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Assessment of the environmental risk factors associated with traumatic dental injuries among WHO index-aged children and adolescents

Mohammad Kamran Khan, Mahendra Kumar Jindal

Abstract:

BACKGROUND: Traumatic dental injuries (TDIs) are becoming a worldwide phenomenon owing to their variable prevalence, and their etiology is considered multifactorial and complex in interactions among various risk factors. These are preventable if risk factors are analyzed and interpreted in all possible scientific manners. The objective of this study was to assess the various environmental risk factors (places of occurrence of TDI) among World Health Organization (WHO) index-aged children and adolescents (12 and 15 years).

MATERIAL AND METHODS: This was the epidemiological cross-sectional study conducted in Aligarh City, Uttar Pradesh, India, in the year 2018, with a sample size of 1000. Multistage random sampling technique was employed. Study data were collected by doing dental examination and structured interview with self-prepared pro forma in ten randomly selected sampling sites (schools) from different regions of the city. Subsequently, data were entered in an Excel sheet and then analyzed with the Chi-square test using the Statistical Package for the Social Sciences (SPSS) software.

RESULTS: Overall, school (63; 46.7%) was found to be the most prevalent environmental risk factor for TDI followed by home (37; 27.4%), roadside (10; 7.4%), and playground (9; 6.7%). Fifteen (11.1%) affected individuals were not able to recall the place of the TDI incident, while 0.7% (1) had TDI occurrence in other places. Among 12-year index-aged children, home (15; 34.1%) was the most common place of TDI in rural regions, while school (27; 67.5%) was the most frequent place of TDI in urban regions. Among 15-year index-aged adolescents, school (19; 59.4%) was found to be the most common place in rural regions, whereas school (9; 47.4%) was the most frequent place of TDI in urban regions.

CONCLUSION: Environmental factors, especially school premises, infrastructure, and playing facilities, need to be upgraded and built with an emphasis on a safer environment for children. Teachers, parents, and school children should be educated and made aware of the preventive measures for dental injuries in schools and homes. Appropriate safety gears should be mandatory to use among children and adolescents during outdoor sports and recreational activities.

Keywords:

Adolescents, children, cross-sectional study, environmental risk factors, epidemiological study, places, TDI, traumatic dental injuries, WHO index age

Introduction

Traumatic dental injuries (TDIs) are becoming a worldwide phenomenon due to their variable prevalence in different

geographical parts of the globe as reported in the dental literature.^[1-4]

It has been reported in recent research that approximately one billion individuals have had a TDI.^[5] Individuals mostly in their

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Department of Pediatric
and Preventive
Dentistry (Pedodontia),
Aligarh Muslim
University (AMU), Aligarh,
Uttar Pradesh, India

Address for correspondence:

Dr. Mohammad Kamran
Khan,
Hamdard Nagar-A,
Civil Line, Aligarh,
Uttar Pradesh, India.
E-mail: mohdkamran0009
@gmail.com

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childhood sustain TDI as compared to older adulthood.^[1-3,6] In the literature, it has been seen that the occurrence of TDIs and their sequelae may increase the burden of caries and periodontal problems in the young age group.^[1] It is well known that TDI has several adverse consequences in terms of physical, functional, aesthetic, psychosocial, and economic impact on the affected children and their parents.^[1-4,6,7] Furthermore, oral health-related quality of life (QoL) is also influenced by TDI.^[6] Various predisposing/risk factors such as age, gender, malocclusion, environmental and behavioral factors, and socioeconomic status with complex interactions among them have been investigated in the literature.^[1-3] However, environmental factors that include the place of occurrence of TDI (e.g., schools, homes, playground, and roadside) are one of the critical factors that have a significant role in the occurrence of TDI event.^[3,4,6-8] The occurrence of TDI incident can be prevented if environmental risk factors are well explored and thoroughly studied for different aspects, and accordingly, preventive measures can aid in the reduction in TDI prevalence in susceptible age group population (children and adolescents).^[4,8,9] Although previous studies have reported various environmental risk factors such as home, school, playgrounds, and roadside, there is paucity in existing dental literature regarding the analysis of the association of dental trauma in relation to different places of TDI occurrence, particularly in relation to World Health Organization (WHO) index age groups of children and adolescents of rural and urban regions of north Indian regions. WHO has recommended that the epidemiological observational research studies should be performed among study participants of index age groups for global monitoring of the status of oral and dental diseases. There is a crucial need for observational analytical studies investigating TDI in relation to the place of TDI occurrence (environmental risk factor or determinant) to halt or minimize the prevalence of such deleterious injuries. Hence, this study was carried out with the aim to analyze the association of TDIs with the various environmental risk factors (place of TDI occurrence) among WHO index-aged children (12 and 15 years) of rural and urban regions. This is a unique study in which a thorough analysis of the environmental risk factors of TDI (places of TDI event) with respect to WHO index-aged participants of rural and urban regions has been done. The manuscript of this original research article has been prepared as per the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Material and Methods

