

Traumatic dental injuries in special health care needs children and association with obesity

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Citation: Basha S, Mohamed RN, Al-Thomali Y, Ashour AA, Al Zahrani FS, Almutair NE. Traumatic dental injuries in special health care needs children and association with obesity. *Ann Saudi Med* 2021; 41(1): 51-58. DOI: 10.5144/0256-4947.2021.51

Received: November 3, 2020

Accepted: December 23, 2020

Published: February 4, 2021

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Funding: None.

BACKGROUND: Special needs children are at a higher risk of dental trauma because of neurological, physical, mental, and behavioral impairments. They are also at higher risk of developing obesity due to the side effects of medication.

OBJECTIVE: Assess the association between traumatic dental injuries (TDIs) and obesity in children with special health care needs.

DESIGN: Analytical cross-sectional study.

SETTING: Schools for special needs children.

STUDY POPULATION AND METHODS: Special needs children with a diagnosis of TDI according to the Andreasen criteria were included in the study. Data on the disability status were obtained from a national demographic survey in 2016. Demographic and dental variables were measured for analysis. Multivariable logistic regression was used to analyse any relationship between TDI prevalence and obesity.

MAIN OUTCOME MEASURE: Relationship of body mass index (BMI) to TDI prevalence.

SAMPLE SIZE: 350 (131 boys and 219 girls) special needs children with a median (interquartile range) age of 12.0 (2.0) years.

RESULTS: Eighty-one (23.1%) children presented with TDIs. The mean (standard deviation) BMI for the entire study population was 24.7 (7.8). Children with obesity had a 30.3% TDI prevalence compared normal-weight children (20.6%) ($P=.035$), but BMI category was not statistically significant in the regression analysis ($P=.541$), which showed that children with an overjet of >3 mm were 4.82 times (CI: 2.55–9.09, $P=.001$) more likely to have TDI than children with an overjet of ≤ 3 mm. Those with inadequate lip coverage were 2.85 times (CI: 1.49–5.44, $P=.002$) more likely to have TDI. Children with cerebral palsy were 3.18 times (CI: 1.89–11.32, $P=.024$) more likely to have TDI than children with other disabilities.

CONCLUSION: The study showed a significant association between TDI prevalence and increased overjet, inadequate lip coverage, and cerebral palsy. The prevalence of TDI among obese special needs children was statistically significant according to bivariate analysis, but not in a multivariate analysis that adjusted for other variables.

LIMITATIONS: Causal relationship cannot be established with cross-sectional study.

CONFLICT OF INTEREST: None.

Children with special health care needs are at higher risk of oral diseases like dental caries, periodontal diseases, and dental trauma due to poor oral hygiene, associated tooth anomalies, neurological impairment, and lack of access to specialized oral care services.¹⁻³ These children utilize specialized services or medical management programs for any mental, physical, cognitive, emotional impairment or limiting condition associated with them.⁴ Traumatic dental injury (TDI) is an emergency oral health problem resulting from damage to primary or permanent teeth and supporting tooth structures, typically caused by an accidental fall.^{3,5} Studies have shown a higher risk of dental trauma among special needs children with autism spectrum disorder (30-39%), cerebral palsy (10.6-57%), sensory impairment (10.8%), and visual impairment (32.5%) due to their neurological, physical, mental, or behavioral impairment.^{3,6-13} These injuries can lead to tooth lesions causing aesthetic, social, psychological, and therapeutic problems, thereby having a negative impact on children's quality of life.^{14,15} Management of these injuries often involves a multidisciplinary approach with high treatment cost causing additional financial burden on parents.¹⁵ Previously, authors have pointed out many risk factors associated with TDI like increased incisal overjet, lack of lip coverage, younger age, male gender, physical activity, and adverse socio economic characteristics.^{6,7,16-18} Along with these risk factors, a few studies have shown a positive association between TDI and obesity among normal children.¹⁹⁻²² Obesity is a known risk factor for injuries related to pelvic, limb, and rib fracture.^{23,24} Along with these body injuries, obese children are possibly at higher risk of dental trauma due to frequent falls and collisions due to less agility. Obesity also modifies the center of gravity, making them prone to frequent falls.²² A higher risk of obesity is also reported among special needs children with a prevalence of 16.5%-51% due to lack of physical activity, inappropriate eating habits, disordered sleep, and adverse effects of antipsychotic medications.^{25-28, 29} Along with disability type, age and gender also influence the childhood obesity.³⁰ Although a positive association of TDI with obesity has been reported among normal children,¹⁹⁻²² no previously published studies have examined the association between obesity and TDI among special needs children despite their higher risk for dental trauma^{3,6-13} and obesity.²⁵⁻²⁸ The current study was intended to evaluate the association of obesity with TDI among special needs children in the City of Taif.

