Color/race inequalities in oral health among Brazilian adolescents*

Cor/raça e desigualdades em saúde bucal entre adolescentes brasileiros

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Abstract

This study assessed oral health outcomes (perceived dental treatment need, untreated dental caries, gingival bleeding, periodontal pockets, and pain in teeth and gums), in relation to color/race inequalities among adolescents in each Brazilian region. The database included dental examination and interview of 16,833 15-19-year-old adolescents, surveyed by the Brazilian health authority, from May 2002 to October 2003, in accordance with international diagnostic criteria standardized by the World Health Organization. Prevalence ratios estimated by Poisson regression, and controlled by socioeconomic status and access to fluoridated piped water, assessed oral health differentials among color/race groups and country's regions. Except for periodontal pockets, prevalence figures were higher in the North and Northeast: perceived dental treatment needs, untreated dental caries, gingival bleeding at probing and pain in teeth and gums varied between 80-83%, 75-76%, 38-43%, and 17-18%, respectively, in these regions. Adolescents living in the Southeast – the richest Brazilian region – presented a better general profile of oral health than their counterparts living in the remaining regions; they had a lower prevalence of untreated dental caries (54%) and unfavorable gingival status (29%). However, the Southeast presented color/race inequalities in all oral health outcomes, with a poorer profile systematically affecting browns or blacks, depending on the oral health condition under consideration. These results reinforce the need for expanding the amplitude of health initiatives aimed at adolescent oral health. Socially appropriate health programs should concurrently aim at the reduction of levels of oral disease and its inequalities.

Keywords: Oral health. Dental caries. Adolescent. Race relations. Brazil.

Resumo

O presente estudo avaliou desfechos de saúde bucal (necessidade de tratamento dentário autopercebida, cárie dentária não tratada, sangramento gengival, bolsa periodontal e dor nos dentes e gengivas) com o intuito de identificar desigualdades por cor/raça entre adolescentes em cada uma das macro-regiões brasileiras. O banco de dados incluiu informações sociodemográficas e de exames bucais de 16.833 adolescentes entre 15-19 anos de idade, investigados pelo Ministério de Saúde entre maio de 2002 e outubro de 2003, conforme critérios diagnósticos preconizados pela Organização Mundial da Saúde. Foram utilizadas razões de prevalência, calculadas por regressão de Poisson e ajustadas para variáveis socioeconômicas e acesso a água fluoretada, para estimar desigualdades nos desfechos de saúde bucal entre os grupos de cor/raça e as macro-regiões brasileiras. Exceto para bolsa periodontal, as estimativas de prevalência foram mais altas no Norte e no Nordeste: necessidade de tratamento dentário autopercebida, cárie dentária não tratada, sangramento gengival e dor nos dentes e gengivas variaram entre 80-83%, 75-76%, 38-43% e 17-18%, respectivamente, nestas regiões. Os adolescentes do Sudeste – a macro-região mais rica do país – apresentaram, em geral, melhores condições de saúde bucal, quando comparados com seus pares das demais macro-regiões; os adolescentes do Sudeste apresentaram menores prevalências de cárie dentária não tratada (54%) e de sangramento gengival (29%). Entretanto, o Sudeste demonstrou desigualdades por cor/raça em todos os desfechos investigados, com piores condições afetando sistematicamente pardos ou pretos, a depender da condição de saúde bucal investigada. Estes resultados reforçam a necessidade de expandir as ações dirigidas à saúde bucal dos adolescentes brasileiros. Programas/intervenções em saúde socialmente sensíveis devem visar a redução de níveis de morbidades bucais, bem como de suas desigualdades.

Palavras-chave: Saúde bucal. Cárie dentária. Adolescentes. Relações raciais. Brasil.

Introduction

Brazil is acknowledged as a continental country because of its large territory and heterogeneous geographic and environmental conditions. Socioeconomic status also varies widely across the Brazilian population, both at the inner-city and macro-regional levels. The Southeast is the most densely populated and industrialized region of the country. It comprises the two largest Brazilian cities (São Paulo and Rio de Janeiro), and together with the South comprises the country's richest regions, with the highest rankings in the Gross Domestic Product (GDP). A dynamic economy based on manufacturing, agribusiness and exports mostly benefits the Southeast, the South and the Center-West regions. The North region is mostly occupied by the Amazon rainforest, and presents a low population density. The Northeast is a densely populated region, chronically affected by drought, poverty and underdevelopment; towns in the North and the Northeast regions suffer the poorest overall profile of socioeconomic standings in Brazil[1].

