Original Research
Community dental health

Association between the city region and traumatic dental injuries among adolescents from Santa Maria, South Brazil

Letícia Donato COMIM[a]
Ângela DALLA NORA[b]
Jessica Klöckner KNORST[b]
Débora Nunes de Oliveira RACKI[a]
Júlio Eduardo do Amaral ZENKNER[b]
Luana Severo ALVES[a]

[a]Universidade Federal de Santa Maria – UFSM, School of Dentistry, Department of Restorative Dentistry, Santa Maria, RS, Brazil.

[b]Universidade Federal de Santa Maria – UFSM, School of Dentistry, Department of Stomatology, Santa Maria, RS, Brazil.

Declaration of Interests: The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

Corresponding Author:
Luana Severo Alves
E-mail: luanaseal@gmail.com

https://doi.org/10.1590/1807-3107bor-2022.vol36.0114

Submitted: August 9, 2021
Accepted for publication: May 2, 2022
Last revision: May 20, 2022

Abstract: This study investigated the association between the city region and traumatic dental injury (TDI) among adolescents from Santa Maria, Rio Grande do Sul, Brazil. A population-based cross-sectional survey was conducted from March to November 2018, which included a representative sample of adolescents (15-19-year-old) attending public and private high schools. A questionnaire on sociodemographic information was sent to the parents/legal guardians of the selected adolescents. TDI in the upper and lower permanent incisors and canines was recorded based on the O'Brien classification. Environmental variables (sociodemographic and structural characteristics of the neighborhoods) were obtained from official publications. Multilevel Poisson regression models were used, and prevalence ratios (PR) and 95% confidence intervals (CI) were calculated. A total of 1,146 adolescents participated in this study. The overall prevalence of TDI was 17.3%, mild trauma was 12.7%, and severe trauma was 5.8%. Adolescents living in the southern region had a prevalence of TDI of 25.3%, compared with 13.6% in the northern region. After adjusting for important cofactors, adolescents living in the southern region were more likely to have TDI than their counterparts in the northern region (PR, 1.91; 95%CI: 1.18-3.11; p = 0.009). Analyzing the number of environmental risk indicators in different regions, the southern region presented a higher mean and median than all other regions. In conclusion, living in the southern region was associated with a higher prevalence and severity of TDI among adolescents from Santa Maria, southern Brazil. Our findings suggest the role of the environment in the epidemiology of TDI.

Keywords: Tooth Injuries; Residence Characteristics; Socioeconomic Factors; Cross-Sectional Study; Epidemiology.

Introduction

Traumatic dental injury (TDI) is considered a public health concern due to its high prevalence and repercussions on economic, physical, social, and emotional well-being.[1-3] It is estimated that one-quarter of adolescents and adults experience TDI at least once during their life course.[4] Previous studies have already discussed the association between individual factors and TDI, such as sex, overjet, lip coverage, obesity, and socioeconomic status (SES).[5,6] However, the role of environmental factors has been scarcely investigated.

Brazilian population-based studies using secondary data from a national oral health survey did not find an association between the municipal human development index and the prevalence of TDI among 12-year-old schoolchildren[7] (national data) as well as among 15-19-year-old adolescents (data from São Paulo state only).[3] In the same way, no association was found between the Gini coefficient and TDI among Brazilian 12-year-olds.[7] Contradictorily, an association between contextual income inequality and TDI was revealed in another study, with a reduction in the Gini coefficient leading to a decrease in the prevalence of TDI.[8] Furthermore, a greater concentration of cases of TDI as well as untreated TDI was found in Brazilian schoolchildren who lived in areas of substandard living conditions and high social vulnerability.[9,10] Similarly, Indian adolescents residing in urban slums had higher odds of having TDI than their pairs from the middle socioeconomic class.[11]

Previous studies have shown a variation in the occurrence of TDI depending on the place of residence,[12] with a higher concentration of trauma found in regions with the worst performance regarding aspects related to the physical environment, social policy, population density, and social cohesion. The association between environmentally deprived regions and TDI has also been associated with violence and accidents at home[9] and social capital.[13] In addition, studies have shown that assault, alcohol/drug use, and traffic accidents might be factors associated with TDI in deprived regions.[2,6,9]

It is well known that the shared social environment at the regional level has a significant effect on the health of residents, regardless of their level of individual risk.[14,15] Furthermore, it is known that diseases do not occur in isolation but as a characteristic of people and their surrounding context as the neighborhood or the residing region.[15-17] Knowledge of the impact of environmental variables on the prevalence of TDI could help define preventive public health strategies where they are needed. In this context, this population-based study aimed to investigate the association between the city region and TDI among adolescents (15-19-year-old) from Santa Maria, southern Brazil. We hypothesized that individuals who lived in environmentally deprived regions would be more likely to have TDI.