SUBJECTS AND METHODS

The study population in this cross-sectional study consisted of special needs children of Taif City, Makkah

Province. The data on children's disability status was extracted from a national demographic, which reported a prevalence of 2.7% among children from 0-19-years of age with 2670 affected children.³¹ The sample size was calculated based on the pilot study result (anticipated population proportion of 0.40, 5% alpha error at 80% power). A sample size of 350 was determined taking into consideration non-response bias. A two-stage random sampling method, with schools as the primary sampling unit and the child as a unit of inquiry, was followed. From the five zones of the City, 25 schools were randomly selected by lottery to meet the required sample size. From each school, 7 to 21 children were randomly selected, proportionate to the number of special care children. Ethical approval was taken from the institutional review board (Ethical clearance number: 39-11007-0029). Before starting the study, the parents/guardians signed written informed consent to permit participation of their children in the study. Seven of the randomly selected children were excluded because they displayed aggressive behavior (with temper tantrums, physical aggression such as hitting or biting), or inability to cooperate; other special needs children were randomly selected in their place. The sociodemographic details (age, sex, disability condition), trauma details (place, cause, treatment details, duration of trauma) were collected through face-to-face interviews with the parent/guardian. The sample was selected based on the following inclusion criteria: Age <18-years and documented special needs type. Based on dental age and children's actual age, the study sample was divided into two groups: 6-11-years (mixed dentition) and 12-16-years (permanent dentition). The disability among special needs children were taken from school records and categorized into six groups according to the World Health Organization Criteria: autistic disorder, cerebral palsy, intellectual disability, Down syndrome, deafness or blindness, or both, multiple disabilities or disability syndromes.³²

Height and weight were recorded to calculate the body mass index (BMI; weight/height in kg/m²). A platform scale was used to weigh the children, which was calibrated before each weight measurement. The child was wearing a minimum amount of clothing, standing erect, and relaxed. Weight was considered to the nearest 100 g. The child was standing barefoot with soles supported on a horizontal surface while measuring the height to nearest 0.1 cm using a stadiometer. As all the participants were Saudi, the Al-Herbish et al³³ criteria was used to categorize the children according to their age and gender into four specified groups: obese – equal to or greater than the 95th percentile, overweight

– 85th to less than 95th percentile, normal weight – 5th percentile to less than 84th percentile and underweight – less than 5th percentile.

For oral examination, all the special needs children included in the study were examined using sterile plane mouth mirrors and community periodontal index (CPI) probes under natural light at the school premises. The diagnosis of TDI was made according to the Andreasen criteria for injuries limited to the crown structure of maxillary and mandibular permanent/primary anterior teeth.³⁴ Enamel fracture was loss of tooth substance confined to enamel. Enamel and dentin fracture without pulp exposure was loss of tooth substance confined to enamel and dentin, but not involving pulp.

Crown fracture without pulp exposure was an incomplete fracture of the tooth without loss of tooth substance. Crown fracture with pulp exposure was a fracture involving the enamel and dentin and exposing the pulp. Enamel fracture + enamel and dentin fracture was the same tooth with visible loss of enamel and vis-

ible loss of enamel and dentin. A missing tooth due to trauma was a tooth lost due to trauma. A treated dental injury was a composite restoration, crown, or any other treatment provided due to trauma. Periodontal injuries and root fractures were not examined as radiographs or transillumination was not used. The tooth with developmental defects, gross dental caries, and crown placement due to reasons other than dental trauma were not included in the TDI. A single examiner examined all children. Color photographs showing typical examples of the different types of traumatic injuries in the textbook and color atlas of traumatic injuries to the teeth by Andreasen and Andreasen³⁴ were used to train the examiner to score the teeth for traumatic injuries. Intra-examiner reproducibility was assessed for TDI criteria by examining 15% of subjects twice, on successive days. Significant intra-examiner calibration was achieved for dental trauma diagnostic criteria (Kappa value of 0.92, $P < .05$). Overjet was measured using the CPI probe as the distance between the most forwardly placed maxil-

Table 1. Body mass index categories according to age, gender and type of disability.

