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Epidemiological pattern of severe malocclusions in Brazilian adolescents

ABSTRACT

OBJECTIVE: To describe the distribution of malocclusion and its associated factors in Brazilian adolescents.

METHODS: Data from 7,328 subjects aged 12 years and 5,445 adolescents aged 15-19 years were analyzed. The adolescents took part in the Brazilian Oral Health Survey (SBBrasil 2010). The outcome was severe malocclusion according to the dental aesthetic index. The independent variables were sex, skin color, monthly household income, possessions, number of individuals in the household, untreated dental caries, missing teeth and dental appointments or lack thereof, frequency, and reason. Logistical regression analysis was carried out, considering the complex sampling cluster design, based on a hierarchical model.

RESULTS: The prevalence of severe malocclusion was 6.5% and 9.1% in the 12-year-olds and the 15-19-year-olds, respectively. After adjustment, those with lighter- skinned black or black skin were 1.59 (95%CI 1.08;2.34) times more likely to present the outcome compared with those with white skin. The loss of one or more first molars increased 2.66 (95%CI 1.26;5.63) the chance to present severe malocclusion by the age of 12. Adolescents aged 15-19 whose household income was below R$ 1,500.00 (OR 2.69 [95%CI 1.62; 4.47]) and those who had seen a dentist for treatment (OR 2.59 [95%CI 2.55;4.34]) had the greatest chance of having severe malocclusion compared with those with higher incomes and those who visited the dentist for prevention.

DESCRIPTORS: Adolescent. Malocclusion, epidemiology. Socioeconomic Factors. Health Inequalities. Dental Health Surveys. Oral Health.

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INTRODUCTION

There have been significant changes in the epidemiological profile of oral health diseases in Brazilian children and adolescents in the last few decades, such as reduction in the prevalence and severity of dental caries.[12] These changes have led to an increase in the development of research into other oral health outcomes such as malocclusion.[8,15] Malocclusion is not a single entity and can be defined as a set of disorders in the growth and development that affects muscles and facial bones during childhood and adolescence[20] and may lead to functional, aesthetic, and psychosocial disturbances, with negative consequences for the individual's quality of life.[15]

Malocclusion are generally considered the third most important oral disorders according to the World Health Organization, identified in international epidemiological investigations.[16] Oral health population-based surveys in Brazil have included investigation of occlusion disorders since the 2002-2003 SBBrasil National Survey. In that study, it was found that 8.2% of 12-year-olds had severe and 9.8% very severe malocclusion. Among 15-19-year-old individuals, 8.0% and 11.1% showed severe and very severe malocclusion, respectively.[16]

Malocclusions originate from the interaction between genetic and environmental factors.[6] Research addressing the etiology and factors associated with malocclusion have produced quite diverse results. Although some studies have highlighted the link between malocclusion and being socioeconomically disadvantaged,[8] others have failed to identify such an association.[3] The same is observed for demographic aspects and the presence of other oral health problems, such as dental caries[8,14] and tooth loss.[17] The presence of association between these aspects and occlusal disorders is not clear among several researches.

Part of this divergence may be due to the occlusal characteristics captured using different measurements instruments. Whereas some studies have investigated factors associated with specific occlusal deviations (anterior open bite, overjet), in others the outcome was malocclusion defined as a whole, shown as a score indicating whether the condition is mild, moderate or severe. For specific occlusal disorders, it is possible to identify proximal and distal associated factors. For moderate and severe malocclusions, it is only possible to evaluate the role played by distal factors as the results combine specific distortions of different etiological origin.[8]

The possibility of identifying inequalities in the distribution of this oral health disorder according to different social and demographic aspects may contribute to provision of orthodontic treatment for the population through specialist orthodontic centers, an oral health care policy of the Brazilian health care system.[a] Knowing the pattern of malocclusion distribution, from a public health view, seeks to achieve two main aims: evaluating the need and priority for treatment of population groups, as well as obtaining data in order to allocate resources appropriately in the provision of oral health care to the population. The aim of this study was to describe the profile of very severe malocclusion in adolescents and to identify associated factors.