Methodology

This cross-sectional study was conducted to assess the oral health status of 15-19-year-old adolescents attending public and private high schools in Santa Maria, a mid-sized city located in southern Brazil, with an estimated total population of 261,031 inhabitants in 2010. Approximately 95% of the entire population lives in urban areas divided into eight administrative regions and 41 neighborhoods.

Adolescents enrolled in urban high schools (n = 37, 26 public and 11 private) who attended any school period (morning, afternoon, or night) were considered eligible for the study. A list of all eligible students was compiled for each school and those eligible adolescents were selected using a table of random numbers (http://www.random.org). The number of enrolled students was proportional to the school size. Individuals using fixed orthodontic appliances or with special needs were not considered eligible.

A total of 1,066 students were considered necessary for the study, considering a prevalence rate of 50% (worst case scenario), 95% confidence interval (CI), power of 80%, and precision level of 3%. A total of 1,600 adolescents should be invited to participate after adding a nonparticipation rate of 50%. This sample size far exceeded that needed for an association study considering a prevalence of TDI of 46% in the exposed group (high-risk neighborhood) and 29% in the unexposed group (low-risk neighborhood).[12]

Data collection was conducted from March to November 2018 and included a questionnaire and clinical oral examination. The study protocol was approved by the Research Ethics Committee of the Federal University of Santa Maria (protocol number 2.178.299). A written informed consent form was obtained from all participants or their legal guardians. The students received a report of their oral health status and were referred for dental treatment when necessary.

A self-administered questionnaire containing questions on sociodemographic information was sent to the parents/legal guardians of the selected adolescents. Clinical examinations were conducted in schools, with students in a supine position, under artificial light, after tooth cleaning and drying, using a clinical mirror and a periodontal probe. TDI in the upper and lower permanent incisors and canines was recorded based on the O'Brien classification:[18] (0) no trauma; (1) enamel fracture only; (2) enamel-dentin fracture; (3) enamel-dentin fracture with pulp exposure; (4) signs of pulp involvement without signs of fracture; (5) missing tooth due to TDI; or (6) other TDI. The overjet was measured as the distance (mm) between the buccal surface of the more prominent upper central incisor and the corresponding lower incisor. The presence of an anterior open bite was defined as the lack of vertical overlap between the upper and lower incisors in the occlusal position (recorded as the distance measured in mm).[19] Lip coverage was visually assessed and considered adequate if the lips completely formed an anterior seal when the mandible was in physiological rest position.[20] Clinical examinations were performed by two examiners who were trained and calibrated for the TDI index. Examiners' reproducibility was assessed before the beginning of the study and during data collection in 5% of the sample. The minimal intraexaminer kappa coefficient was 0.89, whereas the minimal interexaminer kappa value was 0.77.

Based on the home address provided by each adolescent in the questionnaire, the neighborhood where he/she lived was defined according to official sources.[21] The eight original city regions (north, northeast, south, east, west, center, east-center, or west-center) were combined into five regions based on their geographical proximity (north, south, east, west, and center) and were considered the main predictor variable.

Individual variables (sociodemographics and clinical status) were considered adjusting variables due to their well-known relationship with the TDI. Sociodemographic variables included age, sex, and SES. SES was collected using the standard Brazilian economic classification, and households were classified into low (≤ 16 points), mid-low (≥ 17 to ≤ 22 points), mid-high (≥ 23 to ≤ 28 points), or high (≥ 29 points) SES.[22] Clinical variables were overjet (dichotomized into ≤3 mm or >3 mm),[23] anterior open bite, and lip coverage, dichotomized into absent or present.

The outcomes of this study were the prevalence and severity of TDI. The prevalence of TDI was defined as present (at least one tooth with a TDI index ≥ 1) or absent (all teeth with a TDI index = 0). TDI severity was categorized as no TDI (all teeth with a TDI index = 0), mild TDI (at least one tooth with a TDI index = 1), or severe TDI (at least one tooth with a TDI index ≥2).

Data analysis was performed using STATA software (Stata 14,2 for Windows; Stata Corporation, College Station, USA). A weight variable based on the probability of selection and population distribution according to sex and school type was used to adjust for potential bias in the population estimates ("svy" command for complex sample data). The association between environmental and individual variables and outcomes was assessed using multilevel Poisson regression models, considering adolescents as the first-level unit and the city region as the second-level unit. The multilevel model used a scheme of fixed effects with a random intercept. The theoretical model for the study of the determinants of TDI in adolescents, adapted from the World Health Organization, is presented in Figure 1.

The prevalence ratios (PR) and their respective 95% confidence intervals (CI) were estimated. Variables with a p-value of ≤ 0.20 in the unadjusted analysis were included in the adjusted models. The chosen level of significance was 5%.

