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Original Article

Tooth Loss and Associated Factors in Adolescents – Impact Of Extractions For Orthodontic Reason

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Aim: To investigate tooth loss and its determinants in adolescents, considering the effect of extractions due to orthodontics reasons. **Methods:** This cross-sectional study was performed in students from public and private schools aged 15-19 years old from Passo Fundo, Brazil. The proportional randomly chosen sample included 736 adolescents. Clinical examinations and interviews were performed. Associations between prevalence of tooth loss and exposure variables studied were analysed by Poisson Regression with uni- and multivariate robust variance in two models. One model comprised students who had experienced tooth loss without orthodontic reasons and the other with all of the subjects presenting tooth loss. **Results:** Prevalence of tooth loss was 21.1% (mean of 0.42). Higher chances for tooth loss were found in the following features: non-whites (PR=1.72; CI95%:1.15-2.60), poorly schooling mothers (PR=2.2; CI95%:0.96-5.02), from public schools (PR=4.16; CI95%:0.98-17.59), smokers (PR=1.91; CI95%:1.15-3.17). **Conclusion:** Demographic, socioeconomic and behavioural conditions were strongly associated with tooth loss. These associations were more evident when extractions for orthodontic reasons were not included in the analytical models.

Keywords: Adolescence; Dental health surveys; Tooth number; Epidemiology.

Introduction

Tooth loss has been decreasing among Brazilian adolescents. The national epidemiological surveys of 1986 and 2010 have indicated a DMFT (Decayed, Missing, Filled Teeth) reduction, from 6.65[1] to 2.07[2], respectively, for the 12-year-olds. Mean of tooth loss for the 15 to 19-year-old age group in the 1980's ranged between 1.2 and 1.8 with prevalence of at least one lost tooth in almost 70% of adolescents[1,3]. However, in 2003, the national survey indicated a decrease in mean and prevalence of at least one tooth loss to 0.9 teeth and 38.9%, respectively[4]. In another study with a representative sample of the metropolitan region of Porto Alegre, State of Rio Grande do Sul, mean and prevalence of at least one lost tooth were 0.5 teeth and 26%, respectively[5].

Despite this improvement, studies showed that the DMFT usually doubles from 12 year-olds to the 15 to 19-year-old age group[2,6,7], as well as in studies showing high prevalence of periodontal problems in the final stages of adolescence[2,8,9].

In this life stage, dental caries is still the main cause of tooth loss[4,5,10], considering that periodontal diseases still have low impact. Adolescence is when behaviours and attitudes regarding health style usually become definitive, bringing consequences for life[11]. Moreover, tooth loss caused by trauma and orthodontic indication is often considered the second greater cause of tooth loss in this life cycle, and it may usually be observed in studies reporting the premolar as the most lost tooth[9].

Epidemiological studies associating extractions for orthodontic reasons, socioeconomic and cultural aspects and tooth loss are scarce in adolescents, while in other age groups such factors are strongly associated with oral health negative outcomes[12]. Hence, it is important to discuss the adolescent social context, including school, mother's schooling, and school delay. Likewise, ethnicity/skin colour as a proxy of social inequalities has been used[13]. Among the intra oral aspects, extractions for orthodontic reasons are also important.

The high prevalence of malocclusion and orthodontic treatment need among adolescents is noteworthy[14]. The estimates of tooth loss comprise two situations as follows: those who have suffered from oral diseases and those related to orthodontic needs. Thus, in order to avoid confusion bias, it should be noted the uniqueness of this type of approach in studies related to adolescents' tooth loss. Therefore, this study aimed to investigate tooth loss and its determinants in Brazilian adolescents, considering the effect of extractions due to orthodontic treatment.

Material and methods

Study design and location

This cross-sectional study examined adolescents aged from 15 to 19 years old; students enrolled in both public and private high schools in the city of Passo Fundo, State of Rio Grande do Sul, Brazil. In 2012, 7,558 students were enrolled in regular high school in 23 schools divided into 16 public schools (6,256 students – 82.78%) and 7 private schools (1,302 students – 17.22%).