METHODS

Data from the National Oral Health Survey (SBBrasil 2010), carried out by the Brazilian Ministry of Health, was used. This study includes a sample of 12-year-olds and 15- 19-year-old adolescents. The sampling plan considered each of the state capitals and the Federal district and a sample of 30 interior municipalities in each macro-region (North, Northeast, Central-West, Southeast, and South) as domains, giving a total of 32 domains. A two-stage sampling scheme was adopted for the 26 state capitals and the Federal District and a three-stage sampling scheme for the municipalities in the interior of the five Brazilian macro regions. The primary sample units were: (a) municipality, for the interior, and (b) census tract for the state capitals. Data collection was performed at all participants' homes. In this study, the sample size was 7,328 (12-year-olds) and 5,445 (15- to 19-year-olds). Detailed information on the sampling procedure is available in another publication.[18]

Dental examinations and interviews through standardized and pre-coded questionnaires were carried out. Malocclusion was diagnosed using the Dental Aesthetic Index (DAI).[5] The DAI is composed of ten measures: (a) number of incisors, canines, and premolars lost; (b) crowding and (c) spacing in the incisor region; (d) diastema; (e) irregularity anterior maxillary and (e) mandible; (f) anterior maxillary and (g) mandible overjet; (h) anterior open bite; and (i) molar ratio. Each measure receives a specific weighing, yielding a final score, which is categorized into four situations: (a) without malocclusion, score up to 25; (b) defined malocclusion, scores between 26 and 30; (c) severe malocclusion, score between 31 and 35; and (d) very severe malocclusion, scores greater than or equal to 36. In this study, the outcome adopted was the need for immediate treatment (yes/no) or, in other words, the prevalence of very severe malocclusion.

The independent variables were socioeconomic variables as well as the use of dental services related to the interviewee or the family and it was included in the questionnaire. Figure 1 shows the independent variables of the study and the respective adaptations.

[a] Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica, Coordenação Geral de Saúde Bucal. Brasil Sorridente. Brasília (DF); 2003 [cited 2010 Jun 24]. Available from: http://dtr2004.saude.gov.br/dab/cnsb/brasil_sorridente.php

Variables	Description in the original database	Use in this study
Sex	Sex of interviewer/examiner: 1 - Male 2 - Female	No change
Skin color	Self-reporting criteria. 1 - White 2 - Black 3 - Yellow 4 - Brown 5 - Indigenous	Yellow and indigenous were excluded due to low representativeness (1.8% and 0.8% respectively) and black and brown skin were grouped together in one reference category 0 - White 1 - Brown and black skinned
Household crowding	Ratio between the variables "number of residents in the household" and "number of rooms in permanent use as bedrooms by the residents"	Dichotomized by mean into the categories: 0 - 1.5 individuals per bedroom 1 - More than 1.5 individuals per bedroom
Number of goods	Response to the question "How many consumer goods are there in your residence?" Consumer goods include: television, fridge, stereo, microwave, telephone, mobile phone, washing machine, dishwasher, computer and number of cars	Dichotomized by mean into the categories: 0 - More than 6 1 - 6 or fewer
Household income*	Response to the question "Last month, what was the sum, in reais, received by all members of the household, including salary, benefits, pension, rent or other income?" 1 - Below R$ 250.00 2 - From R$ 251.00 to R$ 500.00 3 - From R$ 501.00 to R$ 1,500.00 4 - From R$ 1,501.00 to R$ 2,500.00 5 - From R$ 2,501.00 to R$ 4,500.00 6 - From R$ 4,501.00 to R$ 9,500.00 7 - Over R$ 9,500.00	Considering the distribution of the variables, in which the R$ 501 to R$ 1,500 corresponded to 52.6% of the sample, two categories were created: 0 - Over R$ 1,500.00 1 - Below R$ 1,500.00
Loss of first permanent molar	In the DMFT record, codes "4" and "5" for teeth 16, 26, 36 and 46.	Dichotomized into the categories: 0 - None lost 1 - 1 or more lost
Decayed teeth	In the DMFT record, codes "1" and "2"	Dichotomized into the categories: 0 - None 1 - One or more
Dental visit	Response to the question "Have you ever visited a dentist?" 0 - No 1 - Yes	No change
Frequency of dental visit	Response to the question "When did you last visit a dentist?" 1 - Less than a year ago 2 - One to two years 3 - Three or more years ago	Dichotomized into the categories: 0 - Less than a year ago 1 - More than a year ago
Reason for dental visit	What was the reason for your last visit? 1 - Check-up 2 - Pain 3 - Extraction 4 - Treatment 5 - Other	Dichotomized into the categories: 0 - Check-up 1 - Orthodontic treatment and/or other

