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ORIGINAL ARTICLE

Need for orthodontic treatment among Brazilian adolescents: evaluation based on public health

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Abstract

Objective: To identify the prevalence and the severity of malocclusions and to analyze factors associated with the need for orthodontic treatment of Brazilian adolescents.

Methods: This exploratory, cross-sectional study was carried out based on secondary data from the national epidemiological survey on oral health in Brazil (2002-2003). Sociodemographic conditions, self-perception, and the existence and degree of malocclusion, using the Dental Aesthetic Index, were evaluated in 16,833 adolescent Brazilians selected by probabilistic sample by conglomerates. The dependent variable – need orthodontic treatment – was estimated from the severity of malocclusion. The magnitude and direction of the association in bivariate and multivariate analyzes from a Robust Poisson regression was estimated.

Results: The majority of the adolescents needed orthodontic treatment (53.2%). In the multivariate analysis, the prevalence of the need for orthodontic treatment was larger among females, non-whites, those that perceived a need for treatment, and those that perceived their appearance as normal, bad, or very bad. The need for orthodontic treatment was smaller among those that lived in the Northeast and Central West macro-regions compared to those living in Southeast Brazil and it was also smaller among those that perceived their chewing to be normal or their oral health to be bad or very bad.

Conclusions: There was a high prevalence of orthodontic treatment need among adolescents in Brazil and this need was associated with demographic and subjective issues. The high prevalence of orthodontic needs in adolescents is a challenge to the goals of Brazil's universal public health system.
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Necessidade de tratamento ortodôntico em adolescentes brasileiros: avaliação com base na saúde pública

Resumo
Objetivo: Identificar a prevalência e a gravidade das más oclusões e fatores associados com a necessidade de tratamento ortodôntico dos adolescentes brasileiros.
Métodos: Estudo transversal realizado com base nos dados da pesquisa epidemiológica nacional em saúde bucal no Brasil (2002-2003). Condições sociodemográficas, autopercepção, existência e nível de gravidade da má oclusão, usando o Índice de Estética Dentária, foram avaliados em 16.833 adolescentes brasileiros selecionados por amostra probabilística por conglomerados. A variável dependente – necessidade de tratamento ortodôntico – foi estimada a partir da gravidade da má oclusão. A magnitude e a direção das associações na analise bivariada e multivariada foram estimadas pela regressão de Poisson.
Resultados: A maioria dos adolescentes apresentou necessidade de tratamento ortodôntico (53,2%). Na análise multivariada, a prevalência da necessidade de tratamento ortodôntico foi maior entre as mulheres, os não brancos, entre aqueles que autopercebem a necessidade de tratamento e aqueles que autoperceberam sua aparência como normal, ruim ou muito ruim. A necessidade de tratamento ortodôntico foi menor entre aqueles que viviam nas macrorregiões Nordeste e Centro-Oeste em comparação com aqueles da macrorregião Sudeste e também menor entre aqueles que auto-perceberam sua mastigação como normal e sua saúde bucal como ruim ou muito ruim.
Conclusões: O estudo identificou uma prevalência elevada da necessidade de tratamento ortodôntico em adolescentes no Brasil, sendo associada com questões demográficas e subjetivas de saúde bucal. A alta prevalência de necessidades ortodônticas entre adolescentes é um desafio para o sistema público de saúde brasileiro (SUS).
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Introduction

Brazil has great regional and social inequalities. To address such disparities, the New Constitution of Brazil (1988) recognized health as a right of each citizen and the responsibility of the government, and established the ideological basis for the creation of Brazil's universal public health care system, the Unified System of Health (SUS). This has increased access to healthcare for a great part of the Brazilian population.[1] At Brazil's 11th National Health Conference in 2000, the principles of comprehensive care, humanization and equity were restated as goals for the consolidation of SUS. Additionally, the need to strengthen collective actions regarding public health services and to assure governmental compliance with its responsibility to provide universal, comprehensive, and equitable health care to all Brazilians was stressed.[1-3]

Previous studies have evaluated oral health status, indicating the need for implementation of health public policies for improvement of these conditions and universality of health, considering socioeconomic characteristics.[4-6] Malocclusion, the third most prevalent oral pathology has been considered a priority in global public health and has many adverse consequences, such as psychosocial maladjustment, periodontal disease and unfavorable mastication.[7]