The environmental (sociodemographic and structural) characteristics of the neighborhoods were obtained from official sources:[24] mean income, percentage of literate inhabitants, percentage of white skin color inhabitants, mean household crowding, percentage of residences with piped water, percentage of paved streets, percentage of residences with sewerage system, and percentage of streets with public illumination. The clustering of neighborhood risk indicators in each region was then analyzed.

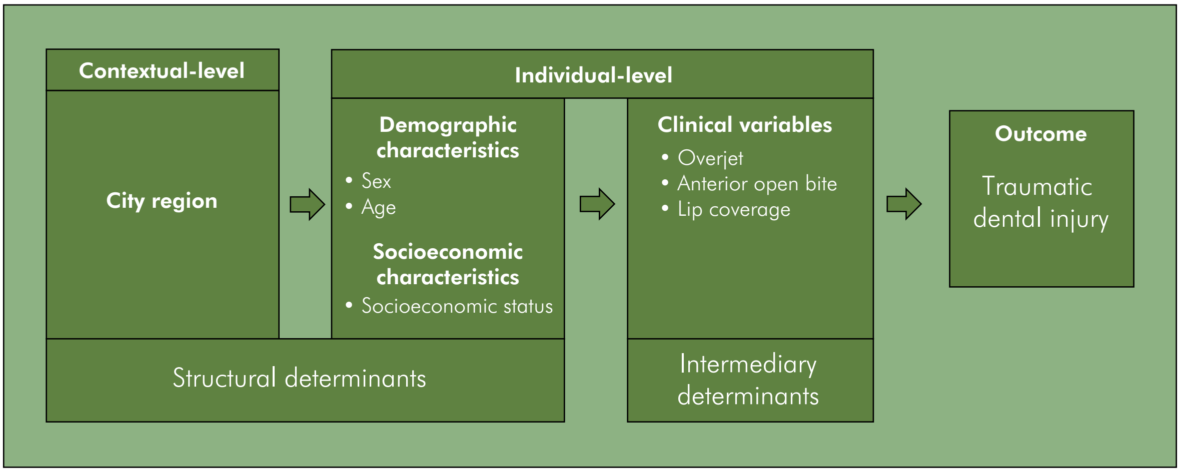

Figure 1. Theoretical model for the study of determinants of TDI in adolescents, adapted from the World Healt Organization.

First, the eight neighborhood sociodemographic and structural factors were dichotomized using the median. For each factor, a neighborhood risk indicator was considered present in neighborhoods located in the "more deprived category" (below the median for all characteristics, except for household crowding). Finally, the number of neighborhood risk indicators was summed (ranging from 0 to 8) and classified as 0-4 or 5-8. The number of neighborhood risk indicators was compared among city regions using the Wald test (means) and the Dunn test (medians).

Results

A total of 1,197 adolescents (15-19-year-old) were included in the study (response rate, 72.3%); however, 51 were excluded from the analysis due to incomplete addresses or because they lived in rural districts or nearby cities, totaling 1,146 students included in the study (Figure 2). Six schools did not agree to participate, resulting in a total of 31 schools.

Table 1 shows the sample distribution, prevalence of TDI, and its unadjusted association with environmental and individual variables. The overall prevalence of TDI in this population was 17.3% (95%CI: 15.1-19.5%), with mild trauma in 12.7% (95%CI: 10.8-14.7%), and severe trauma in 5.8% (95%CI: 4.8-6.9%). Preliminary analysis showed a significantly higher prevalence of TDI among adolescents living in the southern region than in the northern region. In the unadjusted analysis, adolescents living in the southern region were 91% more likely to have TDI than those in the northern region (PR, 1.91; 95%CI: 1.19-3.07; p = 0.007). Furthermore, low SES and overjet > 3 mm also increased the risk of TDI.

The adjusted associations between the environmental and individual variables and the prevalence and severity of TDI are shown in Table 2. After adjustment for important cofactors, the city region remained significantly associated with the prevalence of TDI, with adolescents living in the southern region being more likely to have TDI than their counterparts living in the northern region (PR, 1.91; 95%CI: 1.18-3.11; p = 0.009). This significant association was consistently found for mild trauma (PR, 2.00; 95%CI: 1.12-3.57; p = 0.02); however, this association was not observed for severe trauma (PR, 2.10; 95%CI: 0.87-5.07; p = 0.10). Regarding individual variables, sex and SES were significantly associated with the overall prevalence of TDI in this population.

Table 3 shows the sample distribution according to the number of neighborhood risk indicators by city region. In general, 61% of this adolescent population lived in neighborhoods with up to four neighborhood risk indicators, with this percentage reaching 100% of the residents of the city center. Contradicting the trend observed in the other regions, the majority of individuals living in the southern region (77%) clustered 5-8 risk indicators in their neighborhoods.