Note: R$ 1.00 = US$ 1.97 (08/02/2013)

Figure 1. Description of the independent variables used in the study.

The fieldwork teams were composed of an examiner (dentist) and an interviewer. Teams undertook 40 hours of training in regional workshop. The consensus technique was used to train and calibrate the team.[9] Inter-observer reliability was obtained through the weighted kappa coefficient. The kappa equal to 0.65 was considered the minimum acceptable value for all conditions under study.[18]

Data analysis considered the complex sampling cluster design. The primary sampling units were the municipality (when the domain was the interior of the region) and the census tract (when the domain was the state capital).[18] In the regression analysis, estimates of the unadjusted and adjusted odds ratios (OR) and the respective 95%CI were considered for each independent variable. This analysis was carried out based on a theoretical model with a hierarchical approach.[24] The independent variables were introduced into the modeling from the most distal to the most proximal according to the model of analysis adopted (Table 1). The first level of the model included demographic variables, sex, and skin color (using the skin color of the father and/or mother as proxy). The second level included socioeconomic variables (monthly household income, number of consumer goods, and cluster), and the third level was oral health conditions and use of orthodontic services (Figure 2). This type of analysis provides the fit between the variables on the same level and those in previous levels (Figure 2). Variables with "p"

Table 1. Sample distribution and prevalence with respective confidence intervals of very severe malocclusion, according to age group and independent variables. SBBrasil, 2010.

Variável	Sample				Prevalence of very severe malocclusion (DAI ≥ 36)					
	12 years old		15- 19 years old		12 years old			15- 19 years old		
	n	%	n	%	P (%)	95%CI	p	P (%)	95%CI	p
Sex										
Male	3,639	49.7	2.497	45.9	6.80	4.70;9.70	0.706	9.80	7.40;12.70	0.395
Female	3,689	50.3	2.948	54.1	6.30	4.70;8.30		8.40	6.70;10.60	
Skin color / race										
White	2,897	40.7	2.203	41.6	5.00	3.60;7.10	0.019	7.30	5.20;10.10	0.061
Brown/black	4,225	59.3	3.089	58.4	7.80	5.70;10.50		10.80	8.50;13.60	
Household crowding										
Below 1.5	3,414	46.7	2.812	51.7	5.70	4.50;7.20	0.242	8.00	6.10;10.50	0.209
Over 1.5	3,894	53.3	2.630	48.3	7.20	4.90;10.60		10.30	7.80;13.40	
Number of goods										
More than 6	3,542	48.7	2.874	53.1	5.80	3.80;8.70	0.323	8.00	6.20;10.20	0.091
6 or fewer	3,724	51.3	2.539	46.9	7.40	5.40;10.10		10.60	8.20;13.50	
Household income* (R$)										
Above 1,500.00	1,838	26.5	1.609	31.4	5.10	2.30;10.80	0.398	4.50	2.90;6.90	< 0.001
Below 1,500.00	5,091	73.5	3.516	68.6	7.10	5.40;9.40		11.50	9.50;13.90	
Lost first molar										
None	6,965	95.0	4.585	84.2	6.20	4.70;8.10	0.030	8.30	6.60;10.50	0.027
1 or more	363	5.0	860	15.8	13.70	6.80;25.70		13.90	9.70;19.50	
Teeth with caries										
None	4,220	58.2	2.663	49.6	6.30	4.30;9.20	0.711	6.70	4.90;9.10	0.006
1 or more	3,027	41.8	2.704	50.4	6.90	5.10;9.40		12.00	9.40;15.30	
Dental visit										
Yes	5,918	81.6	4.685	86.6	6.20	4.80;8.00	0.238	9.30	7.50;11.40	0.540
No	1,337	18.4	726	13.4	8.40	4.90;13.80		7.70	4.40;13.10	
Frequency of dental visits										
Less than a year ago	3,570	61.2	2.705	58.4	6.80	4.80;9.60	0.204	8.90	6.70;11.90	0.752
More than a year ago	2,264	38.8	1.925	41.6	4.90	3.30;7.30		9.70	6.70;13.80	
Reason for dental visit										
Check up	2,172	37.1	1.616	34.8	6.30	4.00;9.80	0.775	4.40	2.90;6.60	< 0.001
Treatment or other	3,690	62.9	3.027	65.2	5.90	4.50;7.80		12.00	9.80;14.70	