	Underweight	Normal weight	Overweight	Obese
Age (years)				
6-11 (n=118)	4 (3.4)	56 (47.4)	31 (26.3)	27 (22.9)
12-16 (n=232)	14 (6.0)	109 (47.0)	37 (15.9)	72 (31.1)
Chi-square test, <i>P</i> value, pairwise comparisons (Z test) with Bonferroni correction	0.066			
Gender				
Boys (n=131)	8 (6.1)	61 (46.6)	26 (19.8)	36 (27.5)
Girls (n=219)	10 (4.6)	104 (47.5)	42 (19.2)	63 (28.7)
Chi-square test, <i>P</i> value, pairwise comparisons (Z test) with Bonferroni correction	0.883			
Type of disability Z test				
ID (n=121)	7(5.8)	57 (47.1)	31 (25.6)	26 (21.5)
A (n=74)	3 (4.0)	36 (48.7)	8 (10.8)	27 (36.5)
CP (n=40)	3 (7.5)	18 (45) ^a	1 (2.5) ^a	18 (45)
DS (n=65)	2 (3.1) ^a	37 (56.9) ^a	17 (26.2) ^a	9 (13.8)
DB (n=30)	2 (6.7)	9 (30)	8 (26.6)	11 (36.7)
MD (n=20)	1 (5)	8 (40)	3 (15)	8 (40)
Chi-square test, <i>P</i> value, pairwise comparisons (Z test) with Bonferroni correction	0.005			

Data are number (%) BMI: Body mass index, ID: Intellectual disability, A: Autism, CP: Cerebral palsy, DS: Down syndrome, DB: Deafness or blindness or both, MD: Children with multiple disabilities, syndromes. ^a $<.05$ vs other levels of the variable.

Table 2. Traumatic dental injuries prevalence according to variables studied.

Variables	Traumatic dental injuries (present)	Traumatic dental injuries (not present)
Age (years)		
6-11 years (n=118)	22 (18.6)	96 (81.4)
12-16 years (n=232)	59 (25.4)	173 (74.6)
Chi-square test, <i>P</i> value	0.098	
Gender		
Boys (n=131)	37 (28.2)	94 (71.8)
Girls (n=219)	44 (20.1)	175 (79.9)
Chi-square test, <i>P</i> value	0.054	
BMI		
Underweight (n=18)	2 (11.1)	16 (88.9)
Normal weight (n=165)	34 (20.6)	131 (79.4)
Overweight (n=68)	15 (22.1)	53 (77.9)
Obese (n=99)	30 (30.3) ^a	69 (69.7)
Chi-square test, <i>P</i> value, pairwise comparisons (Z test) with Bonferroni correction	0.035	
Type of disability		
ID (n=121)	23 (19.0)	98 (81.0)
A (n=74)	11 (14.9)	63 (85.1)
CP (n=40)	19 (47.5)	21 (52.5) ^a
DS (n=65)	13 (20.0)	52 (80.0)
DB (n=30)	7 (23.3)	23 (76.7)
MD (n=20)	8 (40.0)	12 (60.0)
Chi-square test, <i>P</i> value, pairwise comparisons (Z test) with Bonferroni correction	0.001	
Overjet		
≤3mm (n=257)	32 (12.5)	225 (87.5)
>3mm (n=93)	49 (52.7)	44 (47.3)
Chi-square test, <i>P</i> value	0.001	
Lip coverage		
Adequate (n=245)	30 (12.2)	215 (87.8)
Inadequate (n=105)	51 (48.6)	54 (51.4)
Chi-square test, <i>P</i> value	0.001	

BMI: Body mass index, ID: Intellectual disability, A: Autism, CP-Cerebral palsy, DS: Down syndrome, DB: Deafness or blindness or both, MD: Children with multiple disabilities, syndromes. ^a<.05 vs other levels of the variable.

lary incisor's labial surface and the corresponding mandibular incisor. The overjet was categorized as ≤3 mm and >3 mm. Lip coverage was defined as the upper lip covering the maxillary incisor at rest. It was recorded as either adequate or inadequate depending upon upper lip seal to the maxillary incisor.³

Data entry and statistical analysis were carried out using IBM SPSS (Armonk, New York, United States: IBM Corp) version 22. Descriptive statistics were recorded for all independent and outcome variables, including frequency distributions, percentages, and mean with standard deviations for BMI, median and interquartile range for age. Except for age, the data was normally distributed. The difference in proportion was tested using Chi-square test for each comparison by discrete groups followed by pairwise comparisons (Z tests) with Bonferroni correction of the *P* value. Multivariable logistic regression analysis was used to determine the relationships between TDI prevalence (yes/no), and obesity controlling for other important potential factors. Other factors included gender, age, overjet, lip coverage, and disability type. All statistical tests were two-sided, and the significance level was set at *P*<.05.

