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Association between dental trauma and alcohol use among adolescents

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Abstract – *Aim*: To investigate the association between dental trauma and alcohol use among adolescents between 14 and 19 years of age. *Materials and Methods*: A cross-sectional study was carried out involving a clinical exam performed by a calibrated researcher (intra-examiner Kappa = 0.93) and a self-administered questionnaire. The sample was representative of schoolchildren from the city of Diamantina (Brazil) and was made up of 738 adolescents. The type of school (public or private) was used as a socioeconomic indicator. Information on alcohol use (high risk and hazardous use) was acquired through the administration of the Alcohol Use Disorders Identification Test, which has been validated for use in Brazil. *Results*: The prevalence of dental trauma was 26.6%, and the prevalence of dangerous alcohol use was 44.3%. Dental trauma was significantly associated with a high risk of problems related to alcohol intake ($P = 0.031$), hazardous alcohol use ($P = 0.009$) and binge drinking ($P = 0.036$). The results of the Poisson logistic regression revealed that hazardous alcohol use [PR = 1.30 (95% CI: 1.01–1.66) $P = 0.042$] remained associated with dental trauma independently from age, gender, overjet, and type of school. *Conclusions*: The high prevalence of dental trauma found among adolescents in the city of Diamantina (Brazil) was greater among those at high risk for problems related to alcohol intake and was significantly associated with hazardous alcohol use.

Dental trauma among children and adolescents is a serious public health problem (1–3). A number of different factors are associated with its etiology, the most important of which are collisions, falls, sports activities, car accidents, and bicycle accidents. Predisposing anatomic factors also favor the occurrence of dental trauma, such as accentuated overjet and inadequate lip seal (4). However, other aspects associated with dental trauma, such as socioeconomic status, risk behavior, and environmental factors, are discussed little in the literature. According to Odoi et al. (5), environmental, social, and behavioral risk factors for traumatic dental injury (TDI) have been overlooked. Socioeconomic status is measured little, and the results have been conflicting.

The association between alcohol and interpersonal violence is well established, and studies carried out in different countries have demonstrated an increase in the association between maxillofacial trauma and alcohol consumption (6–8). The hazardous use of alcohol among youths is a growing concern in many countries. Alcohol lowers the capacity for self-control, encouraging individuals to take on risk behavior. Hazardous alcohol use is the main cause of injuries (including those resulting from traffic accidents), violence (especially domestic violence), and premature death (9). While there are a large number of studies on the prevalence of TDI, there are few investigations into the association between TDI and alcohol intake among adolescents.

The aim of this study was to investigate the prevalence of TDI and its association with alcohol intake among adolescents.

Materials and methods

A cross-sectional study was carried out with students between 14 and 19 years of age in the city of Diamantina (southeastern Brazil).

The sample size was calculated to detect an odds ratio (OR) of 2.0 between exposed and unexposed individuals to achieve an 80% power of demonstrating a significant difference between groups at a 5% level of significance. Data obtained from the pilot study

revealed a 46.15% prevalence of dental trauma among individuals with high risk for alcohol-related problems. These data were employed to estimate the sample size, resulting in a total of 343 individuals. Efficient sample size calculations assume simple random samples. Therefore, sample designs other than simple random sampling have an impact on sampling variability. This is known as the design effect, which is the cumulative effect of design components such as stratification, unequal weighting, and clustering. The effect differs for each design. In this study, cluster sampling was used. The initial calculation (343 students) was corrected by a factor of 1.7 (deff) (10) . To compensate for possible non-responses and/or refusals during the data acquisition phase, the sample was increased by 20%, resulting in a total of 701 students. Students in the ninth year of elementary school education and in high school participated in the study. Each class was coded and submitted to randomization using an automated statistics program, thereby ensuring proportionality by grade.

The data were acquired through a clinical exam of the permanent upper and lower incisors and the administration of a questionnaire on alcohol intake pattern. A pilot study was carried out prior to data acquisition, which identified no need for any changes in the proposed methodology. In this pilot study, the clinical exam was performed by a previously calibrated dentist (P.M.O.F.) (intra-examiner Kappa = 0.93) and involved 101 students between 15 and 19 years of age from public (62.4%) and private (37.6%) schools chosen by convenience.