Source: Drawn up by the authors based on data from the SBBrasil 2010 Project.
R$ 1.00 = US$ 1.97 (02/08/2013)
DAI: Dental Aesthetic Index

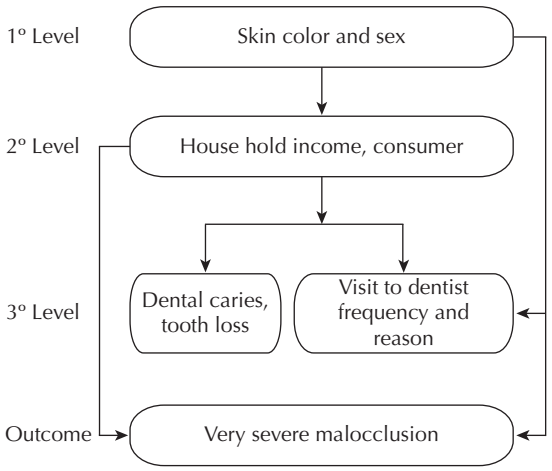


Figure 2. Description of the independent variables used in the study.

value equal to or lower than 0.20 in the bivariate analysis were included in the multiple analysis. Only those variables with $p \leq 0.20$ were included in the final model, and variables with $p < 0.05$ after adjusting for variables at the same level and above were considered to be statistically significant. The variable "sex" was kept in the final model regardless of its statistical significance.

The SBBrasil 2010 Project followed the standards set by the Declaration of Helsinki and was approved by the National Council for Research Ethics, record no. 15,498, 7th January 2010.

RESULTS

A total of 7,328 adolescents aged 12 years and 5,445 adolescents aged 15 to 19 years old took part in the sample. The prevalence of very severe malocclusion in Brazil was 6.5% (95%CI 5.0;8.5) in the subjects aged 12 years and 9.1% (95%CI 7.5;10.9) in those aged 15 to 19 years old. According to the 32 domains investigated, the prevalence of very severe malocclusion in those aged 12 varied from 2.2% in Cuiabá (95%CI 0.6;7.6) to 15.3% (95%CI 8.8;25.3) in Porto Velho, with an estimate for the country as a whole of 6.5% (95%CI 5.0;8.5). In the 15- 19-year-old age group, the overall prevalence was 9.1% (95%CI 7.5;10.9), with the lowest value being 2.0 (95%CI 0.6;6.8) in São Luiz and the highest being 16.8% (95%CI 9.4;28.1) in João Pessoa (Figure 3).

The demographic characteristics of the study population aged 12 and 15- 19-years old were similar. In both groups, a higher proportion of women, participants with brown and black skin compared with those with white skin, those whose household income was below R$1,500.00, and those who had visited a dentist for treatment within the last year were observed. With regard to oral health conditions, the most favorable situation was observed in those aged 12, with only 5.0% having lost one or more first permanent molars, in contrast with 15.8% for those aged 15-19. On the other hand, having at least one tooth with dental caries was observed in 41.8% and 50.4% of those aged 12 and 15 to 19 years old, respectively (Table 1).

