ORIGINAL RESEARCH

Prevalence of Traumatic Injuries to Permanent Anterior Teeth and Predisposing Risk Factors among Government and Private School Children of Kakinada and Rajanagaram of East Godavari District

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Abstract

Aim: To determine the prevalence of traumatic dental injuries (TDI) in permanent anterior teeth and their association with risk factors among children aged 7–13 years of government and private schools in Kakinada and Rajanagaram of East Godavari district, Andhra Pradesh, India.

Materials and methods: A cross-sectional study was carried out among 2,325 school children aged 7–13 years. Each child was examined for TDI, degree of overjet, molar relation, lip coverage, and facial profile. The results were analyzed by Statistical Package for the Social Sciences (SPSS) software and the Chi-squared test was used to compare qualitative data.

Results: The results show that the prevalence of trauma was found to be 12.1%, and there was no disparity between government or private schools and urban and rural areas. There was no much sex predilection. High school children are more prone to TDI than primary school children. The most common place was found to be home, and the most common cause is unknown. Maxillary central incisors are the most commonly affected and enamel fracture is the most common fracture. Among the subjects with trauma, only 4.1% sought treatment.

Conclusion: The subjects with trauma in the present study are found to be having a positive association with risk factors, such as increased overjet, class II division 1 molar relationship, convex facial profile, and inadequate lip coverage. Evidence of a lower rate of treatment outcomes shows the need for increased awareness among parents, teachers, and healthcare providers and the elaboration of prevention strategies for TDI at the population level.

Keywords: Cross-sectional study, Permanent anterior teeth, Prevalence, Risk factors, Traumatic dental injuries.

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Introduction

The TDI has become the most serious dental health problem in children, and its sequelae are of major concern to both clinicians and parents. Dental trauma has now achieved the deserved attention, especially when permanent teeth are affected, and loss of extensive tooth structure results.[1] The causes of TDI include falls, collisions, sporting activities, violence, and traffic accidents.[2] Studies have affirmed that increased overjet, inadequate lip coverage, class II division 1 occlusal relationship, and so on are the most frequent and common risk factors for dental trauma.[2] Prior recognition of these factors help in early intervention and prevention of severe effects due to trauma.

Despite being the third-largest cause of mortality of teeth, treatment for TDI tend to be neglected. Most dental injuries involve the anterior teeth and may have physical and psychological impacts. Implementation of adequate preventive measures requires the knowledge of its risk factors that are based on reliable data pertaining to its prevalence, causes, and risk factors.[3] On the contrary, data on the prevalence of dental injuries in India is relatively sparse.[4]

As there is a lack of statistical data on the prevalence of dental trauma among government and private school children in this particular geographical area, Kakinada and Rajanagaram of East Godavari district, Andhra Pradesh, India, it is necessary to conduct a study to identify the etiology and risk factors to establish preventive measures, educate children, and parents aimed at avoiding future injuries.

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Materials and Methods

A cross-sectional study was carried out among 2,325 school children aged 7–13 years, studying in the government and private schools of Kakinada and Rajanagaram of East Godavari district, to assess the prevalence of trauma to permanent anterior teeth. The estimated sample size was calculated to be 2,305 based on the results obtained from the pilot study.

The whole sample was equally divided between the government and private schools, and thus, a minimum sample

of 1,150 was obtained for each. This sample was further subdivided, and a minimum sample of 575 subjects was obtained from both government and private schools of Kakinada and Rajanagaram. Based on the stratified random sampling technique, 40 schools were selected, with 20 each from Kakinada and Rajanagaram, of which 10 government and 10 private schools were selected till the estimated final sample size was reached.

Children within the specified age groups, who were willing to participate are included in the study. Also, students who had lost their anterior tooth because of dental caries, fluorosis, and reasons other than trauma, and those children who were noncooperative, mentally challenged, and unwilling to participate were excluded from the study. Informed consent was taken from the respective school authorities and from the parents of all individual participants included in the study before the commencement of the study. A schedule for data collection was prepared, and an average of 50–60 school children was examined per day.

Data was collected using a pretested questionnaire, which included demographic details, details of the injury event, risk factors, and treatment details. Clinical examination was done according to the American Dental Association type III dental examination procedure.