The inclusion criterion was the presence of four upper and lower incisors, unless missing due to avulsion. The exclusion criterion was the use of a fixed orthodontic appliance.

Information on alcohol intake was acquired through the self-administered Alcohol Use Disorders Identification Test (AUDIT) that has been validated for use on urban-dwelling Brazilians aged 18–60 years (11). AUDIT was drafted by the World Health Organization as a simple screening method for excessive alcohol consumption and consists of 10 items with a maximum of five response options (overall score: 0–40 points) on recent alcohol use and alcohol-related problems to help healthcare professionals identify hazardous use, harmful use, or possible dependence. Based on the original instrument (12) and a validation study (11), a cutoff point of 7 was adopted. Scores above this cutoff point denoted a high risk for alcohol-related problems. A score of 7 or lower denoted abstinence or a low risk for alcohol-related problems. For the identification of only hazardous alcohol use, the commonly used short version of the questionnaire (AUDIT-C) was employed, which has similar precision to the complete questionnaire (13), adopting a score of 1 or more on Items 2 or 3, based on the guidelines of the questionnaire (12). The *binge drinking* variable was based on the third item and characterized by the consumption of five or more alcoholic drinks on a single occasion. The questionnaires were distributed by the researcher in the classroom and collected immediately after being filled out. The type of school (public or private) was used as an economic indicator.

The participants were examined at the school. An artificial light (Petzl Zoom head lamp®, Petzl America, Clearfield, UT, USA) provided a standardized light source for the exam. The teeth were dried with gauze, and a dental mirror was used. The examiner remained seated in front of the student, who also remained seated. The examiner used appropriate individual protection equipment, and all materials were packaged and sterilized. TDI was classified based on the criteria proposed by Glendor et al. (2007) (14). Only the types of dental trauma that are possible to assess in epidemiological studies without the aid of radiographs were included: enamel fracture, enamel and dentin fracture without pulp involvement, complicated crown fracture (with pulp involvement), extrusive luxation, lateral luxation, and avulsion. To measure overjet, the examiners placed a disposable tongue retractor perpendicular to and in contact with the vestibular face of the lower incisors, marking the contact edge of the upper incisors with the point of a No. 2 pencil. Using a millimeter ruler, the measurement from the tip of the tongue retractor to the pencil mark registered the overjet. Overjet was categorized as ≤ 3 mm and <3 mm (15).

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, version 17.0, SPSS, Chicago, IL, USA). Frequency distribution and the chi-square association test were calculated. Due to the collinearity between the two main independent variables, two models were constructed. The dependent variable (dental trauma) and two main independent variables (high risk of alcohol-related problems and hazardous alcohol use) were first incorporated into each Poisson regression model. The criterion for inclusion of the other independent variables in each model was a significance value of <20% in the outcome of the bivariate analysis.

Ethical considerations

This study received approval from the Human Research Ethics Committee of the *Universidade Federal dos Vales do Jequitinhonha e Mucuri* (Brazil). Authorization was obtained from the Regional School Board and participating schools. The participants and their parents/guardians signed terms of informed consent. Confidentiality with regard to identification was ensured such that identification of the participants was voluntary. All participants with dental trauma were sent for treatment.

Results

Among the 738 students selected, 7.4% ($n = 51$) refused to participate in the clinical exam, leading to a final sample of 687 students. The prevalence of TDI was 26.6% ($n = 183$) [95% CI: 23.3–29.9]. TDI was more prevalent among older students (18–19 years; 37.1%; $n = 49$; $P = 0.010$), the male gender (32.9%; $n = 98$; $P = 0.001$) and those with overjet <3 mm

(32.5%; $n = 93$; $P = 0.005$). No statistically significant association was found between dental trauma and type of school ($P = 0.059$) (Table 1).

The prevalence of high risk for alcohol-related problems was 18.7% ($n = 128$) [95% CI: 15.8–21.6], and the prevalence of hazardous alcohol use was 44.3% ($n = 303$) [95% CI: 40.6–48]. Adolescents between 18 and 19 years of age had a greater risk of alcohol-related problems (32.6%; $n = 43$) and hazardous alcohol use (57.7%; $n = 75$) in comparison with younger adolescents.