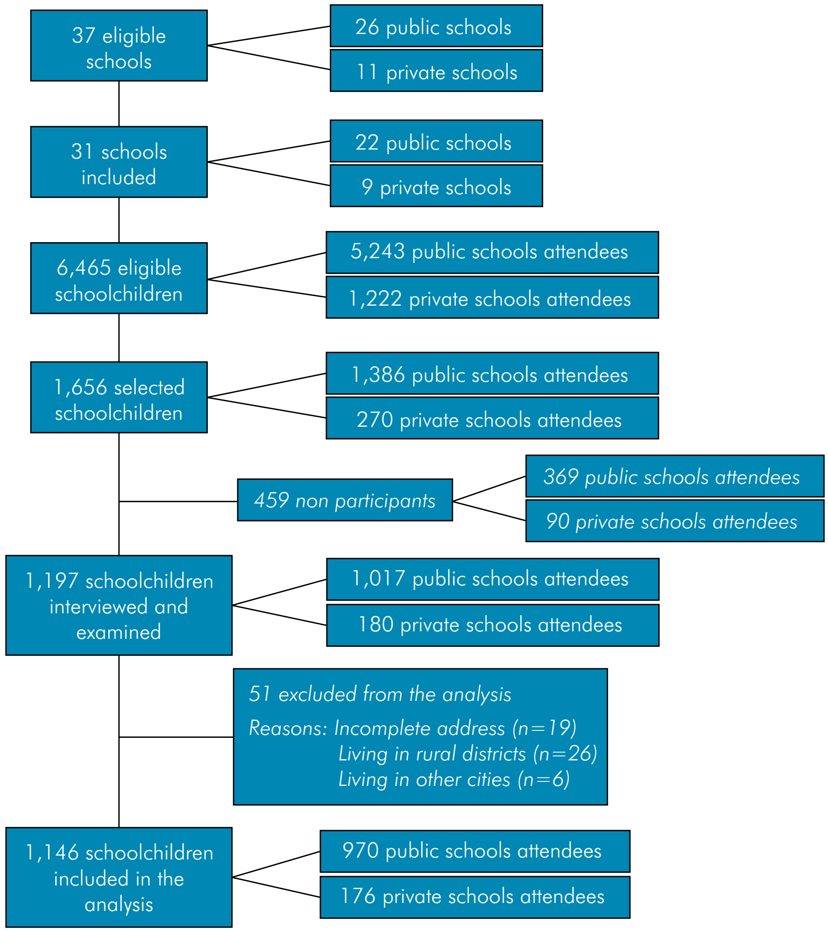

Figure 2. Study flowchart.

Among the other city regions, this percentage ranged from 0% (center) to 45% (west). When comparing the number of neighborhood risk indicators observed among adolescents living in different regions, the southern region had a higher mean/median than all other regions. Figure 3 shows a city map that illustrates the prevalence of TDI in different regions of the city. Neighborhood risk indicators were presented according to the color gradient.

Discussion

This study evaluated the association between the city region and the prevalence and severity of TDI in a representative sample of students aged 15-19 years from a medium-sized city in southern Brazil. Our findings demonstrate that adolescents living in the southern region had a higher prevalence of TDI. As this region clustered the highest number of neighborhood risk indicators, this association follows our conceptual hypothesis.

The findings of the present study support the hypothesis that individuals who live in areas of greater environmental risk are more likely to have TDI than those who live in regions of lower risk. This association remained statistically significant after adjustment for well-known risk indicators of TDI, highlighting the independent importance of environmental and individual factors in the occurrence of TDI. Our results are consistent with an Indian study in which a higher prevalence of TDI was found among adolescents living in deprived areas than among those living in better-off residential areas.[11] Similarly, the physical environment, public social policies, and social cohesion explained 42% of TDI variance between deprived areas in a

Brazilian city.[25] This higher prevalence of TDI in deprived city regions could be related to health inequalities. The role of income inequality over a 10-year period and TDI was verified in a Brazilian study. Children living in cities that experienced a decrease in income inequality were less likely to

Table 1. Sample distribution, prevalence of TDI, and its unadjusted association with environmental and individual variables (multilevel Poisson regression).