The color/race composition of the Brazilian population, according to a pre-coded five-category item included in the 2000 national census[2], was 54%, 6%, 0.4%, 39% and 0.4% of self-classified whites, blacks, yellows (people of Asian ancestry), browns (or *pardos*, the official term for the admixed population in Brazil) and indigenous, respectively. Interestingly, in spite of the peculiarities and fluidity involved in the color/race characterization in Brazil as highlighted by different authors[3-7], the richest Brazilian regions concentrate whites (84% in the South, 62% in the Southeast), whereas the North and Northeast present, respectively, 69% and 66% of browns and blacks[1].

In terms of "racial relations", absent open racial conflict and cordiality have been reported to be outstanding sociologic features of Brazilian society[8,9], and miscegenation a prominent demographic characteristic, since browns make up the second largest group in the country[1]. Notwithstanding, and restricting our focus to the three major

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color/race groupings in Brazil, there is documented evidence on the poorer status of browns and blacks, in comparison to whites, as regards income, education, labor market, law enforcement and health conditions[10-12].

Importantly, disparities in color/race in Brazil have recently been examined through the aggregation of browns and blacks in a single category, a controversial procedure that has been targeted by criticism from different Brazilian scholars[13]. In public health, some authors argue that this procedure may be part of a more general process of construction of the field of "health of the black population"[14], and, also, that collapsing browns and blacks into one stratum may blur important differences between these two groups.

Color/race inequalities in health have been discussed from different perspectives, ranging from their causes to how to reduce or control them[15]. Although health inequalities among color/race groups may be attributed to genetic characteristics, disparities in the distribution of individual health-behaviors, such as diet, exercise, and tobacco use, as well as the over-representation of some groups in lower socioeconomic strata, emerging paradigms to explain this type of health inequality are the psychosocial stress and the structural-constructivist models[16]. The first model emphasizes the stresses associated with minority group status, the experience of racism and discrimination, while the latter focuses, on the intersection of racially stratified social structures with goals and aspirations constructed within racial and ethnic groups as the causes of differences in morbidity and mortality among color/race groups[16].

As regards oral health, color/race inequalities in the distribution of dental caries and periodontal disease have previously been reported in Brazil[17-20]. These studies documented the poorer dental status of browns and blacks, sometimes classified in a single group. However, color/race inequalities in oral health have not been assessed from a geographic perspective, accounting for differences in color/race composition and living standards among regions of the country.

The assessment of inequalities in oral health is particularly relevant to adolescents. The most prevalent oral health outcomes are cumulative and chronic, as well as a source of avoidable pain, functional and aesthetic limitations, which all impact negatively on day-to-day life and self-esteem[21,22]. The objective of this study was to compare selected oral health outcomes of brown, black and white Brazilian adolescents, and to assess the magnitude of differences among macro-regions of the country.

Methods

Database

From May 2002 to October 2003, the Brazilian health authority performed a nationwide survey of oral health (the Brazilian Oral Health Survey), following international diagnostic criteria set up by the World Health Organization in 1997. The original report of the survey* described detailed information on methods of data collection: its conformity to national and international standards of ethics in research involving human participants; forms; how to perform dental examinations and reproducibility of diagnostic methods.

A total of 16,833 adolescents (15 to 19 years of age) living in 250 towns and five Brazilian macro-regions participated in this study. Data collection comprised dental examinations and interviews, using a questionnaire on socio-demographic characteristics, utilization of dental services and self-rated oral health. Dental exams were performed at the household, using natural light, periodontal probes and plane mouth mirrors.

The assessment of color/race followed criteria set forth by the 2000 Brazilian national census[2]. Adolescents were required

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* Brasil. Projeto SB Brasil 2003. Condições de saúde bucal da população brasileira 2002–2003: resultados principais. Brasília: Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica, Coordenação Nacional de Saúde Bucal, 2004.

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to classify their color/race according to the following pre-coded categories, presented in a circular chart: white, brown, black, yellow and indigenous. Due to their low frequency, indigenous (1%) and yellow (3%) participants were excluded from the current analysis, so that all descriptive and analytical issues focused on the comparison among browns, blacks and whites.