Ethical considerations

The Institutional Review Board of the University of Passo Fundo reviewed under protocol #016/2014 and approved the present study following the authorization by the 7th Regional Office of Education to carry out the study in public schools as well as formal approval by the principals of the private schools. All selected students presented the informed consent signed by the parents or legally responsible person.

Sample

The study coordinator invited all of the 23 high schools to participate and 30% of the high school students from each school that accepted to be part of the study were invited to participate. They were randomly chosen by draw from the lists of all high school students aged 15 to 19 years from each participating school, regardless of their school schedule. According to the distribution of male and female students, two blocks of randomization were performed. All selected students received the Informed Consent Form to be signed by their responsible persons. In case of absence, a later contact was made.

Clinical examination and interview

A structured questionnaire including demographic data, socioeconomic condition, general health behaviour, health record, and oral health self-perception was applied with the use of a group of questions from the PCA Tool-SB Brazil adult version, validated in Brazil[15]. Moreover, other questions of interest were included regarding oral health at this age, such as orthodontic history and oral hygiene habits.

All present teeth (except for third molars) were counted with the help of a wooden spatula. We used the World Health Organization (WHO) basis without looking at dental caries, just for tooth loss. Analysis of dental caries, fillings etc. was not performed. The adolescents were examined and interviewed between April and July, 2012 by trained researchers. Teeth that could be somehow restored were considered in the counting. Teeth or roots indicated for extraction were considered absent. The training was performed in high school students who were not selected to participate in the study and 10% of the students were randomly chosen by draw and were re-examined and re-interviewed by the study coordinator to assess reproducibility. An agreement rate of 98% was observed for number of teeth between examinations.

Statistical analysis

The dependent variable of the present study was the prevalence of tooth loss, assessed by the rate of individuals with one or more permanent lost teeth, and severity was assessed by the number of teeth lost per person. The explanatory variables for tooth loss outcome in adolescents were divided into two groups (Figure 1)[16].

Self-reported ethnicity/skin colour was classified as either white or non-white. The socioeconomic condition was assessed by a series of information on income and schooling. The level of parents' schooling was classified in three groups – one group with complete or incomplete higher education, another one with complete or incomplete high school, and a third group gathering everyone who finished elementary

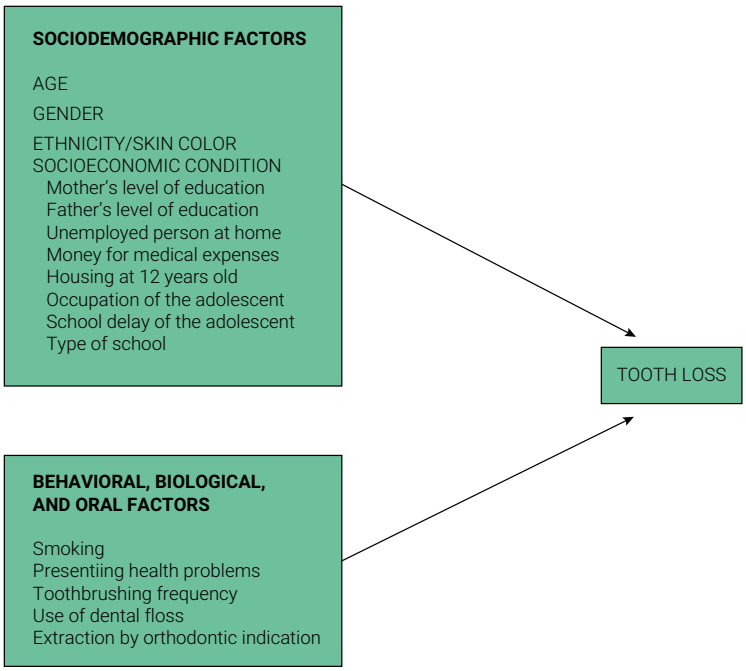

Figure 1. Explanatory variables for tooth loss.

school at the most. Having an unemployed person at home and having money for medical expenses were used as income proxy and dichotomized as either yes or no. Housing at 12 years old was obtained with the question: "When you were 12 years old, did you live in the urban area, rural area, or state capital?" The adolescent's occupation was classified in two groups - one group in which the adolescent only studies, and another one where the adolescent studies and works at least one shift. Adolescent's school delay was defined whenever 16, 17, 18, or 19-year-old adolescents were still in the first year of high school; when 17, 18, and 19-year-old adolescents were still in the second year; and when 18 and 19-year-old adolescents were still in the third year of high school. Public or private school was used as income proxy, as students from public schools are considered to come from lower income families.