RESULTS

Among 350 special needs children, 81 (23.1%) children presented with traumatic dental injuries (TDIs). Of the 81 children with trauma, 19 (23.5%) children visited the dentist for treatment. The median (interquartile range) age was 12.0 (2.0) years. The majority (n=34, 42.0%) of children were exposed to trauma at school premises, followed by 29 (35.8%) at residence, 10 (12.3%) at the park, 3 (3.7%) on the street, and 5 (6.2%) did not know the place of trauma. The main reason for trauma was falling (n=54, 66.7%), followed by striking against object (n=16, 19.8%), self harm (n=5, 6.2%), and six (7.4%) did not know the cause of trauma. The mean BMI was 24.7 (7.8) kg/m². Ninety-nine (28.3%) children were obese, and 68 (19.4%) were overweight. A significant difference was observed between the obese and overweight category in cerebral palsy and Down Syndrome children (**Table 1**).

Children with obesity presented with more TDIs (30.3%) than normal-weight children (20.6%) (*P*=.035). Nineteen children with cerebral palsy had TDIs (47.5%) (**Table 2**). The TDIs were recorded in 110 permanent teeth and 9 deciduous anterior teeth. Eighty-eight permanent upper anterior teeth were affected with TDIs. Among 119 TDI-affected teeth, enamel fracture was recorded in 61 teeth, and enamel-dentine fracture without pulp involvement in 36 teeth (**Table 3**).

Regression analysis showed that children with >3-mm overjet were 4.82 times (CI : 2.55–9.09, *P*=.001)

more likely to have TDIs than children with ≤ 3 -mm overjet (**Table 4**). Those who had inadequate lip coverage were 2.85 times (CI: 1.49–5.44, $P=.002$) more likely of having TDIs. Children with cerebral palsy were 3.18 times (CI: 1.89–11.32, $P=0.024$) more likely to have a TDI than children with autism. Children with obesity were 1.20 times (CI: 0.67–2.17, $P=.541$) more likely to have TDI than normal-weight children. However, the difference was not statistically significant.

DISCUSSION

Dental trauma and obesity constitute important public health problems due to the associated psychological and social problems.²² Previously, many authors have studied the association of obesity with TDIs among normal children.^{19–22} However, this is the first study to evaluate the association of obesity with TDIs among special needs children. The present study showed an overall prevalence of 23.1% for TDIs, whereas the previous studies,^{3,7,13} have reported an overall TDI prevalence of 8.7 to 20.3% among special needs children. This variation may be attributed to the difference in geographic population, age group, and diagnostic criteria used to assess TDIs.¹³ The present study showed a comparable prevalence (14% to 47%) of dental trauma among different disability types in agreement with published studies.^{3,6–13} The children with cerebral palsy presented with significantly higher prevalence (47.5%) of TDIs with

an odds ratio of 3.18, compared to children with autism. This may occur due to limited motor coordination and involuntary physical movements, increasing the risk of accidental falls and consequently increasing TDIs.^{8–10}

In the present study, bivariate analysis showed a significantly higher prevalence of TDIs among obese special needs children compared to normal weight children. The most probable reason may be that obese special needs children present with reduced agility, resulting in accidental falls leading to TDIs.^{22,23} However, regression analysis showed no significant difference in dental trauma with an odds ratio of 1.20 for obese special needs children. Past point prevalence studies have reported odds ratios ranging from 0.7 to 3.8 times for TDI among obese children.^{20,21,35} A meta-analysis by Corrêa-Faria et al. showed a pooled odds ratio of 1.3 for TDIs among obese children without special needs, which correlates with the present study result.²²

An increased overjet with insufficient lip coverage is positively associated with TDI prevalence.^{6,17,18} A recent meta-analysis by Arraj et al¹⁸ showed 2.05 times higher odds ratio for TDIs among children with >3 -mm overjet. The odds ratio of 4.82 reported in the present study suggests that the higher frequency of TDIs in special needs children may be associated with increased overjet. Those who had inadequate lip coverage were 2.85 times more likely to have TDIs. These results confirm that TDI increases proportionately with an increase in

Table 3. Frequency distribution of types of traumatic dental injuries according to teeth affected.