Malocclusions are not classified as diseases and are difficult to define, unlike other issues of oral health,[8] highlighting the importance of a clear definition, as well as an improvement in diagnostic criteria for obtaining epidemiological data regarding these issues in order to facilitate the planning of public health prevention and care.[9] Therefore, there was a need to develop an epidemiological instrument to identify and classify malocclusions and recognize the dental and aesthetic need for orthodontic treatment of a given population to compare such needs among populations or longitudinally. In response to this need, Jenny & Cons developed the Dental Aesthetic Index (DAI) in 1986.[10] It quantifies aesthetic factors and clinical presentations, using both subjective and objective measures to produce a single numerical value that reflects all aspects of malocclusion.[7] The DAI is composed of ten variables and results in a numerical value that classifies the individual on a scale of 13 to 80, which can be categorized into cutoff points.[10] DAI

has been proposed by the World Health Organization (WHO) for the evaluation of malocclusions at the age of 12 and in 15-19-year-old adolescents.

Malocclusion has been singled out as an important problem of oral health among adolescents in Brazil, with prevalence rates above 40%.[11,12] At national level, besides the high prevalence, greater severity of malocclusion among teenagers has been associated with the worst socioeconomic conditions and subjective conditions of oral health, based on data from the epidemiological survey of the oral health conditions of the Brazilian population in 2010.[13] In the years 2002 and 2003, upon the recommendation of WHO, the Ministry of Health in Brazil completed an epidemiological study of oral health conditions in Brazil called SB2000, currently renamed Project SB Brazil 2002-2003.[14] Despite more than a decade after the achievement and dissemination of the results of the SB Brazil 2002-2003 and running a new survey in 2010, no studies were identified in the literature that recorded the prevalence of malocclusion and associated factors with the need for orthodontic treatment among Brazilian adolescents, not allowing comparisons and identification of improvements that have occurred over the years. In this context, this study examined the prevalence and severity of malocclusion and factors associated with the need for orthodontic treatment of Brazilian adolescents, using data from Project SB Brazil 2002-2003 and contextualizing those data within the public health movement in Brazil.

Method

This exploratory, cross-sectional study was carried out based on secondary data from the national epidemiological survey on oral health (SB Brazil 2002-2003). This survey, conducted by the Ministry of Health, investigated different oral health conditions of 108,921 Brazilians from different age groups (18-36 months of age, 5, 12, 15-19, 35-44 and 65-74 years old), living in 250 municipalities of urban and rural areas of all five geographical macro-regions of the country.

The participants were examined and interviewed in their homes. Data was collected regarding their socio-economic conditions, their use of dental services, and their self-perception of their oral health. Assessments of conditions and problems of oral health were based on criteria established by the World Health Organization (WHO) in 1997. A probabilistic cluster sample was used. In each macro-region of the country, cities were randomly selected based on their inclusion in five stratum defined by population size (less than 5,000 habitants, 5,001-10,000, 10,001-50,000, 50,001-100,000, and more than 100,000). All state capitals were included prior to the random sorting process, and hence were not included in this process. Following the random selection of cities, neighborhoods and households were also randomly selected. The response rate for the age group of 15-19 year olds was 84.5%, resulting in the inclusion of 16,833 adolescents in the survey.[15] Dentists, who were trained and calibrated (k≥0,61) in accordance with the criteria established by the WHO in 1997, carried out at-home interviews and exams.[14] The present study is based on data

from this sample of adolescents between the ages of 15 and 19 years.

The dependent variable, the need for orthodontic treatment (NOT), was constructed based on the DAI (Table 1) and has four possible outcomes: lack of normality or mild malocclusions/no need for orthodontic treatment (DAI<25), defined malocclusion/elective NOT (DAI=26-30), severe malocclusion/highly desirable NOT (DAI=31-35), and very severe or disabling malocclusion/essential NOT (DAI≥36).[10] In accordance with the possible outcomes of DAI, this numerical score was categorized into two categories for the dependent variable of this study: no NOT (DAI<25) and NOT (DAI>25).[11]

The independent variables tested were socio-demographics (sex, age, self-reported race, place of residence, macro-region) and subjective conditions (self-perceived need for treatment, oral health, appearance, chewing perception, effect of oral health on relationships). The variable sex (male, female) was maintained in its original form from the original data bank, age was re-categorized into two sets (15-16 years old and 17-19 years old), self-declared skin color was re-categorized into white and non-white categories. Location of residence (urban or rural) and macro-region of Brazil (North, Northeast, South, Southeast, Central-West) were maintained in their original form.