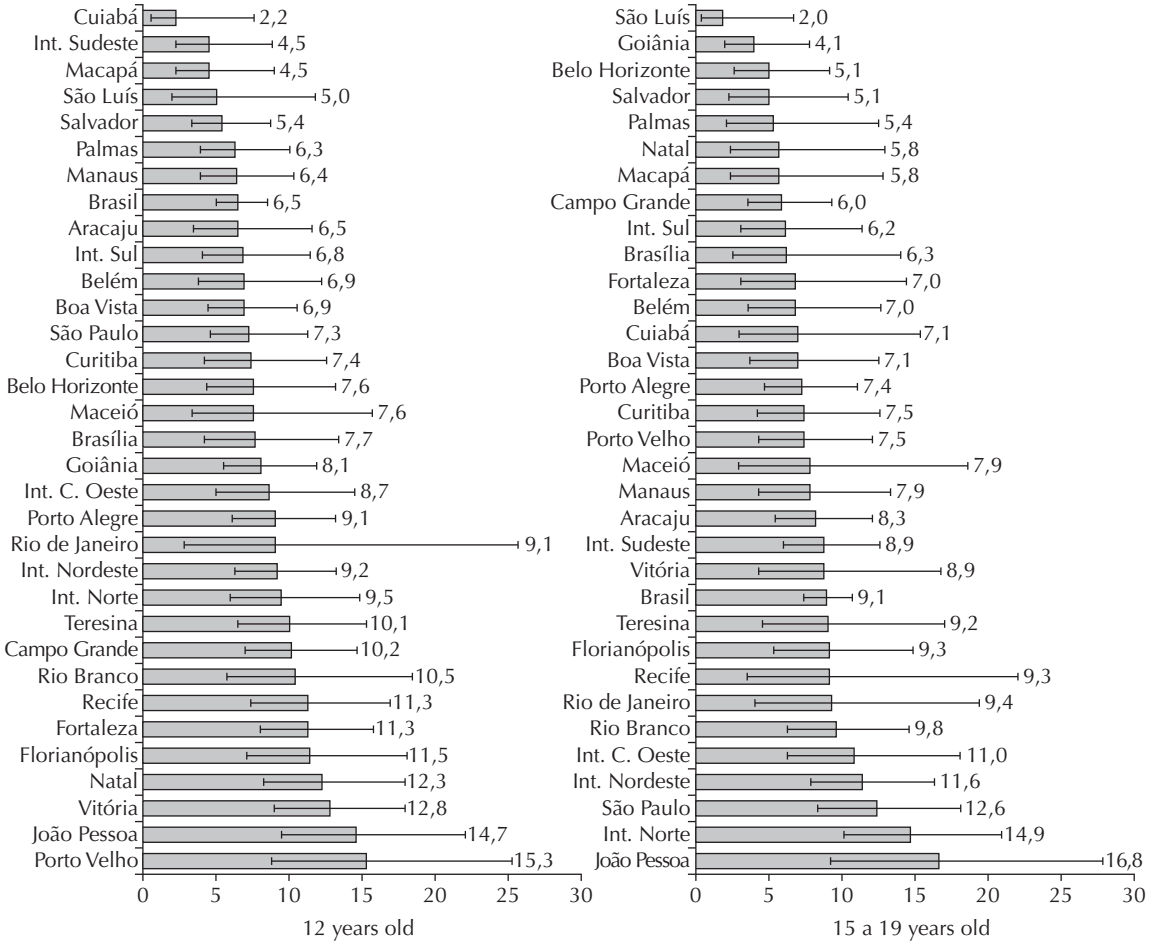
In the 12-year-olds group, significantly higher levels of very severe malocclusion were identified among those with brown or black skin and those who had lost at least one first molar due to dental caries. In the 15- to 19-year-olds, having household income of R$1,500.00 or less, having lost at least one first molar due to dental caries, having one or more untreated dental caries, and having seen a dentist for reasons other than a check-up were factors associated with higher prevalence of very severe malocclusion.