Study design and setting

The current scientific study was the epidemiological analytical cross-sectional study conducted in different regions of a city.

Study participants and sampling

A multistage cluster random sampling method/procedure was employed to obtain the representative study population (sample size). The sample size was determined with the help of the statistical sample formula as follows:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where: n = sample size; Z = z statistics for given level of confidence = 1.96 (for 95% confidence interval); p = expected prevalence = 39.5%; and d = precision = 5.0%.

The abovementioned formula provided a sample of 368 for each group (rural/urban regions); then, after rounding off that, the final sample size of 500 for each group and a total sample size of 1000 were determined. The study participants (children of WHO index ages of 12 and 15 years) of schools from different regions of the district were randomly selected and included in the study to make a sample size.

Data collection tool and technique

The participants were included in this study who met the eligibility criteria, i.e., inclusion and exclusion criteria. A self-constructed pro forma was used to record the findings of an oral examination [Type-3 of American Dental Association (ADA) using sterile mouth mirror, explorer, and under adequate illumination] and to gather the responses/answers from the study participants during a structured interview. Intra-examiner consistency/reliability was assessed by *Cohen's kappa* coefficient (κ) and was found excellent (0.85). The pro forma consisted of questions pertaining to general information, various TDI risk factors including environmental factors, and dental examination findings. The questions in pro forma were printed in English language and were explained to the study participants in their local language by the study's investigator.

The environmental factors, viz. place of occurrence of TDIs in rural and urban regions of Aligarh District, were investigated by asking the close-ended question of having several options/alternatives from the pro forma. The options/alternatives included were the playground, home, school, roadside, other places, and not able to recall. The interview and examination of the TDI-affected teeth were carried out by a single calibrated and trained investigator in the calm, relaxed atmosphere of school premises in accordance with WHO oral health surveys' guidelines (2013). The stringent cross-infection preventive measures were followed during the study.

The study data were entered into the Microsoft Excel sheet and then subjected to statistical analysis by

employing the IBM Statistical Package for the Social Sciences (SPSS) Statistics software v. 20.0 (IBM Corp., Armonk, USA). The level of significance and confidence interval was 5% and 95%, respectively. The data analysis comprised descriptive statistics, i.e., frequency distribution and cross-tabulation. The comparison of the frequencies for the categories of variables between the groups was carried out using the Chi-square test (χ^2) test.

Ethical considerations

The ethical approval for conducting this study was obtained from the Institutional Ethics Committee (IEC), Faculty of Medicine of the Aligarh Muslim University (AMU), Aligarh, Uttar Pradesh, India (D. No. 1030-FM-2018), in 2018. This epidemiological study followed the ethical principles and guidelines of the Declaration of Helsinki (2013). The school's principal/headmasters were contacted and explained about this study, and hence, permission and written informed consent were taken. The assent from study participants and written informed consent from parents/guardians were obtained before initiating the oral examination and structured interview.

Results

The results show the frequency distribution of environmental risk factors of TDIs in terms of place of occurrence of TDI incidents among index age groups.