Each child was examined for TDI [World Health Organization (WHO), 2013],[5] degrees of overjet (WHO, 1997),[6] molar relation (Angle's, 1899),[7] lip coverage (Burden, 1995),[8] and facial profile (Graber, 1972).[9] Overjet was measured with the teeth in centric occlusion and distance from the linguo-incisal edge of the prominent maxillary incisor to the labial surface of the corresponding mandibular incisor; tooth was calculated using a Community Periodontal Index probe. The overjet findings were grouped into three categories <3.5, 3.5–5.5, and >5.5 mm. Lip coverage was recorded on visual inspection and was rated as adequate if the lip covered the upper incisor tooth during the rest position. If incisors were exposed or there was evidence of lip strain upon closure, lip coverage was rated as inadequate.

A facial profile examination was done by viewing the patient from the side. The anterior limit of the maxilla and mandible forms a line that parallels the forehead, lips, and chin profile line. The profile is considered as straight if the line is nearly straight, the profile is convex if the line forms concavity facing the tissue, and the profile is considered concave if the line forms convexity towards the tissue. Subjects with clinical evidence of trauma were interviewed for treatment details, such as whether they had undergone treatment for trauma or not and reasons for not undergoing the treatment. At the end of each day, the investigator reviewed all the filled *pro forma* for accuracy and completeness of recording. School children requiring treatment were referred to the KLR's Lenora Institute of Dental Sciences. Oral health education was provided at the end of each survey. The data were analyzed using SPSS software version 20.0.

Chi-squared test was used to compare qualitative data. A *p*-value of <0.005 is kept as statistically significant.

Results

Out of the total 2,325 school children examined, 282 (12.1%) children were found to be affected by TDI to permanent anterior teeth. The most common age group of children involved in TDIs with the significantly highest prevalence rate ($p \leq 0.0001^{b}$) was found to be among 12-year-old (15.4%), followed by 11-year-old (14.6%), and 13-year-old (13.7%). The study presented that males had a higher traumatic experience (6.9%) compared to females (5.2%). But there was no significant statistical difference ($p = 0.101$). Children attending high school (7.4%) have a statistically significant prevalence ($p = 0.028^{a}$) than those attending primary school (4.7%). There was no difference statistically among the children attending government (5.7%) and private schools (6.5%) ($p = 0.187$), and also among children from Kakinada (urban) 6.1% and Rajanagaram (rural) 6.1% areas, $p = 0.672$ (Table 1).

Among 282 subjects involved in trauma, enamel fracture (8.7%) was the most common type of injury, followed by fractures involving dentin (2.6%) and pulp (0.4%) (Table 2). The most common place of TDIs was found to be home (39%), followed by places other (36.2%) than school (18.1%), and play areas (6.7%) (Table 3). Among the children affected with TDI, the most common cause of trauma was the unknown cause (40.4%), followed by fall (23.4%) and sports (22.7%) (Fig. 1). The most commonly affected tooth was maxillary incisors, with centrals (8.1%), followed by laterals (2.1%), and the least affected were the lower canines (0.2%).

Table 4 shows the prevalence of TDIs according to risk factors. Prevalence of trauma was significantly higher among the subjects with overjet of 3.5–5.5 mm than the subjects with overjet of <3.5 and >5.5 mm ($p = 0.001$). Children with class II division 1 molar relation had a significantly higher prevalence of trauma than those with class I relation and class II division 2, and the least no. of TDIs are found among children with class III molar relation ($p \leq 0.0001^{b}$). Subjects with the convex facial profile (23.4%) were found to be exposed to

Table 1: Prevalence of TDI according to demographic variables

			TDIs (%)		
Children's characteristics		*Number*	*Injuries present*	*Injuries absent*	*p-value*
Age	7–13 years	2,325	282 (12.1)	2,043 (87.9)	<0.000[b]
Class	Primary (3rd–5th)	1,049	110 (4.7)	939 (40.4)	0.028[a]
	High school (6th, 7th)	1,276	172 (7.4)	1,104 (47.5)	
Gender	Male	1,221	161 (6.9)	1,060 (45.6)	0.101
	Female	1,104	121 (5.2)	983 (42.3)	
Type of school	Government	1,174	132 (5.7)	1,042 (44.8)	0.187
	Private	1,151	150 (6.5)	1,001 (43.1)	
Area	Kakinada (urban)	1,135	141 (6.1)	994 (42.8)	0.672
	Rajanagaram (rural)	1,190	141 (6.1)	1,049 (45.1)	

Significant at [a]$p < 0.005$; [b]highly significant at $p < 0.001$

a higher prevalence of trauma, followed by a straight profile (9.2%), and concave being the least affected (7.3%) ($p \leq 0.0001^{b}$). Among the children having adequate lip coverage, 186 (9.2%) had traumatic experiences, which was significantly higher ($p \leq 0.0001^{b}$) than those with adequate lip coverage 96 (29.6%).