Factors associated with the dependent variable were identified. Analyses were conducted using the software *PASW® (Predictive Analytics Software)* version 17.0 for Windows (Statistics for Windows, Version 17.0. SPSS Inc. Chicago, EUA). Significant associations between dependent and independent variables were verified using the chi-square test considering the value for rejection of the null hypothesis to be $p<0.05$ in bivariate analysis. The magnitude and direction of the association in bivariate and multivariate analyses from a Robust Poisson regression were estimated, and a prevalence ratio (PR) with a confidence interval of 95% was

Table 1 Descriptive analysis of Brazilians aged 15-19 years (2002-2003) according to demographic variables.

	n	%
Sex		
Male	7,015	41.7
Female	9,818	58.3
Age		
15-16	8,115	48.2
17-19	8,718	51.8
Self-reported skin color		
White	7,071	42.1
Non-white	9,725	57.9
Place of residence		
Rural	2,244	13.3
Urban	14,569	86.7
Brazilian macro-region		
Southeast	2,981	17.7
North	3,877	23.0
Northeast	3,998	23.8
South	3,841	22.8
Midwest	2,136	12.7

Table 2 Descriptive analysis of Brazilians aged 15-19 years (2002-2003) according to subjective variables.

	n	%
Self-perceived need for treatment		
No	3,811	22.9
Yes	12,810	77.1
Self-perceived oral health status		
Great/good	8,408	53.0
Normal	5,673	35.8
Bad/very bad	1,780	11.2
Self-perception of appearance		
Great/good	9,264	58.4
Normal	4,789	30.2
Bad/very bad	1,815	11.4
Self-perception of chewing		
Great/good	12,293	76.4
Normal	2,706	16.8
Bad/very bad	1,091	6.8
Self-perception of speech		
Great/good	13,630	85.7
Normal	1,734	10.9
Bad/very bad	535	3.4
Self-perception of relationships		
Not affected	11,871	79.3
Affected	3,104	20.7

calculated. Data collection was conducted in accordance with the ethical principles contained in the Resolution of the National Health Advisory Board (CNS), n° 196/95, n° 581/2000 of the Brazilian Ministry of Health.[14]

Results

The majority of the 16,833 adolescents were females between 17 and 19 years old, self-identified as white and living in urban zones (Table 1). Regarding the subjective conditions, most of the adolescents perceived the need for treatment and their oral health as good or excellent (Table 2). There was a greater prevalence of crowding and abnormal molar ratios in the evaluation of components of the DAI. The prevalence of need for orthodontic treatment was 53.2% (Table 3).

In the bivariate analysis, the need of orthodontic treatment was associated with the following variables: sex, skin color, macro-region, and self-reporting of the need for treatment, oral health, chewing, speech, and relationships with others (Table 4).

In the multivariate analysis, the need for orthodontic treatment was higher among females, non-whites, those that perceived a need for dental treatment, and those that perceived their appearance as normal, bad, or very bad. The need for orthodontic treatment was lower among those that lived in the Northeast and Central-West macro-regions compared to those of the Southeast macro-region, and also smaller among those that perceived their

chewing to be normal or their oral health to be bad or very bad (Table 5).

Discussion

This study identified a high prevalence of malocclusion (53.2%), and consequently, a high need for orthodontic treatment. It is widely accepted that adolescents are more vulnerable to socio-demographic and psychosocial factors, and that the lifestyle adopted by them may increase their

Table 3 Descriptive analysis of Brazilians aged 15-19 years (2002-2003) according to *DENTAL AESTHETIC INDEX* variables.

	n	%
Crowding in the anterior segment of the jaw		
None	10,042	59.7
One segment	4,189	24.9
Two segments	2,602	15.4
Misalignment of the anterior upper jaw		
<2 mm	15,262	91.7
≥2 mm	1,384	8.3
Misalignment of the anterior lower jaw		
<2 mm	16,058	96.2
≥2 mm	634	3.8
Maxillary overjet		
<4 mm	13,475	82.5
≥4 mm	2,857	17.5
Mandibular overjet		
<4 mm	16,673	99.8
≥4 mm	33	0.2
Anterior spacing		
None	13,237	78.6
One segment	2,564	15.2
Two segments	1,032	6.1
Medial diastema (gaps)		
0 mm	14,185	85.6
≥1 mm	2,389	14.4
Number of missing teeth in upper jaw		
None	16,002	95.1
One or more	831	4.9
Number of missing teeth in lower jaw		
None	16,343	97.1
One or more	490	2.9
Anterior open bite		
<3 mm	16,137	95.9
≥3 mm	612	3.6
Molar ratios		
Normal	7,918	47.0
Half cusp	5,996	35.6
Full cusp	2,518	15.0
Normative need for orthodontic treatment		
Absent	7,873	46.8
Present	8,960	53.2

Table 4 Bivariate analysis of factors associated with the necessity for orthodontic treatment in 15-19 year old Brazilians, 2002-2003.