Smoking was classified in two groups: adolescents who had never smoked and another one with adolescents that either are currently or former smokers. Having a health problem was classified in two groups: those without a health problem or not being aware of it, and those who referred having a health problem that had lasted or will probably last more than one year. Self-reported toothbrushing frequency was classified in three groups – more than three times a day, three times a day, and less than three times a day. The use of dental floss was dichotomized as either yes or no.

Data analysis was performed using the statistical package SPSS 18 (SPSS Inc., Chicago, United States). Associations between the dependent variable and independent variables were assessed by the chi-square test or Fisher's exact test, and presented by frequency distribution. Poisson regression models with uni- and multivariate robust

variance were used to assess the association between dependent and independent variables. The significance level applied was 5%. The results from exposures regarding prevalence of tooth loss outcome were analysed in two different contexts. The first one only analysed subjects without extraction for orthodontic reasons, and the second context analysed all of the subjects with any tooth loss.

RESULTS

Out of the 23 schools invited, 20 accepted to be part of the study, of which 16 were public and 4 were private schools. From the total of 6,122 students eligible for the study in the 20 schools, 1,836 students were chosen by draw and invited to participate, and 736 (40.08%) accepted the invitation. From these, 323 (43.9%) were males and 413 (56.1%) were females. The reasons for non-participation and the number of subjects in both private and public schools are expressed in Figure 2. The prevalence of at least 1 lost tooth was 21.1% with mean of lost teeth of 0.42.

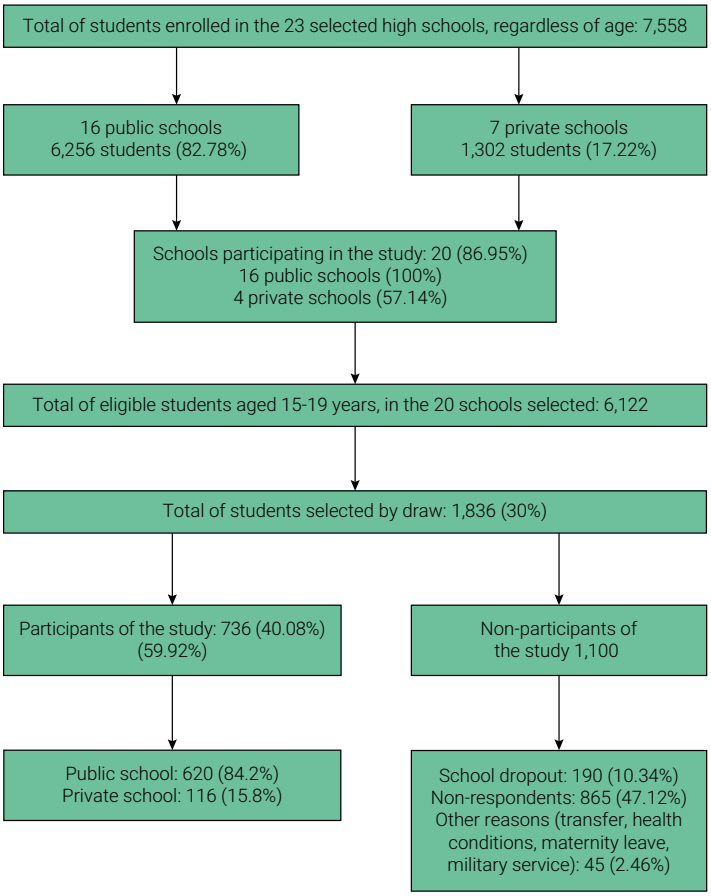

Figure 2. Study flowchart.

Figure 3a and 3b shows the most absent teeth in the sample. The 1st upper premolar, the 1st lower molar, and the 1st lower premolar were the most absent teeth with rates of 21.75, 16.89, and 11.03%, respectively, representing almost 50% of the total lost teeth (Figure 3c).