Among the subjects involved in trauma, only 4.1% sought treatment, and 95.9% neglected the treatment for dental trauma.

Table 2: Distribution of trauma according to type of fracture

Type of trauma	*Frequency*	*%*
No sign of injury	2,043	87.9
Enamel fracture only	203	8.7
Enamel and dentin fracture	60	2.6
Pulp involvement	10	0.4
Missing teeth due to trauma	3	0.1
Other damage	6	0.3
Excluded tooth	0	0
Total	2,325	100.0

Discussion

Traumatic injuries are not a result of any disease but an outcome of several factors that will accumulate throughout life if not appropriately treated. The trend in trauma is not adequately documented, as in dental caries with substantial variation in the prevalence of TDIs.[10] This has been attributed to the factors, such as classification of trauma, diagnostic criteria, research methodology, number of subjects, methods used for patient examination, cultural, and behavioral differences between various study locations and regions.

The present cross-sectional study determines the prevalence of anterior TDI and associated risk factors among 7–13-year-old school children attending the government and private schools of Kakinada and Rajanagaram of East Godavari district, Andhra Pradesh, India. Children between 7–13 years age-group were chosen, because of a sharp rise in physiologic growth curve and development during this period and their active participation in open-air recreations. Although these activities are regarded as markers of growth and development, careless activities, loss of balance, and impaired movements increase injuries. Both the government and private

Table 3: Gender distribution of traumatic dental injuries based on place of injury

		Place of injury				
		Home	*School*	*Play area*	*Other places*	*Total*
Male	Count	70	32	12	47	161
	% within sex	43.5%	19.9%	7.5%	29.2%	100.0%
	% within place of injury	63.6%	62.7%	63.2%	46.1%	57.1%
	% of total	24.8%	11.3%	4.3%	16.7%	57.1%
Female	Count	40	19	7	55	121
	% within sex	33.1%	15.7%	5.8%	45.5%	100.0%
	% within place of injury	36.4%	37.3%	36.8%	53.9%	42.9%
	% of total	14.2%	6.7%	2.5%	19.5%	42.9%
Total	Count	110	51	19	102	282
	% within sex	39.0%	18.1%	6.7%	36.2%	100.0%
	% within place of injury	100.0%	100.0%	100.0%	100.0%	100.0%
	% of total	39.0%	18.1%	6.7%	36.2%	100.0%