Variables	n (%)	Prevalence (95% CI)	Unadjusted analysis PR (95%CI)	Unadjusted analysis p-value
Environmental				
City region				
North	294 (25.6)	13.6 (10.6–16.5)[a]	1.00	
South	122 (10.6)	25.3 (14.9–35.7)[b]	1.91 (1.19–3.07)	0.007
East	187 (16.3)	17.2 (13.2–21.2)[ab]	1.29 (0.81–2.06)	0.29
West	370 (32.3)	17.0 (13.5–20.5)[ab]	1.28 (0.86–1.91)	0.22
Center	173 (15.1)	18.6 (13.4–23.9)[ab]	1.35 (0.84–2.16)	0.21
Individual				
Socio-demographics				
Sex				
Boys	485 (42.3)	19.4 (15.7–23.0)[a]	1.00	
Girls	661 (57.7)	15.4 (11.9–18.9)[a]	0.80 (0.60–1.05)	0.11
Age				
15	265 (23.1)	17.5 (13.7–21.4)[a]	1.00	
16	366 (32.0)	14.7 (8. 9–20.4)[a]	0.87 (0.58–1.28)	0.47
17	358 (31.2)	18.2 (15.0–21.3)[a]	1.01 (0.69–1.48)	0.94
18–19	157 (13.7)	21.4 (15.2–27.7)[a]	1.17 (0.74–1.84)	0.48
Socioeconomic status*				
High	330 (29.8)	14.3 (10.4–18.1)[a]	1.00	
Mid-high	294 (26.5)	17.9 (13.5–22.2)[ab]	1.29 (0.87–1.93)	0.20
Mid-low	305 (27.6)	18.1 (13.0–23.0)[ab]	1.32 (0.89–1.96)	0.16
Low	19 (16.1)	23.0 (17.0–29.0)[b]	1.64 (1.07–2.51)	0.02
Clinical status				
Overjet*				
≤ 3 mm	890 (79.4)	16.0 (13.5–18.6)[a]	1.00	
> 3 mm	231 (29.6)	22.0 (17.0–27.0)[b]	1.40 (1.02–1.94)	0.04
Anterior open bite				
No	1097 (95.7)	17.0 (14.8–19.2)[a]	1.00	
Yes	49 (4.3)	2.4 (1.42–3.40)[a]	1.46 (0.81–2.62)	0.20
Lip coverage*				
No	1028 (89.9)	16.9 (14.9–19.0)[a]	1.00	
Yes	196 (10.1)	19.3 (12.5–26.1)[a]	1.20 (0.78–1.86)	0.41
Total	1146 (100)	17.3 (15.1–19.5)		

TDI: traumatic dental injuries; PR: prevalence ratio; CI: confidence interval; *Missing data. Different letters indicate statistically significant difference between categories ($p < 0.05$, adjusted Wald test).

Table 2. Adjusted association between environmental and individual variables with prevalence and severity of TDI (multilevel Poisson regression).

Variables	Overall TDI prevalence		Mild TDI		Severe TDI	
	PR (95%CI)	p-value	PR (95%CI)	p-value	PR (95%CI)	p-value
Environmental variable						
City region						
North	1.00		1.00		1.00	
South	1.91 (1.18–3.11)	0.009	2.00 (1.12–3.57)	0.02	2.10 (0.87–5.07)	0.10
East	1.41 (0.87–2.29)	0.16	1.39 (0.78–2.51)	0.26	1.51 (0.64–3.60)	0.35
West	1.28 (0.85–1.94)	0.17	1.36 (0.83–2.22)	0.22	1.06 (0.48–2.32)	0.88
Center	1.57 (0.96–2.57)	0.07	1.57 (0.86–2.86)	0.14	1.80 (0.75–4.36)	0.19
Individual						
Socio-demographics						
Sex						
Boys	1.00		1.00		1.00	
Girls	0.74 (0.55–0.99)	0.04	0.80 (0.56–1.13)	0.20	0.53 (0.31–0.91)	0.02
Socioeconomic status						
High	1.00		1.00		1.00	
Mid-high	1.30 (0.86–1.97)	0.21	1.37 (0.84–2.25)	0.21	1.22 (0.56–2.64)	0.61
Mid-low	1.42 (0.94–2.14)	0.10	1.45 (0.88–2.37)	0.14	1.51 (0.72–3.17)	0.28
Low	1.73 (1.10–2.71)	0.02	1.68 (0.97–2.91)	0.06	2.17 (0.96–4.87)	0.06
Clinical status						
Overjet						
≤ 3 mm	1.00		1.00		1.00	
> 3 mm	1.36 (0.97–1.89)	0.07	1.36 (0.91–2.02)	0.13	1.42 (0.77–2.63)	0.26
Anterior open bite						
No	1.00		1.00		1.00	
Yes	1.38 (0.72–2.62)	0.33	1.59 (0.77–3.27)	0.21	1.02 (0.25–4.26)	0.97

PR: prevalence ratio; CI: confidence interval.

Table 3. Sample distribution according to the number of neighborhood risk indicators by city region.