Age, gender, toothbrushing frequency, and dental floss usage were not associated with the prevalence of tooth loss in both analytical models used. Ethnicity, mother's level of schooling, school delay, having money for medical expenses, type of school, and smoking showed association with the prevalence of tooth losses (Table 1).

When the univariate model was analysed, non-white adolescents, those with mothers with low level of education, from families with no money for medical expenses, school delay, students from public schools, and students with smoking history were more likely to present tooth loss (Table 2). The associations are similar; however the extent considerably increases when analysing only adolescents presenting tooth loss without orthodontic reason.

When performing the multivariate analysis with all subjects, higher chances for tooth loss were found in adolescents from mothers with lower level of education, adolescents with school delay, and with history of smoking exposure (Table 2). Adolescents from moth-

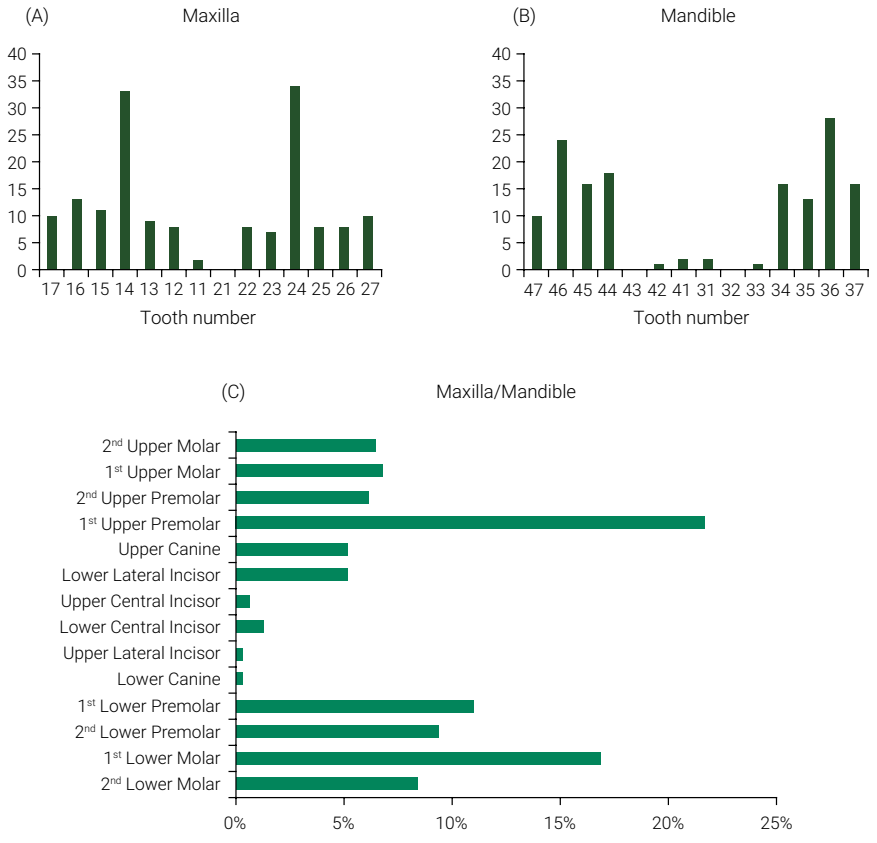

Figure 3. Total number of lost teeth according to the type and location in the sample (n=736) (a, b) and frequency distribution of lost teeth, according to the type of tooth (c).

Table 1. Frequency distribution of exposures regarding prevalence of tooth loss among 15-19 year-old adolescents.