Adolescents at high risk for alcohol-related problems had a significantly greater prevalence of dental trauma ($P = 0.031$). TDI was also more prevalent among those who exhibited hazardous alcohol use (31.7%; $n = 96$), whereas those without this behavior had a lower prevalence of TDI (22.8%; $n = 87$). The association between these variables was statistically significant ($P = 0.009$) (Table 2). The majority of adolescents [$n = 429$, 62.7% (95% CI: 59.1–66.3)] reported having ingested alcoholic beverages, and TDI was more frequent in this group. The prevalence of adolescents who made use of alcohol on a weekly basis and/or nearly daily was 8% ($n = 54$). TDI was nearly twofold more prevalent in this group (48.1%; $n = 26$) in comparison with adolescents who never drank alcoholic beverages and those who drank with a monthly frequency or less (24.9%; $n = 157$; $P < 0.001$). The prevalence of TDI was greater among adolescents who consumed two or more drinks in a normal day (35.3%; $n = 39$; $P = 0.024$) as well as those who consumed five or more drinks on a single occasion (30.9%; $n = 88$; $P = 0.036$) (Table 3).

High risk of alcohol-related problems and hazardous alcohol use were incorporated into the Poisson regression model with age, gender, overjet, and type of school. In the first model, age (18–19 years), the male gender, and overjet <3 mm maintained their statistical significance, but high risk of alcohol-related problems lost significance (Table 4). In the second model, age (18–19 years), the male gender, and overjet <3 mm maintained their statistical significance, including hazardous alcohol use. The prevalence of dental trauma was significantly greater among adolescents who exhibited hazardous alcohol use [PR = 1.30 (95% CI: 1.01–1.66) $P = 0.042$] independently from the other variables (Table 5).

Table 1. Distribution of adolescents according to the presence of dental trauma and independent variables, Diamantina, Brazil, 2010

Independent variables	Presence of trauma *n* (%)	Absence of trauma *n* (%)	Total *n* (%)	*P*
Age groups				
14–15 years	61 (23.9)	194 (76.1)	255 (37.1)	0.010*
16–17 years	73 (24.3)	227 (75.7)	300 (43.7)	
18–19 years	49 (37.1)	83 (62.9)	132 (19.2)	
Total	183 (26.6)	504 (73.4)	687 (100)	
Gender				
Male	98 (32.9)	200 (67.1)	298 (43.4)	0.001*
Female	85 (21.9)	303 (78.1)	388 (56.6)	
Total	183 (26.7)	503 (73.3)	686 (100)	
Overjet				
≤3 mm	89 (22.8)	302 (77.2)	391 (57.8)	0.005*
>3 mm	93 (32.5)	193 (67.5)	286 (42.2)	
Total	182 (26.9)	495 (73.1)	677 (100)	
Type of school				
Public	176 (27.5)	464 (71.1)	640 (93.2)	0.059*
Private	7 (14.9)	40 (85.1)	47 (6.8)	
Total	183 (26.6)	504 (73.4)	687 (100)	

*Chi-square test.
The total number may differ due to missing values.

Discussion

In this study, the prevalence of TDI was high and may be explained by the age of the adolescents, as TDI has a cumulative effect. Although this high prevalence is confirmed in several national studies (16–18), the consequences of TDI, such as feeling embarrassed to smile, laugh and show one's teeth, difficulty in social relationships, irritability and an inability to maintain a healthy emotional state (19), as well as the negative impact on the quality of life underscore the need for greater attention to this issue (1, 20, 21).

The male gender was significantly more affected by TDI than the female gender, which corroborates the findings described in previous studies (22–24) and may be due to the fact that males participate in more energetic activities with a greater risk of trauma, such as contact sports and more aggressive types of games (22). There was a greater prevalence of TDI among adolescents with overjet <3 mm. A systematic review involving meta-analysis studies revealed that overjet <3 mm increases the odds of an individual suffering some type of TDI, regardless of other variables such as age and gender (15).