Oral health outcomes

Dummy variables assessed the following oral health outcomes:

- Perceived dental treatment need: adolescents answered a direct question asking whether they considered being in need of any dental treatment.
- Prevalence of untreated dental caries: having at least one permanent tooth diagnosed with caries (World Health Organization, 1997), including filled teeth that also presented further tooth decay.
- Gingival bleeding at probing: assessed by the Community Periodontal Index (equal to 1 in at least one mouth sextant, World Health Organization, 1997).
- Periodontal pockets: assessed by the Community Periodontal Index (equal to 4-5mm – shallow pockets – or ≥ 6 – deep pockets – in at least one mouth sextant, World Health Organization, 1997).
- Pain in teeth and gums: direct question referring to the previous six months and to pain of "moderate" to "severe" degree.

Socio-demographic conditions

In addition to sex, age, and color/race, other socio-demographic conditions were analyzed in this study. Living area refers to the comparison between rural and urban areas. Fluoridated water distinguished towns that added fluoride to their piped water supply for at least 5 subsequent years from those that did not. Family income was the only non-dichotomous variable: no income at all; lower than one Brazilian minimum wage; from one to two minimum wages;

and more than two minimum wages. The Brazilian minimum wage is a national standard for this measurement, which roughly corresponded to US$70 during the period of data collection.

Household crowding – a proxy for socioeconomic status in epidemiologic studies[23] – was assessed by the ratio between the number of dwellers and rooms in the household. The comparative analysis was adjusted by age and household crowding as parametrically assessed; i.e. these variables were not categorized.

School delay was assessed in terms of a less than expected number of years of study for the corresponding age; this variable was incorporated in the overall assessment of the human development index in Brazil[1]. The current study considered delayed in school, adolescents with at least one year of delay in relation to the expected number of years of study for their corresponding age (11 years of study for adolescents aged 18 and 19 years; 10 years of study for 17-year-olds; 9 for 16 and 8 for those aged 15). Adolescents with school delay included those that, for any reason, interrupted formal school attendance before concluding high school.

Data analysis

The distribution of adolescents by socio-demographic characteristics and oral health outcomes was described for each Brazilian macro-region. The comparative analysis considered the Southeast region – the richest in the country – as reference. The assessment of oral health outcomes among regions used the prevalence ratio, 95% confidence intervals and p-values, as estimated by multivariable Poisson regression models[24] and adjusted by sex, age, color/race, housing area, fluoridated piped water, school delay, household crowding and family income.

The comparison of oral health outcomes among browns, blacks and whites in each region used the same analytical strategy, with adjustment for: (1) age only; and (2)

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sex, age, living area, fluoridated piped water, school delay, household crowding and family income. This assessment considered whites as the reference category and browns and blacks as comparison groups.

In the regression analyses, the maximum number of participants corresponded to those with non-missing values in all variables included in the models. The variable with the highest percentage of missing observations was school delay (2%). Statistical analysis was performed with Stata, version 9 for Windows. The selection of participants in the Brazilian Oral Health Survey followed a multistage, probabilistic sampling design, but the sampling process was never concluded, so that sampling weights and the sample's structural variables (selection strata and primary sampling units) could not be correctly defined[25]. However, since the main objective of the present study is to evaluate the relationship between exposures (e.g.: color/race) and outcomes (e.g.: perceived dental treatment need) and not to produce precise prevalence estimates for the country as a whole, absence of sampling weights and structural variables in the analyses are not of major concern.

The study protocol was approved by the Brazilian National Human Research Ethics Council, document number 581/2000, on 21 July 2000. All participants or their guardians, in case of individuals under the age of 18, provided written informed consents.

Results

The proportion of self-classified brown and black adolescents was higher in the North and Northeast regions; these regions also presented a worse profile of socioeconomic status; i.e. higher proportion of adolescents with school delay, household crowding and family income lower than two Brazilian minimum wages (Table 1). The proportion of adolescents living in towns without fluoridated piped water was expressively higher in the North and Northeast regions.