$p = 0.048$; Chi-squared value = 7.92

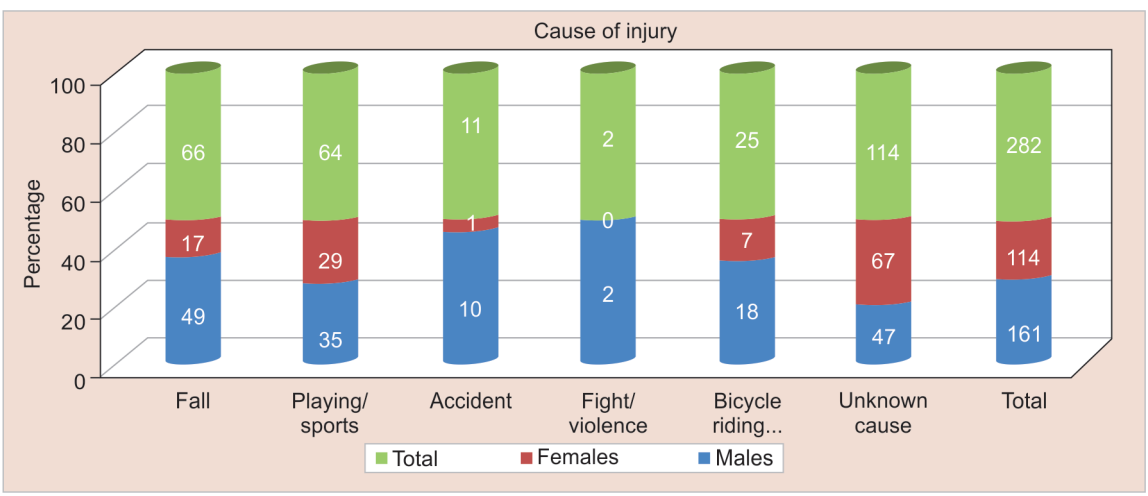

Fig. 1: Distribution of trauma according to cause of injury

Table 4: Prevalence of TDI according to risk factors

Children's characteristics		*Number*	*TDIs*			*p-value*
			Injuries present	*Injuries absent*	*(%) of TDI*	
Overjet	<3.5 mm	2,101	209	1,892	9.9%	0.0001**
	3.5–5.5 mm	161	65	96	40.3%	
	>5.5 mm	63	8	55	12.6%	
Molar relation	Class I	1,864	182	1,682	9.7%	<0.0001**
	Class II division 1	365	94	271	25.7%	
	Class II division 2	41	3	38	7.3%	
	Class III	55	3	52	5.4%	
Facial profile	Straight	1,770	163	1,607	9.2%	<0.0001**
	Convex	487	114	373	23.4%	
	Concave	68	5	63	7.3%	
Lip coverage	Adequate	2,001	186	1,815	9.2%	<0.001**
	Inadequate	324	96	228	29.6%	

Significant at **$p < 0.005$ and highly significant at $p < 0.001$

school pupils were considered in order to make the sample more representative, with wider range of children from all the social, economic, and cultural backgrounds. In the current study, among the 2,325 children examined, 282 had experienced TDI, reporting an overall prevalence rate of 12.1%. Similar results (12.7%) were found in the study conducted by Martins et al.[11] This result was <14.85% found by Hegde and Sajnani,[12] who conducted a similar study on the South Indian population. In comparison, studies done by Kumar et al.[13] reported a prevalence of 18.04%, which was much higher than the present study. These varied differences in reported rates can be attributed to several different factors, including the study type, methodology, study size and population, geographic location, and cultural differences.

According to the present study, children involved in TDI with significantly the highest prevalence rate found among 12 years of age, followed by 11 years and 13 years ($p \leq 0.0001^{b}$). This is due to active involvement in intense outdoor activities during this period. A similar result was obtained by Gupta et al.,[10] and contrary to results obtained by Bilder et al.,[14] who conducted a study among 12–15-year-old school children, where 15-year-old children had twice the chance to get TDI than 12-year-old children.

In the present study, the male-to-female ratio was 1.3:1, which was is in harmony with the review by Bastone et al.,[15] where the male-to-female ratio ranged from 1.3–2.3:1. These indicate that although males are more prone to fractures than females, a less significant difference shows that there is increased participation of females in sports activities. A similar report was submitted by Traebert et al.,[16] who found a diminished gender ratio of trauma prevalence due to a profound rise in sports activities among females.

The reason for high school children experiencing more trauma than primary school children could be the active involvement in outdoor activities in this age group. This clearly shows that there is an escalation in the prevalence of TDIs with age. There was found to be no statistically significant difference between the traumatic experience among pupils attending government and private schools, although the prevalence rate was a little higher in private schools. These findings are in contrast with Gupta et al.,[10] in which TDIs were more prevalent in private schools than in government schools, and agree with the study conducted by Frujeri et al.[17] One potential explanation for this can be ascribed to the safe play areas in private schools, where there could be better opportunities for athletic events.

There was no variation in the trauma prevalence among the urban and rural populations, and there is no statistically significant difference in the traumatic experiences among the children attending government or private schools in Kakinada and Rajanagaram. A similar result was obtained by Saraswathi and Kumar.[18] This may be because of better development of rural areas similar to urban areas and behavioral modifications in rural children due to better education in rural areas. A good education system provided in India, which is equal to both urban and rural areas, shows betterment in behavior and discipline among school-going children. The right environment and play areas in government and private schools in urban and rural populations definitely play a role in preventing trauma among school-going children.

Variations in TDI can be due to age, gender, socioeconomic status, and play environment of the children. The primary cause of trauma in the present study was unknown (40.4%), followed by falls (23.4%), and sports (22.7%). This was in contrast to the findings of Ravishankar et al.,[19] who conducted a similar study in Davanagere among 12-year-old school children. He reported the significant causes of trauma as falling, followed by collision. The majority of the children were unaware of the cause of the injury because of the retrospective nature of the study and this be the possible explanation for poor reporting of the traumatic event.

