TDI and physical environment was similar (0.88 to 0.83) when controlling for social environment. However, it was diluted by the other confounding factors. The adjusted OR of the full model was 0.89, virtually the same as the crude OR of 0.88. Overall, the physical environment was not significantly associated with TDI ($p = 0.44$).

The interactions between the explanatory variables and the school environments, and between the explanatory variables themselves, were examined using the Wald's test with significance level less than 0.10. There were significant interactions between TDI, sex and the social environment of schools ($p = 0.08$) and the physical environment of schools ($p = 0.07$).

Since there were significant interactions for sex, the multilevel analyses of the associations between TDI and the school environments were performed separately for boys and girls (Table 4). In boys, there was a significant association between TDI and social environment of schools after adjusting for physical environment of schools, age, marital and educational status of parents. A more supportive social environment was significantly more protective (adjusted OR = 0.65, $p = 0.022$) than a less supportive social environment. However, there was no significant association between the physical environment of schools and TDI in boys (Table 4).

Table 4 Multilevel analyses for the associations between traumatic dental injuries and school environments, by sex

Sex	School environment	Number of children (%)	Adjusted OR (95% CI)
Boys	Social environment		
	Less supportive schools	769 (57.8)	1
	More supportive schools	562 (42.2)	0.65 (0.45, 0.94) [1*]
	Physical environment		
	Less favorable schools	894 (67.2)	1
	More favorable schools	437 (32.8)	1.06 (0.74, 1.52) [2]
Girls	Social environment		
	Less supportive schools	630 (45.2)	1
	More supportive schools	764 (54.8)	0.82 (0.55, 1.23) [3]
	Physical environment		
	Less favorable schools	839 (60.2)	1
	More favorable schools	555 (39.8)	0.80 (0.54, 1.20) [4]

* Wald's Z = -2.290, p = 0.022
[1] The final model: adjusted for physical environment, age, marital status of parent, employment status of parent, and educational status of parent
[2] The final model: adjusted for social environment, age, and marital status of parent
[3] The final model: adjusted for physical environment, age, and marital status of parent
[4] The final model: adjusted for social environment, age, marital status of parent, and employment status of parent.

In girls, there was a statistically insignificant tendency for a more supportive social environment to be more protective (adjusted OR = 0.82) than a less supportive social environment after adjusting for physical environment of schools, age and marital status of parents (Table 4). In contrast to the boys, girls attending schools with a more favourable physical environment had a lower risk of TDI than those attending schools with a less favourable physical environment after adjusting for social environment of schools, age, marital and employment status of parents (OR = 0.80) (Table 4).

Despite there being no statistically significantly interaction between the social and physical environments, it was considered worthwhile investigating the associations between TDI and the combination of sex, and schools' social and physical environments. The results of the further analyses show that there was a significantly lower risk of TDI in girls, whatever the type of school social and physical environment compared to boys (Table 5). In boys, on the other hand, schools with a more supportive social environment with either type of physical environment were more protective than less socially supportive and physically favorable environments (Table 5).

When performing a subgroup analysis for sex, there was no significant association between TDI and the combination of social and physical environments of schools. In boys, it was confirmed that there was a tendency for the more socially supportive environment to be more protective rather than the effect of any type of physical environment. However, in girls, this protective tendency was only apparent when the school environment was both more socially supportive, and physically favourable (Table 6).

DISCUSSION

The hypothesis of this study was that the prevalence of TDI in children attending schools with more socially supportive and physically favourable envi-

Table 5 Multilevel analyses for the associations between traumatic dental injuries and the combination of sex and social and physical environment of schools

Sex and social and physical environment	Number of children	Adjusted OR (95% CI) †
Boys in schools with a less supportive social and less favorable physical environment	388	1
Boys in schools with a less supportive social but more favorable physical environment	381	1.10 (0.70, 1.72)
Boys in schools with a more supportive social but less favorable physical environment	506	0.69 (0.44, 1.09)
Boys in schools with a more supportive social and more favorable physical environment	56	0.62 (0.31, 1.25)
Girls in schools with a less supportive social and less favorable physical environment	358	0.41 (0.30, 0.56)
Girls in schools with a less supportive social but more favorable physical environment	272	0.38 (0.24, 0.62)
Girls in schools with a more supportive social but less favorable physical environment	481	0.38 (0.24, 0.61)
Girls in schools with a more supportive social and more favorable physical environment	283	0.22 (0.13, 0.40)

† The final model: adjusted for age, employment status of parent, and educational and marital status of parent.

ronments would be significantly lower than in those attending in schools with less socially supportive and physically favourable environments. This hypothesis was partially substantiated. There were significant differences in levels of TDI in relation to whether schools were socially supportive, or not. The social environment of the schools was more important for boys than girls. Overall, schools with better social environments had a protective effect on the occurrence of TDI.