Number of neighborhood risk indicators	North	South	East	West	Center	Total
0-4	176 (60%)	28 (23%)	123 (66%)	203 (55%)	173 (100%)	703 (61%)
5-8	118 (40%)	94 (77%)	64 (34%)	167 (45%)	0 (0%)	443 (39%)
Mean (sd)	3.8 (2.2)[a]	5.3 (1.9)[b]	4.7 (1.9)[c]	4.5 (2.0)[c]	0.9 (0.9)[d]	3.9 (2.3)
Median (P25-P75)	4 (3-5)[a]	6 (5-6)[b]	4 (3-7)[c]	4 (3-6)[c]	1 (0-1)[d]	4 (2-6)

*Neighborhood risk indicators assessed: income, % literate inhabitants, % white skin color inhabitants, household crowding, % piped water, % paved street, % sewerage system, and % public illumination. A neighborhood risk indicator was considered present in neighborhoods located in the category indicating a more deprived condition (below the median for all characteristics, except for household crowding). Different letters indicate statistically significant differences between categories ($p < 0.05$, Wald test for means and Dunn test for medians).

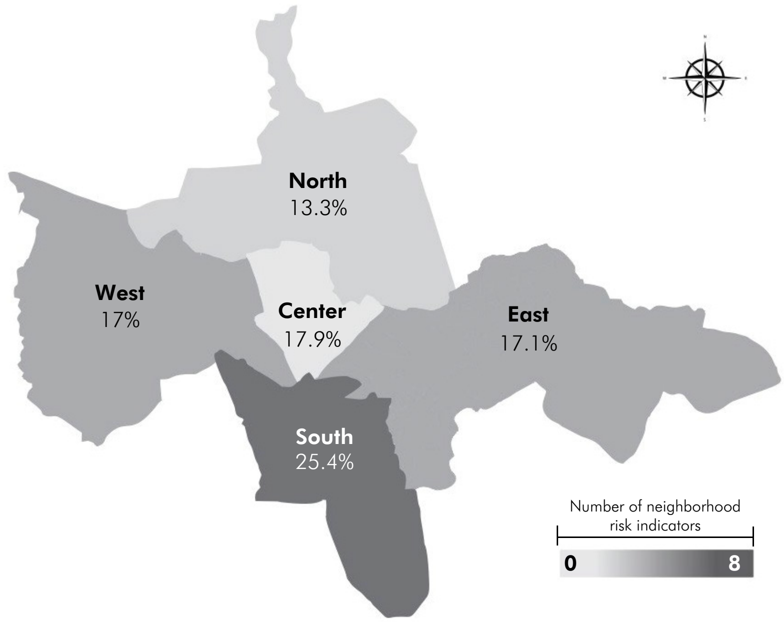

Figure 3. City map illustrating the prevalence of TDI in the different regions of the city, Santa Maria, southern Brazil.

have TDI, thus showing the influence of contextual inequality at the city level on TDI.[8] Furthermore, Marcenes and Murray found that the prevalence of TDI in a very deprived area of London was higher than the overall figure for England.[26] In addition, overcrowded households tended to increase the likelihood of experiencing TDI.

In this study, adolescents living in the southern region were 91% more likely to have TDI than their counterparts living in the northeastern region. When only mild cases of TDI were considered, residents of the southern region had a 2-fold increased risk. A possible explanation for this higher risk could be related to the environmental conditions in the southern region. Of the eight sociodemographic and structural variables of the neighborhoods assessed, the southern region had the highest number of characteristics in the deprived category compared to all other regions (mean, 5.3; median, 6). This result suggests the role of social and environmental contexts in individual health conditions.[14,27,28] In this sense, the place of residence where adolescents live may influence their lifestyles and their level of exposure to health risk factors, such as dangerous roads, dwelling conditions, and unprotected industrial and building sites.[12,28,29]

Although there is no consensus in the literature on the association between individual SES and TDI,[6,24] our analysis revealed that adolescents with low SES had a 73% higher prevalence of TDI than those with high SES. Individuals living in conditions of socioeconomic disadvantage tend to be more exposed to high violence indexes and unsafe urban environments, being less achieved by information on preventive strategies.[5,30] It has been shown that adolescents from less affluent families tend to live in unsafe environments without professional supervision and the nonuse of safety equipment for sports,[27] thus, they are more likely to suffer TDI. It is important to emphasize that the effects of individual and environmental SES were detected independently in the adjusted model. Being a girl afforded a 26% and 47% lower prevalence of TDI and severe TDI, respectively, which agrees with most studies investigating predisposing factors.[5,6,31-33]

In this study, the combination of poor sociodemographic characteristics and poor structure may have made adolescents more prone to TDI than their counterparts. Although we found a higher prevalence of TDI in the region with the highest number of environmental risk indicators (south), the region with the lowest number (center) did not have the lowest experience of TDI. This lack of a gradient was also found in another study conducted with Brazilian adolescents.[12] Hypothesis is that other determinant variables, not included in this study, could help explain the relationship found between the city region and TDI. However, official data on other variables, such as accident rates, bicycle paths, transport, and violence, were not available, which may be considered a limitation of our study. These findings provide additional elements for future research on other contextual determinants and individual variables associated with TDI. This study followed a cross-sectional design, which can be considered another limitation since inferences of causality cannot be drawn.