Although there is gender predilection in the cause of traumatic injury, where fall ($n = 49$) was the most common cause among males and unknown cause ($n = 67$) among females, this shows the involvement of males in more vigorous activities. Moreover, unknown causes have been postulated as a strategy to conceal the real causes (e.g., physical abuse or assaults) because of shame or fear (Taiwo and Jalo, 2011).[20] In cases of TDIs as a result of violence, children tend to report false causes or claim to forget the cause of the injury (Bendo et al., 2010).[21] Children from adverse family backgrounds experience higher degrees of parental punishment, physical abuse, and domestic violence (Nicolau et al., 2003).[22] Thus, it is essential for oral health professionals to be aware of the signs and symptoms of violence and report suspected cases to the authorities.

The most common place of TDIs was found to be home (39%), followed by places other (36.2%) than school (18.1%), and play areas (6.7%). Results were similar to a study done by Ravishankar et al.19 in Davanagere. The present study showed a gender predilection in

the commonplace of traumatic experiences. Among males, the home (43.5%) was found to be the most common place, whereas, in females, the commonplace of TDI was reported to be the other places (45.5%) than school, home, and play area. This result explains the fact that children spend most of their time at home engaged in various activities like bicycle riding, fighting with siblings, etc., rather than at school, and injuries that occurred during holidays or summer vacation ascertain these findings. Education on preventive measures must be provided to children, parents, and teachers. Also, physical education teachers should supervise sports activity at school, and proper preventive measures should be followed like using a helmet, protective mouthguard, and face shields should be made compulsory.[23]

Traumatic dental injuries (TDIs) were most common on maxillary teeth with central incisors (8.1%), followed by lateral incisors (2.1%), and mandibular central incisors (1.3%). In comparison, the least affected tooth was found to be the lower canine (0.2%). This is similar to the results reported by Hegde and Sajnani,[12] and corroborates the results of other studies.[24] Early eruption, vulnerable position, and protrusive position of these teeth could be a possible explanation. Furthermore, its early eruption coincides with the time when the child begins to play or participate in any physical activity.

Among 282 subjects involved in trauma, enamel fracture was reported to be the more commonest type of injury than the subjects with fractures involving enamel and dentin. The results of this study are in accordance with the studies by Caldas and Burgos,[25] and Navabazam and Farahani,[26] whereas not in harmony with the studies by Brunner et al.,[27] Bücher et al.,[28] who reported enamel and dentin fracture as the commonest type. Individuals with minor enamel fractures might not undergo any treatment as they are pain-free, or sometimes they might not be aware of it. This might be the reason for higher recording in these studies.

Prevalence of trauma was significantly higher among the subjects with overjet 3.5–5.5 mm than the subjects with overjet of <3.5 and overjet >5.5 mm ($p = 0.001^{b}$). This indicates that subjects with increased overjet between 3.5–5.5 and >5.5 mm are at a higher risk of exposure to trauma, suggesting a positive correlation between increased overjet and higher susceptibility to dental injury.

In some studies, the protrusion is defined >3–3.5 mm,[16,29] whereas some others begin to define at >5.0 mm,[30] which makes the comparison difficult. Petti et al.[31] reported that individuals with overjet of 3 mm or more were 2.5 times more at risk of TDI than individuals with normal overjet. Based on the findings of the present study and the conflicting results in the existing literature, consideration of overjet as a risk factor for TDI should be done cautiously. There are two reasons for this:[32] first, overjet on TDI is more often influenced by confounding factors, such as age, gender, lip coverage, and tooth development. Thus, the statistical method of choice should be a model analysis to consider confounders' effects (Nguyen et al.,).[33] Second, the overjet is reported as a categorical variable by introducing an empirically based cutoff point, which leads to loss of information. Instead, treating overjet as a continuous variable and analyzing its relation to TDI, along with the confounding effects will provide greater insight into the risk factors for dental injuries. It may be because of the varied sample sizes and population, various modes of measurement, intra-examiner reliability, consistency, and so on, that differ from one study to another study.