In the unadjusted analysis for the 12-year-olds, individuals with brown or black skin ($p = 0.019$) and having lost one or more first permanent molar ($p = 0.030$) are more likely to present very severe malocclusion than those in the reference categories. Both variables remained in the final model after adjusted analysis, with a small increase (nearly 10%) observed in the magnitude of the association of the variable having lost one or more first molars and the outcome (Table 2).

Regarding the 15- 19 years-old group, having monthly household income up to R$1,500.00 ($p < 0.001$), having lost one or more first permanent molars ($p = 0.006$), and to have the last dental visit for treatment ($p = 0.001$) were associated with the presence of very severe malocclusion in the unadjusted analysis (Table 2). After adjustment, it was verified that an income of R$ 1,500.00 or lower remained associated with the outcome, although the magnitude of that association declined. Having one or more teeth with untreated dental caries lost statistical significance after adjustment for the variables skin color and income, whereas having received dental treatment remained significantly associated with the outcome after adjusting for the variables skin color, income, and having one or more untreated dental caries (Table 2).

DISCUSSION

There was no significant variation in the distribution pattern of very severe malocclusion in Brazilian adolescents according to the state capitals and the interior of the different regions. Moreover, lower levels of income, brown or black skin people, loss of first permanent molar, and the presence of dental treatment were associated with very severe malocclusion after adjusting for potential confounders. Despite being a population-based study and adopting standardized methodology the SBBrasil 2010 is a cross-sectional study which limits the ability to make causal inference.



Source: SBBrasil 2010 database.

Figure 3. Prevalence of very severe malocclusion in individuals of 12 and 15-19 years of age, according to domain (state capitals and interior of the regions). SBBrasil, 2010.

Table 2. Unadjusted and adjusted analysis of the outcome "prevalence of very severe malocclusion" for independent variables according to age group. SBBrasil, 2010

Variável	Unadjusted analysis*			Adjusted analysis[a]		
	OR	95%CI	p	OR	95%CI	p
12 years old						
Brown or black skin	1.59	1.08;2.34	0.019	1.59	1.08;2.34	0.019
Lost one or more molars	2.43	1.09;5.40	0.030	2.66	1.26;5.63	0.010
More than a year since last visit to the dentist	0.71	0.41;1.21	0.204	0.64	0.37;1.10	0.106
15 to 19 years old						
Brown or black skin	1.54	0.98;2.42	0.061	1.54	0.98;2.42	0.061
Possess 6 or fewer goods	1.37	0.95;1.97	0.091	[b]	[b]	[b]
Income below R$ 1,500.00[c]	2.78	1.70;4.54	< 0.001	2.69	1.62;4.47	< 0.001
Lost one or more molars	1.78	1.07;2.97	0.027	[b]	[b]	[b]
One or more teeth with dental caries	1.90	1.20;3.00	0.006	1.49	0.91;2.43	0.112
Visited dentist for treatment or other reason	2.95	1.84;4.73	0.001	2.59	1.55;4.34	0.001

* $p \leq 0.20$

[a] Adjusted for sex

[b] Excluded after entrance in the model, as $p > 0.20$ in the adjusted analysis.

[c] R$ 1.00 = US$ 1.97 (02/08/2013)

The prevalence of very severe malocclusion found in this study was similar to findings from studies carried out in Iran (10.9%)[4] and in Tanzania (6.9%),[19] and to those performed in Brazil, such as the study carried out in the state of São Paulo (8.2% in 12-year-olds and 6.5% in 18-year-olds),[8] in Recife (5.8% in 13- to 15-year-olds),[10] and in Belo Horizonte (13.2% in 10- to 14-year-olds).[11] On the other hand, a study in India (1.8%)[21] identified a lower prevalence, whereas a study in Nigeria found a higher one (17.0% for 12- to 16-year-olds).[1] The difference in the studied age groups and the chance of accessing orthodontic treatment may vary between countries, which limits direct comparisons.[7]

Adolescents aged 12 years old who self-reported brown or black skin had a higher chance of having severe malocclusion than those with white skin. Research on the Brazilian population shows that brown and black skinned individuals, generally, have lower income than those with white skin, even taking other socioeconomic and demographic factors such as schooling, sex, and age into account.[2,22] In this study, the difference observed regarding skin color, may be an important indicator of socioeconomic inequalities because brown and black skinned individuals are still placed at the bottom of the social ladder in Brazil.