		Only subjects without extractions for orthodontic reasons			All subjects		
		Yes – n (%)	No – n (%)	P-value*	Yes – n (%)	No – n (%)	P-value*
Age	15	23 (26.7%)	186 (34.1%)	0.443	40 (25.8%)	196 (33.7%)	0.239
	16	27 (31.4%)	182 (33.4 %)		52 (33.5%)	199 (34.3%)	
	17	24 (27.9%)	124 (22.8%)		46 (29.7%)	129 (22.2%)	
	18	9 (10.5%)	43 (7.9%)		13 (8.4%)	45 (7.7%)	
	19	3 (3.5%)	10 (1.8%)		4 (2.6%)	12 (2.1%)	
Gender	Male	34 (39.5%)	248 (45.5%)	0.351	60 (38.7%)	263 (45.3%)	0.146
	Female	52 (60.5%)	297 (54.5%)		95 (61.3%)	318 (54.7%)	
Ethnicity	White	42 (48.8%)	392 (71.9%)	<0.001	93 (60.0%)	418 (71.9%)	0.006
	Non-white	44 (51.2%)	153 (28.1%)		62 (40.0%)	163 (28.1%)	
Mother's level of education	Complete or incomplete higher education	7 (8.1%)	135 (24.8%)	<0.001	21 (13.5%)	143 (24.6%)	0.002
	Complete or incomplete high school	23 (26.7%)	199 (36.5%)		53 (34.2%)	212 (36.5%)	
	Finished up to elementary school	56 (65.1%)	211 (38.7%)		81 (52.3%)	226 (38.9%)	
Father's level of education	Complete or incomplete higher education	6 (7.0%)	98 (18.0%)	0.005	17 (11.0%)	107 (18.4%)	0.082
	Complete or incomplete high school	26 (30.2%)	196 (36.0%)		58 (37.4%)	208 (35.8%)	
	Finished up to elementary school	54 (62.8%)	251 (46.0%)		80 (51.6%)	266 (45.8%)	
Unemployed person at home	Yes	19 (22.4%)	89 (16.5%)	0.215	34 (22.1%)	91 (15.8%)	0.071
	No	66 (77.6%)	452 (83.5%)		120 (77.9%)	486 (84.2%)	
Money for medical expenses	Yes	57 (66.3%)	439 (80.6%)	0.004	112 (72.3%)	469 (80.7%)	0.026
	No	29 (33.7%)	106 (19.4%)		43 (27.7%)	112 (19.3%)	
Housing at 12 years old	Urban	79 (91.9%)	514 (94.3%)	0.337	141 (91.0%)	548 (94.3%)	0.140
	Rural	7 (8.1%)	31 (5.7%)		14 (9.0%)	33 (5.7%)	
Occupation of the adolescent	Studies only	48 (55.8%)	361 (66.2%)	0.068	97 (62.6%)	387 (66.6%)	0.391
	Studies and works	38 (44.2%)	184 (33.8%)		58 (37.4%)	194 (33.4%)	
School delay of the adolescent	Yes	40 (46.5%)	138 (25.3%)	<0.001	95 (61.3%)	436 (75.0%)	0.001
	No	46 (53.5%)	407 (70.7%)		60 (38.7%)	145 (25.0%)	
Type of school	Public	84 (97.7%)	448 (82.2%)	<0.001	140 (90.3%)	480 (82.6%)	0.018
	Private	2 (2.3%)	97 (17.8%)		15 (9.7%)	101 (17.4%)	
Smoking	Never smoked	72 (83.7%)	519 (95.2%)	<0.001	138 (89.0%)	555 (95.5%)	0.006
	Former smoker or currently smokes	14 (16.3%)	26 (4.8%)		17 (11.0%)	26 (4.5%)	
Having health problems	Yes	15 (17.6%)	65 (12.1%)	0.164	21 (13.6%)	70 (12.2%)	0.681
	No	70 (82.4%)	471 (87.9%)		133 (86.4%)	502 (87.8%)	
Toothbrushing frequency	>3X a day	27 (31.4%)	132 (24.2%)	0.161	44 (28.4%)	142 (24.4%)	0.467
	3X a day	42 (48.8%)	326 (59.8%)		85 (54.8%)	350 (60.2%)	
	<3X a day	17 (19.8%)	87 (16.0%)		26 (16.8%)	89 (15.4%)	
Use of dental floss	Yes	38 (44.2%)	286 (52.5%)	0.165	79 (51.0%)	311 (53.5%)	0.588
	No	48 (55.8%)	259 (47.5%)		76 (49.0%)	270 (6.5%)	

Table 2. Univariate and multivariate analyses models associating exposures regarding prevalence of tooth loss outcome among adolescents from 15 to 19 years old.