Perceived dental treatment need, untreated dental caries, and gingival bleeding were the most prevalent oral health outcomes nationwide; periodontal pocket was the least prevalent. Having had at least one episode of moderate to severe pain in teeth or gums during the previous six months affected from 14% to 18% of adolescents in each region. All oral health outcomes were unequally distributed among Brazilian regions; in general, the North and Northeast regions presented a poorer oral health profile than the remaining ones (Table 1).

The Southeast region presented a better overall profile of oral health than the North and, especially, the Northeast. The inter-region comparisons indicated a significant difference between the Southeast and the Northeast for perceived dental treatment need, untreated dental caries and gingival bleeding (Table 2); the difference of higher magnitude was observed for gingival bleeding at probing. Untreated dental caries was the only oral health outcome ranking significantly higher (p<0.05) for the South and Center-West regions than for the Southeast. For the remaining oral health outcomes, no statistically significant differences were observed.

The majority of oral health outcomes were unequally distributed according to color/race in each Brazilian region (Table 3). Overall, a color/race gradient in the prevalence of these outcomes was observed: the darker the participants' color, the higher the prevalence of unfavorable oral health conditions. Importantly, there were exceptions to this oral health gradient with, for instance, blacks in the Northeast scoring lower than browns and whites with regard to periodontal pockets. Another exception was that blacks showed prevalence estimates half the way between that of browns and whites, such as in the cases of perceived dental treatment need in the South, untreated dental caries in the Southeast, and pain in teeth and gums in the Northeast. For some oral health outcomes, though, the prevalence in blacks was equal to that of whites (e.g.: perceived dental treatment need in the Center-West and untreated dental caries in the Northeast, see Table 3).

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Table 1 - Socio-demographic characteristics and oral health outcomes: prevalence in the sample according to each Brazilian region. 15-19-year-old adolescents (N = 16,126), Brazil, 2002-2003.
Tabela 1 – Características sociodemográficas e desfechos de saúde bucal: prevalência na amostra segundo cada região brasileira. Adolescentes de 15-19 anos (N = 16.126), Brasil, 2002-2003.

Socio-demographic characteristics	Brazilian macro-regions (%)					
	North	**Northeast**	**Southeast**	**South**	**Center-West**	**Brazil**
Female sex	59.2	60.6	57.5	55.4	58.0	58.2
Color/race						
Brown	65.8	64.9	33.0	13.8	47.6	45.7
Black	11.4	9.1	18.6	5.0	9.8	10.5
Living in the rural area	7.8	19.0	16.3	13.5	9.0	13.5
Absent fluoridated water	93.7	83.8	44.8	14.8	48.7	59.1
Adolescents with "school delay"	70.9	65.8	48.9	42.6	50.6	56.8
Average "household crowding"	1.3	1.0	0.9	0.8	0.9	1.0
Family income (minimum wages – MW*)						
None	4.9	6.5	9.7	4.8	8.5	6.4
< 1 Brazilian MW	35.7	45.7	20.7	11.9	18.9	28.0
1 ≤ 2 Brazilian MW	30.9	23.7	25.7	23.3	22.5	25.4
> 2 Brazilian MW	27.5	20.2	44.0	59.5	45.8	38.2
Oral health outcomes	**North**	**Northeast**	**Southeast**	**South**	**Center-West**	**Brazil**
Perceived dental treatment need	83.0	80.1	74.5	68.9	70.7	76.1
Untreated dental caries	75.8	74.7	53.8	56.5	64.1	65.8
Gingival bleeding at probing	37.8	43.0	28.9	32.7	25.7	34.8
Periodontal pockets	2.1	1.0	1.6	0.9	0.9	1.3
Pain in teeth and gums	16.9	18.4	15.8	13.5	17.3	16.4

* One Brazilian minimum wage corresponded to US$70 during the period of data collection.
* Um salário mínimo brasileiro correspondia a 70 dólares americanos durante o período de coleta de dados.

Table 2 - Prevalence ratios of oral health outcomes among Brazilian regions (taking the Southeast as the reference category). 15-19-year-old adolescents (N = 16,126), Brazil, 2002-2003.
Tabela 2 – Razões de prevalência para desfechos de saúde bucal entre as regiões brasileiras (tomando o Sudeste como a categoria de referência). Adolescentes de 15-19 anos (N = 16.126), Brasil, 2002-2003.