Type of TDI	Upper anterior permanent (n=663)	Lower anterior permanent (n=732)	Upper anterior primary (n=83)	Lower anterior primary (n=69)	Total TDI (n=119)
	n (%)	n (%)	n (%)	n (%)	n (%)
Enamel fracture	44 (6.6)	12 (1.6)	3 (3.6)	2 (2.9)	61 (51.3)
Enamel and dentin fracture without pulp exposure	27 (4.1)	7 (1.0)	2 (2.4)	0	36 (30.2)
Crown fracture without pulp exposure	9 (1.4)	2 (0.3)	1 (1.2)	0	12 (10.1)
Crown fracture with pulp exposure	2 (0.3)	0	0	0	2 (1.7)
Enamel fracture + Enamel and dentin fracture	3 (0.5)	1 (0.1)	1 (1.2)	0	5 (4.2)
Missing tooth due to trauma	0	0	0	0	0
Treated dental injury	3 (0.5)	0	0	0	3 (2.5)
Total traumatic dental injuries	88 (13.3)	22 (3.0)	7 (8.4)	2 (2.9)	119 (100)

Table 4. Multivariable regression analysis with dental trauma as dependent variable.

Dental trauma	B	SE	Wald	P value	Adjusted OR	95% CI	
						Lower bound	Upper bound
Intercept	-1.24	0.59	4.45	.035			
Age (years)							
6-11	1 ^a						
12-16	0.43	0.35	1.48	.224	1.54	0.77	3.07
Gender							
Male	1 ^a						
Female	0.74	0.34	1.64	.031	0.48	0.25	0.94
Disability							
AU	1 ^a						
ID	0.92	0.62	1.63	.074	1.04	0.89	10.29
CP	1.16	0.65	3.19	.024	3.18	1.89	11.32
DS	0.21	0.64	0.10	.748	1.23	0.35	4.35
DB	0.83	0.64	0.63	.076	1.09	0.89	10.71
MD	1.11	0.72	3.15	.502	1.52	1.61	10.37
BMI							
UW and NW	1 ^a						
OW and obese	0.18	0.30	1.37	.541	1.20	0.67	2.17
Overjet							
≤3mm	1 ^a						
>3mm	1.57	0.32	23.52	.001	4.82	2.55	9.09
Lip-coverage							
Adequate	1 ^a						
Inadequate	1.05	0.33	10.07	.002	2.85	1.49	5.44

Chi-square likelihood ratio=86.766, df=10, $P<.001$; Overall model test=chi-square 86.766, df 10, $P<.001$, Nagelkerke $R^2=0.332$, Cox and Snell $R^2=0.220$.

^aReference, CI: Confidence interval, OR: Odds ratio, SE: Standard error, BMI: Body mass index, UW: underweight, NW: normal weight, OW: overweight, ID: Intellectual disability, A: Autism, CP: Cerebral palsy, DS: Down syndrome, DB: Deafness or blindness or both, MD: Children with multiple disabilities, syndromes.

overjet and insufficient lip coverage.^{6,16-18} Enamel fracture of permanent upper anterior teeth was the most common TDI, which is consistent with previously published literature.^{6,7,13} This would be expected due to the forward position of the upper anterior teeth in the jaw, which usually sustains the primary impact of dental trauma occurring for whatever reason, either in normal or in special needs children.¹⁸

Only 23.1% of children sought dental treatment, possibly due to lack of awareness among caregivers and the challenging health status of the child, which requires trained oral health care professionals willing to treat these children.³⁶ Limitations of our study included

an inability to establish causal relationships since it was a cross-sectional study. The observed association could have been influenced by factors like non-radiographic diagnostic criteria chosen for the study, school environment and learning activities, dental caries, and enamel hypoplasia. The chances of recall bias in reporting dental trauma by parents/guardians cannot be ruled out.

To conclude, the present study results showed significant association between TDIs and increased overjet, inadequate lip coverage and cerebral palsy. The prevalence of TDIs among obese special needs children was statistically significant according to bivariate analysis; however, the same could not be confirmed with mul-

tivariate regression analysis. The majority of TDIs occurred at school premises followed by the home, indicating a need for oral health education for teachers and parents on prevention of dental trauma and care after injury. The government of Saudi Arabia recognizes equal rights for special health care needs children and has implemented clear policies and guidelines in this regard. However, it is essential to encourage both the public and the private health sector to implement prac-

tical solutions to prevent childhood obesity and TDIs among special needs children through an integrated approach.

Acknowledgment

Present research work is supported by, Taif University Researchers Supporting Project number (TURSP-2020/62), Taif University, P.O Box 11099, Taif 21944, Saudi Arabia.

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