		Univariate analysis				Multivariate analysis			
		Only subjects without extraction for orthodontic reason		All of the subjects		Only subjects without extraction for orthodontic reason		All of the subjects	
		PR	CI 95% (p-value)	PR	CI 95% (p-value)	PR	CI 95% (p-value)	PR	CI 95% (p-value)
Age	19	1 (ref.)		1 (ref.)					
	15	0.47	0.16-1.40 (0.173)	0.67	0.27-1.65 (0.394)				
	16	0.56	0.20-1.60 (0.280)	0.82	0.34-2.00 (0.676)				
	17	0.70	0.24-2.02 (0.513)	1.05	0.43-2.54 (0.911)				
	18	0.75	0.24-2.40 (0.626)	0.90	0.34-2.38 (0.826)				
Gender	Male	0.81	0.54-1.21 (0.303)	0.80	0.60-1.07 (0.147)				
Ethnicity	Non-white	2.31	1.57-3.4 (<0.001)	1.51	1.14-2.00 (0.004)	1.72	1.15-2.60 (0.009)	1.27	0.94-1.71 (0.100)
Mother's level of education	Higher education	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
	High school	2.1	0.93-4.77 (0.076)	1.56	0.98-2.50 (0.061)	1.32	0.56-3.11 (0.500)	1.39	0.86-2.24 (0.170)
	Illiterate and complete elementary school	4.25	1.99-9.09 (<0.001)	2.06	1.33-3.20 (0.001)	2.20	0.96-5.02 (0.060)	1.67	1.05-2.67 (0.029)
Unemployed person at home	Yes	1.38	0.87-2.2 (0.175)	1.37	0.99-1.90 (0.060)				
Money for medical expenses	No	1.87	1.25-2.8 (0.002)	1.44	1.06-1.95 (0.019)				
Housing at 12 years old	Urban	0.72	0.36-1.46 (0.364)	0.68	0.43-1.09 (0.112)				
Occupation of the adolescent	Studies and works	0.69	0.46-1.02 (0.060)	0.87	0.65-1.16 (0.345)				
School delay	Lower level of education	2.2	1.50-3.26 (<0.001)	1.63	1.23-2.16 (0.001)	1.41	0.95-2.09 (0.086)	1.36	1.05-2.32 (0.028)
Type of school	Public	7.82	1.95-31.24 (0.004)	1.75	1.06-2.90 (0.027)	4.16	0.98-17.59 (0.050)		
Smoking	Yes	2.87	1.79-4.62 (<0.001)	1.98	1.33-2.95 (0.001)	1.91	1.15-3.17 (0.011)	1.56	1.05-2.32 (0.034)
Having health problems	Yes	1.45	0.87-2.4 (0.151)	1.10	0.74-1.65 (0.638)	1.83	1.14-2.98 (0.013)		
Toothbrushing frequency	>3X a day	1 (ref.)		1 (ref.)					
	3X a day	0.67	0.43-1.05 (0.081)	0.96	0.18-0.30 (0.835)				
	<3X a day	0.96	0.55-1.67 (0.893)	0.83	0.60-1.14 (0.243)				
Use of dental floss	No	1.33	0.9-1.98 (0.155)	1.08	0.82-1.43 (0.570)				

ers with low level of education, and with school delay presented 67% (p=0.029) and 36% (p=0.028) more chances of having already lost teeth, respectively. Demographic, socioeconomic, behavioural, and health aspects become more evident in the multivariate analysis including only adolescents without extraction for orthodontic reasons. The ones presenting more chances of having tooth loss are non-white, students from mothers with low level of education, students from public schools, with smoking history, and with any health problem (Table 2). Non-white students had 72% (p=0.009) higher chances of having experienced tooth loss. Furthermore, studying in public schools increased the chances in 4.16 (p=0.05) times. Having some history of smoking or reporting health problems increased in 91% (p=0.011) and 83% (p=0.013) the chance of teeth loss, respectively.

DISCUSSION

This study aimed to determine the occurrence and factors associated with tooth loss in adolescents in a medium-sized city in southern Brazil. Additionally, it sought to understand the occasional differences in the profile of tooth loss, considering the history of orthodontic treatment. When individuals experiencing extractions due to orthodontic indication, the magnitude of the associations found in this study were higher, reinforcing the role of social determinants in tooth loss in adolescents. In the final sample, the rate of socio-demographic variable, such as gender and ethnicity, and type of school were similar to the city population.