Outcomes of oral health	North		Northeast		Southeast	South		Center-West	
	PR	**95 CI**	**PR**	**95 CI**	reference	**PR**	**95 CI**	**PR**	**95 CI**
Perceived dental treatment need	1.02	0.93-1.11	**1.13**	**1.03-1.11**	1.00	0.97	0.89-1.05	1.00	0.89-1.13
Untreated dental caries	**1.19**	**1.09-1.30**	**1.21**	**1.10-1.33**	1.00	**1.15**	**1.05-1.27**	**1.18**	**1.07-1.30**
Gingival bleeding at probing	1.21	0.98-1.49	**1.41**	**1.12-1.78**	1.00	1.21	0.93-1.57	0.90	0.70-1.17
Periodontal pockets	1.14	0.46-2.80	0.50	0.21-1.18	1.00	0.67	0.33-1.37	0.60	0.29-1.21
Pain in the teeth and gums	0.88	0.69-1.14	1.01	0.82-1.25	1.00	0.88	0.69-1.11	1.09	0.85-1.39

PR = prevalence ratio assessed by Poisson regression analysis and adjusted by age, color/race, living area, fluoridated piped water, school delay, household crowding and family income. *PR = razão de prevalência avaliada pela análise de regressão de Poisson e ajustada por idade, cor/raça, água encanada fluoretada, atraso escolar, aglomeração domiciliar e renda familiar.*
95 CI = 95% confidence interval. *Intervalo de confiança de 95%.*
Bold types in the table highlight statistically significant associations (p < 0.05). *Os números em negrito na tabela indicam associações estatisticamente significantes (p < 0,05).*

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Table 3 - Prevalence estimates and prevalence ratios of oral health outcomes according to color/race and Brazilian regions. 15-19-year-olds (N = 16,126), Brazil, 2002-2003.
Tabela 3 – Prevalência e razões de prevalência para desfechos de saúde bucal segundo cor/raça e as regiões brasileiras. Adolescentes de 15-19 anos (N = 16.126), Brasil, 2002-2003.

Oral health outcomes	North			Northeast			Southeast			South			Center-West		
	Prevalence	PR	95 CI	Prevalence	PR	95 CI	Prevalence	PR	95 CI	Prevalence	PR	95 CI	Prevalence	PR	95 CI
Perceived dental treatment need															
Whites	82.2	1.00		79.7	1.00		70.5	1.00		67.4	1.00		67.2	1.00	
Browns	83.1	1.03	0.98-1.08	80.0	1.10	0.98-1.23	78.4	**1.11**	**1.03-1.19**	77.2	**1.13**	**1.01-1.26**	74.5	1.20	0.98-1.49
Blacks	84.1	1.05	0.97-1.14	81.3	1.05	0.87-1.26	78.0	1.11	0.98-1.25	70.2	1.02	0.91-1.15	67.2	1.26	0.96-1.66
Untreated dental caries															
Whites	70.4	1.00		71.9	1.00		49.4	1.00		54.8	1.00		57.2	1.00	
Browns	77.5	**1.10**	**1.03-1.18**	76.4	1.06	0.99-1.14	60.7	**1.23**	**1.10-1.36**	63.8	**1.16**	**1.03-1.31**	69.1	**1.21**	**1.07-1.37**
Blacks	76.8	1.09	0.97-1.23	71.4	0.99	0.89-1.11	53.2	1.08	0.91-1.28	64.6	**1.18**	**1.01-1.38**	70.2	**1.23**	**1.07-1.37**
Gingival bleeding at probing															
Whites	37.5	1.00		38.6	1.00		23.5	1.00		32.2	1.00		25.0	1.00	
Browns	36.8	0.98	0.84-1.15	43.7	1.13	0.96-1.33	33.2	**1.41**	**1.16-1.73**	35.4	1.10	0.74-1.64	25.5	1.02	0.82-1.28
Blacks	43.6	1.16	0.98-1.37	50.4	**1.31**	**1.01-1.69**	35.7	**1.52**	**1.08-2.16**	33.7	1.05	0.74-1.49	29.8	1.20	0.85-1.68
Periodontal pockets															
Whites	1.2	1.00		1.5	1.00		0.9	1.00		0.6	1.00		0.8	1.00	
Browns	2.4	2.07	0.97-4.38	0.8	0.57	0.24-1.35	1.3	1.46	0.58-3.70	1.8	2.91	0.89-9.54	1.1	1.47	0.54-4.06
Blacks	2.4	2.04	0.69-6.04	0.6	0.38	0.14-1.04	4.3	**5.03**	**2.68-9.42**	1.7	2.60	0.68-9.95	0.5	0.65	0.08-4.94
Pain in the teeth and gums															
Whites	15.4	1.00		15.3	1.00		13.2	1.00		13.2	1.00		14.4	1.00	
Browns	17.4	1.20	0.96-1.52	19.8	**1.42**	**1.08-1.87**	17.6	1.32	0.94-1.86	15.2	1.11	0.79-1.56	19.7	1.45	0.97-2.15
Blacks	17.3	1.27	0.91-1.78	17.8	1.25	0.79-1.98	19.4	**1.48**	**1.06-2.07**	13.3	0.96	0.63-1.47	18.7	**1.69**	**1.16-2.49**