Table 1 demonstrates the overall frequency and percentage of environmental risk factors among index age groups (12 and 15 years) in 135 affected children with traumatic dental trauma. School (46.7%) was found to be the most prevalent environmental risk factor for TDI followed by home (27.4%), roadside (7.4%), and playground (6.7%). Furthermore, 11.1% of affected individuals were not able to recall the place of TDI incident, while 0.7% of affected individuals had TDI occurrence in other places.

Table 2 illustrates the frequency and percentage of various environmental risk factors (place of TDI

Table 1: Distribution of environmental risk factors (place of occurrence of TDI incident) among affected study participants of index-aged children and adolescents

Place of occurrence of traumatic dental injuries (TDI)	Frequency (n)	Percentage (%)
Playground	9	6.7%
Home	37	27.4%
School	63	46.7%
Roadside	10	7.4%
Others	01	0.7%
Not able to recall	15	11.1%
Total	135	100%

event) in relation to index age group and geographical region (rural/urban).

In rural regions

In this study, 12-year aged children showed the highest TDI prevalence at homes (15; 34.1%) followed by schools, roadside, playground, and others. 15-year aged adolescents demonstrated the highest TDI prevalence at schools (19; 59.4%) [Table 2].

In urban regions

12-year-old children were found with the highest TDI occurrence at schools (27; 67.5%) followed by home, playground, and roadside. 15-year aged adolescents demonstrated the highest TDI prevalence at schools (9; 47.4%) [Table 2].

The statistically significant difference in prevalence of TDI in relation to place of occurrence was observed in rural region (P value < 0.05), whereas in urban regions, the difference in frequencies of place of TDI occurrence was found statistically nonsignificant.

Discussion

TDIs are emerging as a public dental health concern along with several adverse sequelae in the young population, especially children and adolescents.^[10] However, such deleterious traumatic injuries with multifactorial etiology are preventable if the associated risk/predisposing factors are appropriately addressed and eliminated effectively.^[8,10] Multiple risk factors for TDI have been studied.^[8,10] However, children's activities and their environment have been seen to be more significant factors or determinants than their age and gender^[2,11] Environmental factors (place of TDI) have been evaluated in index ages of 12 and 15 in some previous epidemiological studies.^[8,10]

In the current study, environmental factors in terms of place of TDI occurrence among index age group participants of 12 and 15 years were assessed, in which overall school was found to be the most frequent place of TDI event followed by home, roadside, and playground. These findings indicate that school premise is the strongest environmental risk factor for TDI occurrence in children of index ages of 12 and 15 years because of the following possible reasons such as follows: Individuals in their growing age do spend more time of the day at schools, mostly all the sports-related activities or recreational or extracurricular are done at school premises, lesser supervision of the children in the schools as compared to home, and teachers are not vigilant for the students during playing activities in the schools and lack of health promotion education and protective measures, e.g., impact-absorbing surfaces, mouth guards

Table 2: Distribution of environmental risk factors (place of occurrence of TDI) in relation to index ages (12 and 15 years) and regions (rural and urban)

Regions	Index ages	Place of occurrence of traumatic dental injuries (TDI)						Total	P
		Playground	Home	School	Roadside	Others	Not able to recall		
Rural	12 years	4	15	8	8	1	8	44	0.008*
		9.1%	34.1%	18.2%	18.2%	2.3%	18.2%	100%	
	15 years	1	8	19	1	0	3	32	
		3.1%	25%	59.4%	3.1%	0.0%	9.4%	100%	
	Total	5	23	27	9	1	11	76	
		6.6%	30.3%	35.5%	11.8%	1.3%	14.5%	100%	
Urban	12 years	2	8	27	1	0	2	40	0.522
		5%	20%	67.5%	2.5%	0.0%	5%	100%	
	15 years	2	6	9	0	0	2	19	
		10.5%	31.6%	47.4%	0.0%	0.0%	10.5%	100%	
	Total	4	14	36	1	0	4	59	
		6.8%	23.7%	61%	1.7%	0.0%	6.8%	100%	