No statistically significant association was found between the prevalence of TDI and type of school (public or private). A similar result is reported in another Brazilian study (2). Although the type of school may be a questionable socioeconomic indicator due to the lack of family involvement for a more precise assessment, a recent study reports that a child's type of school is positively associated with mother's level of education, household income, and

Table 2. Distribution of adolescents according to dental trauma and alcohol intake, Diamantina, Brazil, 2010

Independent variables	Presence of TDI *n* (%)	Absence of TDI *n* (%)	Total *n* (%)	*P*
AUDIT				
Low risk	139 (25.0)	417 (75.0)	556 (81.3)	0.031*
High risk	44 (34.4)	84 (65.6)	128 (18.7)	
Total	183 (26.6)	504 (73.4)	684 (100)	
Audit-C				
Hazardous use	96 (31.7)	207 (68.3)	303 (44.3)	0.009*
Non-hazardous use	87 (22.8)	294 (77.2)	381 (55.7)	
Total	183 (26.8)	501 (73.2)	684 (100)	

AUDIT, alcohol use disorders identification test; TDI, traumatic dental injury.
*Chi-square test.

Table 3. Distribution of adolescents according to the presence of dental trauma and alcohol intake, Diamantina, Brazil, 2010

Independent variables	Presence of trauma *n* (%)	Absence of trauma *n* (%)	Total *n* (%)	*P*
Intake frequency				
Non-drinker	54 (21.2)	201 (78.8)	255 (37.3)	0.011*
Drinker	129 (30.1)	501 (73.2)	429 (62.7)	
Total	183 (26.8)	501 (73.2)	684 (100)	
Never/up to monthly	157 (24.9)	473 (75.1)	630 (92)	<0.001*
Weekly/daily	26 (48.1)	28 (51.9)	54 (8)	
Total	183 (26.8)	501 (73.2)	684 (100)	
Drinks on normal day				
0 or 1 drink	143 (25.0)	428 (75.0)	571 (83.8)	0.024
Two or more drinks	39 (35.5)	71 (64.5)	110 (16.2)	
Total	182 (27.7)	499 (73.3)	681 (100.0)	
$\geq$5 drinks on single occasion (binge drinking)				
No	93 (23.7)	300 (76.3)	393 (58)	0.036*
Yes	88 (30.9)	197 (69.1)	285 (42)	
Total	181 (26.7)	497 (73.3)	678 (100)	

*Chi-square test.
The total number may differ due to missing values.

Table 4. Poisson logistic regression analysis of dental trauma, alcohol intake risk, and independent variables among adolescents, Minas Gerais, Brazil (n = 687), 2010

Dependent variable	Independent variables		PR (95% CI) Crude	*P*	PR (95% CI) Adjusted	*P*
TDI						
	AUDIT	High risk	1.57 (1.04–2.37)	0.031	1.25 (0.93–1.68)	0.132*
	School	Public	2.16 (0.95–4.92)	0.059	1.61 (0.81–3.22)	0.175
	Age	(18–19)	1.88 (1.19–2.96)	0.007	1.54 (1.11–2.13)	0.010
		(16–17)	1.02 (0.69–1.51)	0.910	0.98 (0.73–1.30)	0.841
	Gender	Male	1.74 (1.24–2.45)	0.001	1.50 (1.17–1.93)	0.001
	Overjet	>3 mm	1.63 (1.16–2.30)	0.005	1.43 (1.12–1.83)	0.004

AUDIT, alcohol use disorders identification test; PR, prevalence ratio; CI, confidence interval; TDI, traumatic dental injury.
*Adjusted for age, gender, and overjet.

Table 5. Poisson logistic regression analysis of dental trauma, hazardous alcohol use, and independent variables among adolescents, Minas Gerais, Brazil (n = 687), 2010

Dependent variable	Independent variables		PR (95% CI) Crude	*P*	PR (95% CI) Adjusted	*P*
TDI						
	Alcohol use	Hazardous	1.56 (1.11–2.20)	0.009	1.30 (1.01–1.66)	0.042*
	School	Public	2.16 (0.95–4.92)	0.059	1.61 (0.81–3.21)	0.175
	Age	18–19	1.88 (1.19–2.96)	0.007	1.51 (1.10–2.09)	0.011
		16–17	1.02 (0.69–1.51)	0.910	1.51 (1.18–1.93)	0.001
	Gender	Male	1.74 (1.24–2.45)	0.001	1.43 (1.12–1.82)	0.004
	Overjet	>3 mm	1.63 (1.16–2.30)	0.005	0.95 (0.71–1.28)	0.753

PR, prevalence ratio; CI, confidence interval; TDI, traumatic dental injury.
*Adjusted for age, gender, and overjet.

household overcrowding, suggesting that this indicator is a viable alternative as a predictor of caries experience in epidemiological studies involving Brazilian children (25).