PR = prevalence ratio assessed by Poisson regression analysis and adjusted by age. *PR = razão de prevalência avaliada pela análise de regressão de Poisson e ajustada por idade.*
95 CI = 95% confidence interval. *Intervalo de confiança de 95%*
Bold types in the table highlight statistically significant associations (p < 0.05). *Os números em negrito na tabela indicam associações estatisticamente significantes (p < 0,05).*

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Table 4 - Prevalence ratios of oral health outcomes among color/race groups (self-classified whites as the reference group) in each Brazilian region. 15-19-year-old adolescents (N = 16,126), Brazil, 2002-2003.

Tabela 4 – Razões de prevalência para desfechos de saúde bucal entre grupos de cor/raça (autoclassificados como brancos como o grupo de referência) em cada região brasileira. Adolescentes de 15-19 anos (N = 16.126), Brasil, 2002-2003.

Oral health outcomes	North		Northeast		Southeast		South		Center-West	
	PR	**95 CI**	**PR**	**95 CI**	**PR**	**95 CI**	**PR**	**95 CI**	**PR**	**95 CI**
Perceived dental treatment need										
Browns	1.02	0.98-1.07	1.01	0.94-1.09	**1.08**	**1.01-1.16**	**1.10**	**1.01-1.20**	1.10	1.00-1.20
Blacks	1.04	0.98-1.10	1.00	0.86-1.18	1.05	0.94-1.17	1.03	0.92-1.14	1.06	0.95-1.21
Untreated dental caries										
Browns	**1.08**	**1.00-1.15**	1.05	0.99-1.11	**1.17**	**1.06-1.30**	1.09	0.97-1.21	**1.15**	**1.03-1.28**
Blacks	1.05	0.94-1.16	1.01	0.94-1.08	0.97	0.83-1.14	1.12	0.97-1.30	**1.18**	**1.04-1.34**
Gingival bleeding at probing										
Browns	0.96	0.83-1.12	1.11	0.94-1.30	**1.30**	**1.09-1.55**	1.08	0.73-1.57	1.03	0.83-1.29
Blacks	1.10	0.93-1.30	1.25	0.99-1.58	1.32	0.95-1.82	1.03	0.74-1.44	1.18	0.86-1.63
Periodontal pockets										
Browns	1.95	0.89-4.29	0.53	0.22-1.28	1.22	0.50-2.94	2.76	0.72-10.59	1.50	0.58-3.86
Blacks	1.97	0.63-6.20	**0.31**	**0.15-0.67**	**3.13**	**1.68-5.82**	2.65	0.82-8.61	0.54	0.07-4.33
Pain in the teeth and gums										
Browns	1.16	0.94-1.43	1.08	0.96-1.21	1.24	0.95-1.65	1.02	0.76-1.36	1.13	0.97-1.32
Blacks	1.21	0.90-1.63	1.10	0.93-1.31	**1.34**	**1.01-1.76**	0.88	0.58-1.35	1.10	0.91-1.33

PR = prevalence ratio assessed by Poisson regression analysis and adjusted by age, living area, fluoridated piped water, school delay, household crowding and family income/*PR = razão de prevalência avaliada por análise de regressão de Poisson e ajustada por idade, area de moradia, água encanada fluoretada, atraso na escola, aglomeração domiciliar e renda familiar.*
95 CI = 95% confidence interval/ *Intervalo de confiança de 95%.*
Bold types in the table highlight statistically significant associations (p < 0.05)/ *Os números em negrito na tabela indicam associações estatisticamente significantes (p < 0,05).*