As TDIs are multifactorial, the relation between dental trauma and lip coverage is not well documented in the literature. The prevalence of trauma in the present study was significantly higher with inadequate lip coverage than those with adequate lip coverage ($p \leq 0.0001^{b}$). Similar studies conducted by Cortes et al.,[34] observed an increased risk of TDI among subjects with inadequate lip coverage, whereas Traebert et al.[16] found no such association between them. The present cross-sectional study is on par with other studies, which suggest that lips with adequate competency has a protective effect to the anterior teeth by functioning as a cushion and preventing them from traumatic forces.[19] Limited shielding effects of lips with protruded or forwardly placed front teeth has a role in getting dental trauma.[35]

Prevalence of trauma was found to be significantly high among subjects with a convex facial profile (23.4%), followed by a straight profile (9.2%), and concave being the least (7.3%) ($p \leq 0.0001^{b}$), suggesting that prognathic maxilla, either skeletal or dental, with convex facial profile, stands as a risk factor of TDI. Therefore, an early reduction of the maxillary protrusion is considered one of the essential preventive measures for decreasing fractures of the permanent anterior teeth.[36]

In the present study, children with class II division 1 molar relation had a significantly higher prevalence of trauma than those with class I and class II division 2, and the least number of TDIs are found among children with class III molar relation ($p \leq 0.0001^{b}$). A similar study was done by Rai and Munshi[37] in Southern India, who reported that the highest number of TDIs were associated with class II division 1. This result is contrary to the study conducted by Govindarajan et al.,[38] where children with class I molar relation show higher data of traumatic experience. Patients with class II division 1 malocclusion suffered more risk of anterior tooth fracture, maybe because of increased overjet.

Similar to previous studies reported by Ravishankar et al.,[19] Gupta et al.,[35] and Juneja et al.,[8] the present study also supports the fact that TDI are associated with risk factors, such as increased overjet, convex facial profile, class II division 1 malocclusion, and inadequate lip coverage. Advanced studies are yet to be conducted to reveal the factors that elevate the risk of damage to the permanent anterior dentition. Such data is essential to accomplish newer methods of preventive strategies for reducing the prevalence of this condition. Additional prospective research on representative groups is needed to clarify the dynamics of dental trauma and help incorporate prevention interventions to minimize dental trauma incidence.[39] This study showed that 95.9% of children with TDIs had not undergone any treatment, whereas, a study done by Ashwitha et al.[40] found a higher rate of replacement of the missing anterior tooth due to trauma. The reasons for such neglect could be explained as the poor socioeconomic status of the people who cannot afford private dental treatment in developing countries, wherein the public services are unable to offer more complex dental treatments. Also, these lower treatment rates can be explained by the fact that TDI is not a disease, and hence parents might not pay the necessary attention to it (Taiwo and Jalo).[20] This depends on the severity of the injury, as most common TDIs are enamel fractures, which could have a lower potential to produce a negative impact on children and their parents.

Another factor that ascertains treatment neglect is the clinicians' lack of knowledge regarding the treatment of dental trauma. The lack of standard treatment protocols and varied methodologies for the classification of trauma may have left the professionals spiritless, resulting in discontinuing education about the updated approach to the treatment of TDI. A combination of evidence-based practice and better clinical judgments can be enhanced by ongoing education that affords stabilized methodologies and protocols. This in return facilitates appropriate treatment decisions and probably enthuses the professionals.

Conclusion

The results of the present study state that the prevalence of trauma in the region of East Godavari district was found to be 12.1%, and there was no disparity in the trauma prevalence among government or private schools and urban and rural areas. Also, there was not much sex predilection. High school children are at higher risk of TDI than primary school children. The most common place was found to be home and the most common cause is unknown. Maxillary central incisors are the most prone tooth and enamel fracture is the most common.

The subjects with trauma in the present study have a positive association with risk factors, such as increased overjet, class II division 1 molar relationship, convex facial profile, and inadequate lip coverage, suggesting that these are the most frequent and common risk factors for dental trauma. The results of the present study are similar to most of the previous studies done on TDI.

Clinical Significance

Children with untreated TDIs were significantly more concerned about their appearance and experienced a noticeable impact on their daily lives than children with unexposed or treated dental injuries.[10] This study can be considered noteworthy for pediatric dentists, as there are fewer studies pertaining to TDI in young permanent dentition. It not only provides information about behavioral and anthropometric risk factors involving the incidence of TDIs in school-going children but also helps pediatric dentists in clinical practice by the implementation of prevention strategies for TDI at the population level.

An interception by early orthodontics in predisposed children proved to be an effective preventive strategy. Moreover, protective devices, such as mouth guards and face shields have an impact on the incidence and severity of TDIs during sports activities. Besides, improvements in the playing environment, close monitoring of the children, and adoption of health safety policies presumably impact a positive dental attitude towards the prevention of dental injuries.[19]

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