The main finding was that the social environment had a greater effect than the physical environment on the level of TDI. The relatively good physical environments of the schools in Muang District may explain this. Although the schools were dichotomised by physical environment, those schools classified as having a 'poorer' physical environment were of a reasonable standard. The differences in physical environment were nevertheless great enough to have some protective effect on the chances of girls having TDI. Girls attending schools with both and more supportive social and favourable physical environments were less likely to have TDI than girls attending schools with more supportive social but less favourable physical environments. The finding that girls are more sensitive than boys to the same physical environments, in terms of risk of TDI, may explain the widespread finding of differences by sex in the prevalence of TDI (O'Brien, 1994; Kania et al, 1996; Kaste et al, 1996; Petti et al, 1997; Cortes et al, 2001).

The finding that schools with more supportive environments had a lower 'risk' of TDI corroborates the findings from the studies of Health Promoting Schools, which showed that such schools enhance the health of schoolchildren (Moysés et al, 2003). More importantly, the findings by Moysés et al (2003) that Health Promoting Schools in Brazil had lower rates of TDI lend support to the findings from the present study. Their results showed that chil-

Table 6 Multilevel analyses for the associations between traumatic dental injuries and the combination of the social and physical environment of schools, by sex

Sex	Social and physical environments of schools	Number of children	Adjusted OR (95% CI)
Boys	Less supportive social and less favorable physical environment	388	1
	Less supportive social but more favorable physical environment	381	1.09 (0.71, 1.67) [1]
	More supportive social but less favorable physical environment	506	0.70 (0.45, 1.08) [1]
	More supportive social and more favorable physical environment	56	0.59 (0.29, 1.17) [1]
Girls	Less supportive social and less favorable physical environment	358	1
	Less supportive social but more favorable physical environment	272	1.02 (0.60, 1.72) [2]
	More supportive social but less favorable physical environment	481	1.06 (0.64, 1.78) [2]
	More supportive social and more favorable physical environment	283	0.61 (0.33, 1.13) [2]

[1] The final model: adjusted for age, marital status of parent, employment status of parent, educational status of parent, and family income.
[2] The final model: adjusted for age, employment status of parent, family income, and educational status of parent.

dren in supportive schools had better oral health than in non-supportive schools. The chances of having TDI were 9.7% less in schools that demonstrated a commitment towards health and safety. Some of the criteria used in Moysés study were similar to those in the present study.

In addition to the sex variable, another important alternative explanation for the associations between school environments and TDI was the socio-economic and marital status of the parents. Children with 'both parents' were independently and significantly less likely to have a TDI than those with 'no or a single parent'. Without controlling for the 'marital status of parents' variable, the protective effect of both the social and physical environments on TDI was overestimated. Employment and educational statusof parents was also independently significantly associated with TDI. Although children with employed parents were more protected compared to those with unemployed parents, the 'employment status of parents' appeared to be important in influencing the association between social environment on TDI in boys, and the association between physical environment and TDI in girls. However, the 'educational status of parents' affected only the relationship between social environment and TDI in boys.

The prevalence of TDI to permanent anterior teeth in this study was much higher than in other studies using the same criteria for TDI (Cortes et al 2001). The high prevalence of TDI in this Thai population is probably due to three causes of injuries: high rates of 'misuse of teeth' (18.6%), 'accidentally biting hard material' (9.9%) and 'do not know' (21.7%). They accounted for half of the ways that injury events occurred. Although it is difficult to com-

pare the 'misuse of teeth' with other populations because data are not available, the practice of using teeth for a wide variety of non-eating functions in Thai children is frequently mentioned by foreign observers. Another practice, which is relatively common in Thailand, is 'biting ice' and 'animal bones'. Animal bones are frequently chopped up in the preparation of foods in Thailand. Small fragments of bone remain in foods and are unexpectedly bitten. Biting on 'animal bones', 'stones in rice' and 'other hard materials' accounted for 9.9% of all vectors for TDI. The high levels of 'do not know' responses may indicate that the child was suppressing sensitive reasons for the injury.

CONCLUSION

The prevalence of traumatic dental injuries to permanent teeth was high in this survey of Thai schoolchildren. Children attending schools with more supportive social environments were likely to have a significantly lower risk of having traumatic dental injuries than those attending schools with less supportive social environments. This finding was statistically significant in boys but not in girls. In girls, there was an insignificant tendency. There was no significant association between traumatic dental injuries and physical environments of schools. Nevertheless, there was a tendency for the prevalence of traumatic dental injuries in girls attending schools with more physically favourable environments to be lower than in those attending schools with less physically favourable environments.

In boys, there was a tendency for the more socially supportive environment to be more protective rather than the effect of any type of physical environment. However, in girls, this protective tendency was only apparent when school environments were both more socially supportive, and physically favourable.

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