Pearson Chi-square test values: 15.624 (rural region); 3.219 (urban region). Degree of freedom: five (rural regions); four (urban regions). *Statistically significant; $P < 0.05$

and helmets in the school premises. Similar findings have been observed in some previous studies where the school was the most frequent place of TDI occurrence.^[12-14]

In contrast, other studies have reported home as the most common place of TDI incident.^[10,15,16]

In the present study, 12-year index-aged children of rural regions were found with a higher prevalence of TDI at home as an environmental risk factor and that indicates that the parents might not supervise their children during playing or leisure activities at home or may be due to the casual or careless behavior of the children and parents in the rural regions. Other possible reasons might be the lesser education and awareness regarding dental traumatic injuries and their prevention.

The environmental determinants have been overtly associated with the incidence of dental trauma in children. Environmental factors include the nature and density of housing and physical (infrastructure) characteristics of schools and neighborhoods (playgrounds).^[17]

The social and physical environment of the school has been reported to be an influential factor in the occurrence of TDI in children.^[4] In schools, good social relationships or friendly interactions among schoolmates lead to a healthy environment.^[4] Children in school having supportive social environment has been observed to have remarkably lesser TDI as compared to children in school having non-supportive social environment.^[4,18] Furthermore, health-promoting schools have been reported to have lower TDI prevalence due to their commitment toward safety and health of children.^[4,18] Schools with children under good teacher supervision and better student-to-staff ratio have been seen with a lower prevalence of TDI.^[4] Physical characteristics of the school's infrastructure including

school playgrounds, sports facilities, and stairways are stronger related to TDI incidence.^[4,19] Ground surfaces of playing areas should be impact-absorbing surfaces to minimize the impact and severity of fall-related injuries.^[19] It has been reported that the students from schools having patios made of soft floors (sand and grass) were found to be with lower prevalence of TDI as compared to ones that had constructed of cement/concrete.^[6] It has been suggested that children's play areas (playgrounds, sports courts, and patios) should incorporate soft floors to diminish the occurrence and extent of dental injuries.^[2,3,6] Schools having access ramps along with stairs have been found to be associated with lower TDI prevalence in children as compared to schools that have only stairs.^[6]

The possible relationship between school bullying and TDI has been investigated in some studies.^[20] The lack of knowledge and awareness among teachers and school staff about the preventive measures and first-aid management for dental trauma in children in schools is believed to be an influential factor in rise of TDI prevalence in the school environment.^[11,21]

When home is taken into consideration as an environmental risk factor for TDI, then the family structure has been described as a significant determinant for dental trauma in children along with the socioeconomic status of parents.^[22] Several aspects/factors of the family environment such as family structure, parenting styles, and also the parental relationship have been associated with the health status of the children.^[23] Family structure, that is, children of single parent, and reconstituted families have been reported to have a greater incidence of traumatic injuries among children. Also, the development of aggressive behavior in children of such family environment may make them susceptible to injuries at home.^[22] Domestic violence has been

reported in a study as a factor for dental injuries at home premises.^[24]

The increased involvement or participation of growing individuals/children in playing activities, competitive and noncompetitive sports, the accentuated use of motor vehicles/automobiles by adolescents, and the increased habit/trend of keeping pet animals are the risk factors for TDI occurrence in children and adolescents in home, playground, or roadside. In the context of TDI occurring in roadside/street environment, it has been found in research that individuals who do not wear safety tools (helmets and seat belts) on the road/street while driving car/bike/bicycle or traveling in bus/car are mostly affected with traumatic injuries on head region including jaw and teeth. Moreover, usage of earphone/smartphones during walking or riding vehicle on roads has been shown to be linked with the higher occurrence of dental injuries in adolescents.^[25] Using smartphones may be a source of distraction from the surroundings of the traffic, which may result in dental injuries.