	Yes		No			
	n	%	n	%	PR (95%CI)	p
Sex						
Male	3,819	54.4	3,196	45.6	1	
Female	5,141	52.4	4,677	47.6	1.01 (1.00-1.02)	**<0.01**
Age						
15-16	4,338	53.5	3,777	46.5	1	
17-19	4,622	53.0	4,096	47.0	0.99 (0.98-1.00)	0.56
Self-declared skin color						
White	3,690	52.2	3,381	47.8	1	
Non-white	5,254	54.0	4,471	46.0	1.01 (1.00-1.02)	**0.01**
Location of residence						
Rural	1,199	53.4	1,045	46.6	1	
Urban	7,753	53.2	6,816	46.8	1.00 (0.98-1.01)	0.84
Brazilian macro-region						
Southeast	1,616	54.2	1,365	45.8	1	
North	2,083	53.7	1,794	46.3	0.99 (0.98-1.01)	0.69
Northeast	2,134	53.4	1,864	46.6	0.99 (0.97-1.01)	0.49
South	2,068	53.8	1,773	46.2	0.99 (0.98-1.01)	0.76
Midwest	1,059	49.6	1,077	50.4	0.97 (0.95-0.98)	**<0.01**
Self-per2ception of need for treatment						
No	1,862	48.9	1,949	51.1	1	
Yes	6,992	54.6	5,818	45.4	1.03 (1.02-1.05)	**<0.01**
Self-perception of oral health status						
Great/good	4,210	50.1	4,198	49.9	1	
Normal	3,204	56.5	2,469	43.5	1.04 (1.03-1.05)	**<0.01**
Bad/very bad	1,025	57.6	755	42.4	1.05 (1.03-1.06)	**<0.01**
Self-perception of appearance						
Great/good	4,473	48.3	4,791	51.7	1	
Normal	2,791	58.3	1,998	41.7	1.06 (1.05-1.07)	**<0.01**
Bad/very bad	1,184	65.2	631	34.8	1.11 (1.09-1.13)	**<0.01**
Self-perception of chewing						
Great/good	6,445	52.4	5,848	47.6	1	
Normal	1,474	54.5	1,232	45.5	1.01 (1.00-1.02)	**0.05**
Bad/very bad	639	58.6	452	41.4	1.04 (1.02-1.06)	**<0.01**
Self-perception of speech						
Great/good	7,170	52.6	6,460	47.4	1	
Normal	978	56.4	756	43.6	1.02 (1.00-1.04)	**<0.01**
Bad/very bad	318	59.4	217	40.6	1.04 (1.01-1.07)	**<0.01**
Self-perception of relationships						
Not affected	6,177	52.0	5,694	48.0	1	
Affected	1,804	58.1	1,300	41.9	1.04 (1.02-1.05)	**<0.01**

PR (95% CI), prevalence ratio (95% confidence interval).

susceptibility to disease during adolescence and at future points in their life course. Adolescents may be particularly vulnerable because they no longer benefit from the care and attention given to children, and they also do not benefit from the maturity of adulthood.[16] The prevalence of malocclusion that requires treatment varies from country to country.

The prevalence among Brazilian adolescents was somewhat consistent with the prevalence of 53.15% in Mexican schoolchildren (12-18 years) in the city of Puebla,[17] however, it is greater than the high need for orthodontic treatment reported in other countries, such as India (20-43%)[18,19] and Nigeria (40.7%).[20] When compared with the rates identified in some Brazilian cities, the values observed in the

Table 5 Multivariate analysis of factors associated with the necessity for orthodontic treatment in 15-19 year old Brazilians, 2002-2003.