The influence of socioeconomic conditions on malocclusions has been addressed by few studies, and so far, the findings are inconclusive. In this study, the chance of adolescents aged 15 to 19 years old with lower levels of family income, having severe malocclusion was almost three times greater compared with those with higher income. Economic conditions seem to play an important role in oral health. Complex interrelations between these factors and other determinants, such as level of schooling; knowledge; certain behaviors; access to basic services and goods, healthy food consumption, access to hygiene products, and health-care services are observed. Some studies have also found an association between socioeconomic characteristics and malocclusion[8,23] and some have not.[3,11]

Adolescents aged 12 years old who had lost a first molar due to dental caries had a nearly three times higher chance of having very severe malocclusion than those who were caries free. Some studies also identified an association between malocclusion and dental caries in the permanent teeth.[4,8,21] Considering the decreasing rates of dental caries in Brazilian children,[8] the loss of first permanent molar may be a marker of social exclusion, characterizing those adolescents living in households with substantially fewer life opportunities.

Young people who reported having had dental treatment showed a 2.5 times higher chance of suffering very severe malocclusion. This association remained significant even after adjusted for skin color and income. Although orthodontic normative needs are relevant at this age, orthodontic care in Brazil is still scarce and only accessible to those from the higher social strata. Consequently, the majority of dental treatment reported in this study may have happened due to general dental treatment. All of these aspects reflect the complex interrelation among socioeconomic and behavioral determinants as well as the access to basic services on malocclusion.

Comparing the prevalence of malocclusion with nation-wide findings from 2003, it can be seen that the magnitude of the problem remains the same, affecting up to one in ten adolescents. This group comprises young people with very severe malocclusion which could lead to psychosocial problems related to appearance and orofacial aesthetics; functional disorders, including muscle pain and temporomandibular, and difficulties with chewing, swallowing and with digestion and pronunciation; moreover this group has greater susceptibility to dental trauma, periodontal disease, and dental caries.[13,15] The estimated population of Brazilian adolescents aged 12 to 19 years old, in 2010, accounts for nearly 2.7 million people, with higher prevalence among those on lower monthly incomes, those with brown and black skin and those who had lost at least one permanent molar.

Consequently, public health policy that provides free of charge specialized services specialists may improve adolescents' quality of life. A significant implication is that, without a public health policy which provides public services with specialists and with suitable working conditions, these young people face difficulties in socializing, with serious consequences for their quality of life and their opportunities.

The provision of specialist services through the Brazilian public health-care system was structured in 2004, with the creation of specialist centers within the National Oral Health Care Policy. However, it was only from the end of 2010 (Brasil, 2010 – Portaria SAS 2010) that orthodontic treatment was included as a *Sistema Único de Saúde* (SUS, Brazilian Health System) procedure.[b] Up until February 2012, the SUS outpatients' information system recorded 8,810 orthodontic appliances, 3,978 of these in the age group between 10 and 14 years old and 2,051 in the age group between 15 and 19 years old.

There is gap in the provision of specialized services along with regional inequalities. The North region has

[b] Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica, Coordenação Geral de Saúde Bucal. Nota Técnica: Portaria 718/SAS. Brasília (DF); 2010 [citado 2010 mai 12]. Disponível em: http://189.28.128.100/dab/docs/geral/nota_portaria718_sas4.pdf

8% of the Brazilian population and corresponds to nearly 2% of the procedures; the Northeast, with 27.8% of the population, had 1,527 procedures (17%) while 53% of all orthodontic procedures were carried out in the Southeast, where 42% of Brazilians live.

From a public health policy perspective, epidemiological data provided by this study may inform policy makers when allocating both distribution and provision of resources and in choosing priorities for orthodontic treatment aiming to achieve the principle of equity in oral health care.

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