It is well known that prevention is better than cure. In the same way, TDI prevalence in various environments (schools, homes, playground, or roads) can be minimized among children by appropriate preventive efforts and measures from schools, teachers, parents, government authorities, and policymakers. The preventive measures (primary and secondary prevention) for TDI occurrence among children and adolescents are as follows: creating awareness and knowledge about TDI among teachers, parents, and children with the help of conducting dental educational camps, dental awareness programs, and news on televisions and newspapers, distributing informative pamphlets and brochure, pasting informative posters on public places, and using protective devices such as mouth guards, headgear, faceguards, helmets, seat belts, and interceptive treatment of developing malocclusions.^[26,27] Nowadays, the Internet and social media platforms can be utilized to create awareness regarding the preventive strategies for the prevention of TDI occurrence and elimination of possible risk factors of dental injuries among children and adolescent. Schools' infrastructure and facilities need to be upgraded and optimized, while school students and teachers need to be educated through seminars and lectures about the significance of TDIs.^[28] Schools should be health-promotional and supportive schools. The Academy of Sports Dentistry (ASD) recommends the use of properly fitted mouth guard under a dentist's supervision for people involved in contact sports. Type I—custom-fabricated mouth guards are more preferred over type II—mouth-formed (boil and bite) and type III—stock mouth guards.^[29] Road traffic accidents (RTAs) due to vehicles such

as car, motorcycle, and bicycle with riders or pedestrians have been increasing to cause dental and maxillofacial injuries, which need to be pondered for preventive strategies. RTAs due to vehicles such as car, motorcycle, and bicycle with riders or pedestrians have been increasing to cause dental and maxillofacial injuries, which need to be pondered for preventive strategies.^[30]

Apart from biological, oral, environmental, or behavioral factors, a few new factors such as social capital and binge drinking (alcohol) have been studied in recent studies in the context of TDI prevalence.^[31]

Since TDI is multifactorial in etiology and results in complex interactions among different risk/predisposing factors, hence, the reduction in the prevalence of TDI can only be accomplished by appropriately addressing the risk factors (malocclusion, environmental, behavioral factors, etc.) associated with dental traumatic injuries.^[2,3,5,8,9] A poster with the title of "Save your Tooth" was suggested by the International Association of Dental Traumatology (IADT) for the awareness of the public about dental trauma. An IADT's mobile app "ToothSOS" can be a good source of knowledge for managing dental trauma incident.

Oral health education programs primarily focus to improve oral health literacy and awareness for encouraging the desirable behavioral changes for achieving optimal dental health.^[32,33]

Several positive outcomes in school children and adolescents such as oral cleanliness, oral health knowledge, and dental attitude/behavior have been observed by conducting oral health education programs in schools.^[32,33] Schools can also render supportive and preventive measures to identify the school children in need of dental treatment and also can refer them to dental hospitals or clinics. Oral health-promoting schools can be a good step or initiative for preventing oro-dental problems in children.^[32,33]

The strength of the present study is that the environmental factors (place of the TDI event) of TDI among WHO index-aged children and adolescents (12 years and 15 years) have been thoroughly analyzed in a standardized way. This study including study participants (WHO index-aged groups) will help in comparing different variables/parameters in a standard way (WHO index-aged groups). The environment of growing children is considered critical in terms of providing safer playing or creativity areas in schools, homes, etc. However, future studies can be performed among other age groups including adults to analyze TDIs in relation to environmental factors.

Conclusion

Based on the results of the current study, it can be concluded that schools followed by homes are the most frequent place (environmental factor) of occurrence of TDIs in both rural and urban regions. However, playgrounds (parks) and roadside places were also found associated with TDI incidents but with relatively lesser prevalence. Hence, environmental factors, especially school premises, infrastructure, and playing facilities, need to be upgraded and built with an emphasis on a safer environment for children. In addition, teachers, parents, and children should be made aware of the preventive measures for TDI. Mouth guards, faceguards, helmets, seatbelts, and other safety equipment should be mandatory to use for children during sports and riding or traveling on the roads.

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Conflicts of interest

There are no conflicts of interest.

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