Among the strengths of this study, we could emphasize that its sample was selected at random and composed of 1,146 students attending public and private schools during any school period (morning, afternoon, and evening) and included participants from 41 neighborhoods of the city. Although six schools did not agree to participate, they were distributed proportionally according to school type and evenly spread throughout the city regions. Therefore, selection bias was prevented, and a representative sample of the population was obtained providing high external validity for the study.

Conclusion

In conclusion, this population-based cross-sectional study showed that living in the southern region was associated with a higher prevalence and severity of TDI among adolescents (15-19-year-old) from Santa Maria, southern Brazil. As this region clustered a greater number of neighborhood risk indicators, our findings suggest the role of the environment in the epidemiology of TDI.

Acknowledgments

We acknowledge the support of the National Coordination of Postgraduate Education (CAPES), Ministry of Education, Brazil (funding code 001), Municipality Oral Health Policy of Santa Maria, and Federal University of Santa Maria. We would also like to thank all volunteers, their parents/legal guardians, and schools for their contributions.

References

1. Glendor U. Epidemiology of traumatic dental injuries: a 12 year review of the literature. Dent Traumatol. 2008 Dec;24(6):603-11. https://doi.org/10.1111/j.16009657.2008.00696.x
2. Andersson L. Epidemiology of traumatic dental injuries. J Endod. 2013 Mar;39(3 Suppl):S2-5. https://doi.org/10.1016/j.joen.2012.11.021
3. Fonseca RC, Antunes JL, Cascaes AM, Bomfim RA. Individual and contextual factors associated with traumatic dental injuries in a population of Brazilian adolescents. Dent Traumatol. 2019 Jun;35(3):171-80. https://doi.org/10.1111/edt.12469
4. Lam R. Epidemiology and outcomes of traumatic dental injuries: a review of the literature. Aust Dent J. 2016 . Mar;61:Suppl 1:420. https://doi.org/10.1111/adj.12395
5. Damé-Teixeira N, Alves LS, Susin C, Maltz M. Traumatic dental injury among 12yearold South Brazilian schoolchildren: prevalence, severity, and risk indicators. Dent Traumatol. 2013 Feb;29(1):52-8. https://doi.org/10.1111/j.16009657.2012.01124.x
6. Soares TR, Magno MB, Jural LA, Loureiro JM, Chianca TK, Risso PA, et al. Risk factors for traumatic dental injuries in the Brazilian population: A critical review. Dent Traumatol. 2018 Dec;34(6):445-54. https://doi.org/10.1111/edt.12439
7. Bomfim RA, Herrera DR, DeCarli AD. Oral healthrelated quality of life and risk factors associated with traumatic dental injuries in Brazilian children: a multilevel approach. Dent Traumatol. 2017 Oct;33(5):358-68. https://doi.org/10.1111/edt.12348
8. Vettore MV, Efhima S, Machuca C, Lamarca GA. Income inequality and traumatic dental injuries in 12yearold children: a multilevel analysis. Dent Traumatol. 2017 Oct;33(5):375-82. https://doi.org/10.1111/edt.12350
9. Moysés ST, Camilotti AG, Vetorello M, Moysés SJ. Spatial analysis of dental trauma in 12yearold schoolchildren in Curitiba, Brazil. Dent Traumatol. 2008 Aug;24(4):449-53. https://doi.org/10.1111/j.16009657.2008.00617.x
10. Bendo CB, Vale MP, Figueiredo LD, Pordeus IA, Paiva SM. Social vulnerability and traumatic dental injury among Brazilian schoolchildren: a populationbased study. Int J Environ Res Public Health. 2012 Dec;9(12):4278-91. https://doi.org/10.3390/ijerph9124278