	PR (95%CI)	p value
Sex		
Male	1	
Female	1.01 (1.00-1.02)	0.01
Self-declared skin color		
White	1	
Non-white	1.01 (1.00-1.02)	0.01
Brazilian macro-region		
Southeast	1	
North	0.99 (0.97-1.00)	0.33
Northeast	0.98 (0.96-1.00)	0.05
South	1.01 (0.99-1.02)	0.21
Self-perception of need for treatment		
No	1	
Yes	1.02 (1.01-1.03)	<0.01
Self-perception of oral health status		
Great/good	1	
Normal	1.00 (0.99-1.01)	0.39
Bad/very bad	0.97 (0.95-0.99)	0.03
Self-perception of appearance		
Great/good	1	
Normal	1.06 (1.05-1.08)	<0.01
Bad/very bad	1.12 (1.10-1.14)	<0.01
Self-perception of chewing		
Great/good	1	
Normal	0.98 (0.96-0.99)	0.02
Bad/very bad	0.99 (0.97-1.01)	0.73

PR (95% CI), prevalence ratio (95% confidence interval).

present study were higher than those recorded in the city of Tubarão (SC, Southern Brazil) (45.6%)[12], and lower than the values identified in Belo Horizonte (MG, Southeast Brazil) (62,0%),[11] both studies using the DAI.

The need for orthodontic treatment was associated with adolescents' sex, skin color, Brazilian macro-region, self-perception of the need for treatment, oral health status, appearance and chewing. The findings of this project (Oral Health Brazil – 2002-2003)[15] were used for the launching of the Project Brazil Smiles in 2004. Public oral health centers for dental specialties (CEOs) were opened to the public offering at least oral diagnosis specialists (emphasizing oral cancer), minor oral surgery of hard and soft tissues, endodontics specialists, and treatment for patients with special needs. The offer of free orthodontic treatment in the CEOs began in 2011, following the Regular Meeting of the Tripartite Commission in Brasilia, capital of Brazil.[21]

The organization and access to health services can be stratified in three distinct and interrelated levels: primary care, secondary care, and tertiary (hospital-based) care. In the area of oral health, primary care comprises a set of targeted actions to identify, prevent and solve major problems of the affected population.[1] Secondary care covers more advanced treatments by oral health specialists in clinical and functional rehabilitation.[22] Tertiary care in Brazil's public oral health care programs includes some high-cost procedures, performed primarily by private providers and public university hospitals, and paid for with public funds at prices close to market value.[23] Considering this organization of comprehensive care, orthodontic treatment is within the secondary service network.

Gender differences and cultural factors affect the prevalence of malocclusions. The prevalence of need for orthodontic treatment was higher among female Brazilian adolescents, perhaps due to the smaller jaw size in females that may lead to the lack of an adequate amount of space for the teeth,[24] or perhaps because women generally are more concerned with aesthetics,[25,26] or because they are more prone to seeking preventive care.[27] Socioeconomic, cultural, and behavioral differences between racial groups and macro-regions may also account for some of the inequalities in the need for orthodontic treatment between these groups.[26]

Similarly, a variety of sociocultural and psychological factors may influence self-perception of the need for orthodontic treatment. Adolescents who seek out orthodontic treatment may be concerned about improving their appearance and social acceptance, since people with malocclusion may feel shy, lose employment opportunities, and feel sorry for themselves, due to the compromised appearance of their teeth. Different types of malocclusions may produce changes not only in the aesthetic acceptability of appearance but in functionality and quality of life in terms of chewing, swallowing, breathing, smiling, and speaking, as well as experiences of pain and temporomandibular joint disorders.[27] In this study there was a greater prevalence of the need for treatment among those that perceived their oral health to be bad or very bad and among those who perceived their chewing as normal.

While the oral health strategies developed by SUS have led to positive outcomes for many Brazilians, inequalities based on socio-demographic factors persist.[1] Therefore, the public system has yet to fully meet its goals of providing equitable, universal, and inclusive care to meet the oral health care needs of all Brazilian citizens. To better attend to core principles of the public health system, such as universality, comprehensive care, and equity with regards to oral, and consequently overall health, access to orthodontic treatment within the public health care sector needs to be continually expanded in Brazil.

The estimates of the oral health conditions of the Brazilian population produced by this project have been discussed in the literature, but full data of the research were not published.[28,29] The data used were generated over a decade ago; however, such associations had not been exploited yet by previous studies. Furthermore, given the methodological characteristics, cause-and-effect relationships between associations cannot be established. Despite these limitations, a high prevalence of need for orthodontic treatment among adolescents in Brazil was identified, associated with demographic and subjective issues that define oral health. The high prevalence of orthodontic needs in adolescents is a challenge to the goals of Brazil's universal public health system.

Funding

Conflicts of interest

The authors declare no conflicts of interest.

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