The association between TDI and socioeconomic status has not been sufficiently studied in the literature (26), and the results are conflicting (24, 27). Such conflicts are the consequence of differences in the individual components of these indicators and the small number of papers published, which hinders comparisons between studies (26). In Brazil, studying at a public or private school can determine the type of social environment in which a student lives, the toys/possessions he/she has and the sports and non-sportive activities he/she practices (2). Thus, this variable was used as a socioeconomic indicator in this study.

Alcohol use among adolescents is a controversial issue in social and academic realms in Brazil. Brazilian law prohibits the sale of alcoholic beverages to minors (Law 9294, of June 15, 1996), but alcohol intake is common among youths, whether at home, at parties, or even in public settings (28). Negligence and permissiveness is evident in the results of the present study, which reports a high prevalence of minors at high risk

for alcohol-related problems and those who exhibit hazardous drinking.

There was a higher prevalence of both indicators (high risk and hazardous drinking) among older adolescents (18 and 19 years of age), suggesting that inadequate consumption increases with age. This finding was expected, as the legal age for buying and consuming alcoholic beverages in Brazil is 18 years. High risk for alcohol-related problems was significantly associated with TDI independently from gender, overjet, and studying at a public school, but lost its significance when incorporated into the Poisson logistic regression model. It is important to consider that the AUDIT questionnaire is composed of 10 items related to the consumption of alcoholic beverages, with 70% of the questions addressing the adverse consequences of alcohol use and the self-perception of alcohol-related problems experienced in the previous year. When this questionnaire is administered to young populations with a shorter history of alcohol intake, as in this study, it is likely that the results differ from those obtained from adult populations with consolidated drinking habits. According to Babor et al. (12), although not all individuals who make hazardous use of alcohol become dependent, no one develops alcohol dependence without having consumed alcohol for some time.

Hazardous alcohol use, which was only based on the current consumption pattern, remained in the final Poisson model and was significantly associated with TDI independently from the other variables. This measure is likely more suitable for the assessment of current alcohol intake patterns in a population with incipient, non-consolidated drinking habits. Moreover, this variable addresses binge drinking (consumption of five or more drinks on a single occasion) (29), which was reported by nearly half of the adolescents and had a statistically significant association with TDI. Some studies have reported associations between binge drinking and automobile accidents (30) and interpersonal violence (31, 32). Moreover, facial and head injuries (33) are cited as a consequence of these types of accidents. A retrospective study involving 335 charts of patients with facial trauma found that the highest prevalence of this type of injury was among youths, and the majority of cases were associated with alcohol consumption (32).

Therefore, hazardous alcohol use may be a mediating factor in the increase in violence and automobile accidents and, consequently, the increase in dental trauma. Further studies addressing the cause-and-effect relationship between alcohol intake patterns and TDI among adolescents should be carried out at emergencies wards to investigate the relationship between dental injuries, automobile accidents, or interpersonal violence and alcohol consumption.

Some methodological limitations should be considered. Although the AUDIT questionnaire has been validated on an urban Brazilian sample aged 18–60 years (11) and is one of the most widely used scales for assessing alcohol abuse/dependence, with recognized psychometric qualities (34), some debate remains regarding the best cutoff point to be assumed, with a lower value for the female gender (35), as well as the different performance of the scale in different populations in relation to ethnic background and gender (36, 37) and information on the psychometric properties of the questionnaire on adolescent populations (38). The short version (AUDIT-C) corresponds to the first three questions of the long version (AUDIT) and was tested in the pilot study, which demonstrated that no changes in sentence structure or wording were needed.

The results of this study reveal a high prevalence of TDI and hazardous drinking among adolescents in the city of Diamantina (Brazil). The findings suggest that adolescents at high risk for alcohol-related problems and hazardous drinking have a greater prevalence of dental trauma. Further studies addressing the cause-and-effect relationship between alcohol intake patterns and TDI among adolescents are needed to gain a better understanding of the relationships between these important public health problems and contribute toward alcohol prevention programs directed at adolescent students in both public and private schools.

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