The results of the present study show a relatively high prevalence of tooth loss in adolescents (21.1%), and mean of 0.42 lost teeth. The national 1986 and 2003[1,4] surveys show means of 1.2 and 0.9, respectively. The same situation may be observed for prevalence of tooth loss; rates decreasing from 38.9% in 2003[4] to 26% in 2006[5], and to 21.1% in the present study. Despite the results of the present study have suggested a decrease in prevalence of tooth loss, they are higher than the ones observed in the last national survey in 2010, which shows mean and prevalence of tooth loss of 0.38 and 8.9%, respectively[2].

Most studies in Brazil indicate the first lower molar as the most frequently lost tooth[3,4,5]. However, this study showed that the first upper premolar was the most absent tooth. These results are in accordance with other studies[9,12,17]. This tendency may be explained by the change in the epidemiological profile of dental caries mainly observed by the reduction of DMFT, and by the extraction of premolars for orthodontic reasons. However, epidemiological studies should confirm these findings.

Tooth loss was assessed by two distinct models. This separation in two models aimed to avoid extractions for orthodontic reasons to be considered an outcome, especially in the analysis of demographic and socioeconomic variables. Age, gender, toothbrushing frequency, and dental floss usage were not associated with tooth loss in both models. Age is considered a risk indicator for tooth loss, especially in adults and the elderly[5,18]. In this study it was included only 15 to 19-year-old adolescents, and this is a short period to detect differences in tooth loss.

Several other studies show that female adolescents present higher prevalence of tooth loss. However, these results are controversial, considering that some of these studies do not show significant differences[3,5,12], such as the present study, while others reveal statistically significant differences[4,19].

The socioeconomic conditions are strong determinants for tooth loss[20]. Data from the present study clearly show that being a white adolescent is a protective factor against tooth loss. The question of ethnicity should be understood more as a proxy of socioeconomic status than a biological variable. White individuals in Brazil have higher level of education and income than other ethnicities, leading to more access to dental services, more knowledge and behaviour regarding oral hygiene care. Similarly, adolescents from mothers with low level of education had more chances of presenting tooth loss. The relation between mother's level of education and oral health of children and adolescents is clear[21,22], mainly regarding dental caries.

Likewise, adolescents with lower level of education presented higher chances of having experienced tooth loss. Results similar to other studies show that lower level of education was related to worse oral health conditions[4,23]. Students from public schools who participated in the present study had significantly higher chances of having tooth loss. This is compatible with results that show significant differences in oral health, among students from schools where the socioeconomic differences are highlighted[8,24].

Adolescents who reported some history with smoking presented higher risk of having tooth loss. However, only 5.8% of adolescents have reported this, which is a low rate and it was also observed in other studies[25,26]. Either way, smoking usually starts in adolescence and is associated to school problems[26].

Regarding the limitations of the present study, the claimed representativeness is strict to adolescents who are studying. Furthermore, a sample size calculation was not performed. Analytical epidemiological studies need a minimum amount of 40-50 individuals for each variable in test. As a census would not be possible, we calculated that an invitation of 30% of the adolescents would suffice for the different analyses that would be performed, which is the case of this study. In the literature, other studies in this field have used smaller and similar sample sizes[27,28].

Additionally, the response rate tends to be diminishing in adolescent studies, mainly because of the lack of signature in the informed consent. However, the analytical approach, with the relatively high number of individuals, strengthens the encountered associations, making possible to extrapolate the results regarding higher chances of presenting such an important and impacting event such as tooth loss.

The results of the present study show that by removing extractions for orthodontic reason from the analysis, the demographic and socioeconomic differences become more evident while increasing the extent of associations. Moreover, it is necessary to measure the impact that extractions for orthodontic reasons brings on the mean and prevalence of tooth loss in adolescents, considering that such distinct causes of tooth losses seem to be part of the same process.

Moreover, it is necessary to measure the impact that extractions for orthodontic reasons brings on the mean and prevalence of tooth loss in adolescents, considering that both variables seem to be part of the same process.

In conclusion, demographic, socioeconomic, and behavioural conditions were strongly associated with tooth loss. Extractions for orthodontic reasons have impact on tooth loss estimates.

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