11. Mathur MR, Watt RG, Millett CJ, Parmar P, Tsakos G. Determinants of socioeconomic inequalities in traumatic dental injuries among urban Indian adolescents. PLoS One. 2015 Oct;10(10):e0140860. https://doi.org/10.1371/journal.pone.0140860
12. Carvalho ML, Moysés SJ, Bueno RE, Shimakura S, Moysés ST. A geographical population analysis of dental trauma in schoolchildren aged 12 and 15 in the city of Curitiba, Brazil. BMC Health Serv Res. 2010 Jul;10(1):203. https://doi.org/10.1186/1472696310203
13. Pattussi MP, Hardy R, Sheiham A. Neighborhood social capital and dental injuries in Brazilian adolescents. Am J Public Health. 2006 Aug;96(8):1462-8. https://doi.org/10.2105/AJPH.2005.066159
14. Kalff AC, Kroes M, Vles JS, Hendriksen JG, Feron FJ, Steyaert J, et al. Neighbourhood level and individual level SES effects on child problem behaviour: a multilevel analysis. J Epidemiol Community Health. 2001 Apr;55(4):246-50. https://doi.org/10.1136/jech.55.4.246
15. Sisson KL. Theoretical explanations for social inequalities in oral health. Community Dent Oral Epidemiol. 2007 Apr;35(2):81-8. https://doi.org/10.1111/j.16000528.2007.00354.x
16. Solar O, Irwin A. A conceptual framework for action on the social determinants of health. Geneva: World Health Organization; 2010. (Social determinants of health discussion, paper 2. Policy and practice).
17. Diez Roux AV, Mair C. Neighborhoods and health. Ann N Y Acad Sci. 2010 Feb;1186(1):125-45. https://doi.org/10.1111/j.17496632.2009.05333.x
18. O'Brien M. Children's dental health in the United Kingdom 1993: report of dental survey: office of population censuses and surveys. London: Her Maj esty's Stationary Office; 1994.
19. World Health Organization. Oral health surveys: basic methods. Geneva: World Health Organization; 1997.
20. Jackson D. Lip positions and incisor relationships. Br Dent J. 1962;112:147-58.
21. Instituto de Planejamento de Santa Maria. Mapa da Área Urbana do Município. Santa Maria: Instituto de Planejamento de Santa Maria [cited 2020 Jul]. Available from: http://iplan.santamaria.rs.gov.br/mapas.php
22. Associação Brasileira de Estudos Populacionais. Critério de classificação econômica brasileira. São Paulo: Associação Brasileira de Estudos Populacionais; 2015.
23. Silva-Oliveira F, Goursand D, Ferreira RC, Paiva PC, Paiva HN, Ferreira EF, et al. Traumatic dental injuries in Brazilian children and oral healthrelated quality of life. Dent Traumatol. 2018 Feb;34(1):28-35. https://doi.org/10.1111/edt.12358
24. Instituto Brasileiro de Geografia e Estatística. Censo 2010. Brasília, DF: Instituto Brasileiro de Geografia e Estatística; 2020 [cited 2020 Ago 20]. Available from: https://censo2010.ibge.gov.br
25. Moysés SJ, Moysés ST, McCarthy M, Sheiham A. Intraurban differentials in child dental trauma in relation to healthy cities policies in Curitiba, Brazil. Health Place. 2006 Mar;12(1):48-64. https://doi.org/10.1016/j.healthplace.2004.10.001
26. Marcenes W, Murray S. Social deprivation and traumatic dental injuries among 14yearold schoolchildren in Newham, London. Dent Traumatol. 2001 Feb;17(1):17-21. https://doi.org/10.1034/j.16009657.2001.170104.x
27. Vettore MV, Aqeeli A. The roles of contextual and individual social determinants of oral healthrelated quality of life in Brazilian adults. Qual Life Res. 2016 Apr;25(4):1029-42. https://doi.org/10.1007/s1113601511180
28. Haynes R, Reading R, Gale S. Household and neighbourhood risks for injury to 514 year old children. Soc Sci Med. 2003 Aug;57(4):625-36. https://doi.org/10.1016/S02779536(02)00446X
29. Wilkinson R, Marmot M. Social determinants of health: the solid facts. 2nd ed. Copenhagen: International Center for Health and Society; 2003.
30. FreireMaia FB, Auad SM, Abreu MH, Sardenberg F, Martins MT, Paiva SM, et al. Oral health related quality of life and traumatic dental injuries in young permanent incisors in Brazilian schoolchildren: a multilevel approach. PLoS One. 2015 Aug;10(8):e0135369. https://doi.org/10.1371/journal.pone.0135369
31. Nguyen QV, Bezemer PD, Habets L, PrahlAndersen B. A systematic review of the relationship between overjet size and traumatic dental injuries. Eur J Orthod. 1999 Oct;21(5):503-15. https://doi.org/10.1093/ejo/21.5.503
32. Aldrigui JM, Jabbar NS, Bonecker M, Braga MM, Wanderley MT. Trends and associated factors in prevalence of dental trauma in Latin America and Caribbean: a systematic review and metaanalysis. Community Dent Oral Epidemiol. 2014 Feb;42(1):30-42. https://doi.org/10.1111/cdoe.12053
33. AzamiAghdash S, Ebadifard Azar F, Pournaghi Azar F, Rezapour A, MoradiJoo M, Moosavi A, et al. Prevalence, etiology, and types of dental trauma in children and adolescents: systematic review and metaanalysis. Med J Islam Repub Iran. 2015 Jul;29(4):234.