Despite the fact that the Southeast region had a better overall profile of oral health, it was the single region presenting color/race inequalities in all oral health outcomes (Tables 3 and 4). In the Southeast region, black adolescents had a prevalence of periodontal pockets five times higher, as well as 48% more pain in teeth and gums, in comparison with whites (Table 3). When controlled by socio-demographic variables and access to fluoridated water, these differences were slightly reduced, but remained statistically significant (Table 4). Blacks from the Northeast were almost 60% less affected by periodontal pockets than whites (Table 3); further adjustment by socio-demographic factors and access to fluoridated water did not expressively affect the magnitude of this difference (Table 4). With regard to brown adolescents in the Southeast, these presented a 30%, 17% and 8% higher prevalence of gingival bleeding, untreated dental caries and perceived dental treatment need, respectively, when compared to whites, net of socio-demographics and access to fluoridated water (Table 4). Untreated dental caries was also more prevalent in browns in the North and Center-West regions even after full adjustment for covariates. In the last-mentioned region, the prevalence of untreated dental caries was also higher in blacks, when compared to whites (Tables 3 and 4). Compared to whites, browns from the South showed a 10% higher prevalence of perceived dental treatment need.

Discussion

This study documented and assessed the magnitude of inequalities in adoles-

cents' oral health outcomes among Brazilian geographic regions, and among color/race groups in each geographic region. The most relevant result is the identification of the Southeast – the richest Brazilian region – as concurrently presenting an improved overall profile of oral health in the country and color/race inequalities in all oral health outcomes under consideration.

It is important to mention, though, that the magnitudes of the majority of color/race inequalities, specifically for perceived dental treatment need, untreated dental caries, gingival bleeding and pain in teeth and gums, was low and involved brown-white comparisons more frequently. Browns perceived the need for dental treatment more, were more affected by untreated dental caries, and showed a higher prevalence of gingival bleeding. In these cases, in spite of having effects of similar magnitude also reported for blacks, statistical significance was mostly observed for browns due, probably, to the higher sample size of browns in all Brazilian regions.

The poorer oral health status of brown and black adolescents had already been reported in Brazil, as regards a higher prevalence of decayed teeth[26]. The prevalence of untreated dental caries and gingival bleeding was previously documented as higher for brown and black schoolchildren, also categorized in only one group countrywide, than for their white counterparts[18,19]. With regard to pain in teeth and gums, a similar finding was observed in adults from a Southern Brazilian city: blacks living in Pelotas showed a 30% higher toothache prevalence than whites, while the prevalence in browns was not statistically different from that of whites[27].

The color/race inequality of highest magnitude was observed for periodontal pockets and was statistically higher for blacks living in the Southeast and lower for blacks in the Northeast, when compared to whites. The latter represents an unexpected finding. Although not statistically significant, browns and blacks in the North and South were equally more affected by periodontal pockets than whites. Peres et al.[20] reported a higher prevalence of periodontal disease in brown and black than in white adults, and stated that the odds of blacks was slightly higher, after adjustment for schooling level, income, sex, age and geographic region. Therefore, the current study confirms and reinforces previous observations on color/race inequalities for several oral health outcomes in the Brazilian context.

This study also reported that the North and Northeast regions had the poorest indices of oral health, which is not surprising, since these regions present the poorest profile of socioeconomic status in the country, and the association between deprivation and oral health has been extensively evidenced for several Brazilian contexts. Therefore, the identification of poorer oral health in deprived regions is consistent with studies showing socioeconomic inequalities in the prevalence of dental caries in adolescents living in different Brazilian contexts for the country as a whole[18]; for the states of São Paulo[21]; Bahia[28]; Santa Catarina[29,30]; Rio Grande do Sul[31]; and Paraná[32], in particular.

Following a major strand of research in racial inequalities in health, the present study assessed oral health differentials among color/race categories, adjusting for possible confounders in the context of multivariable modeling. Such a methodological approach has strengths and weaknesses, which all deserve to be mentioned and appreciated more carefully.

First, it is clear that this strategy can provide important evidence on societal patterns of distribution of health and disease. As long as color/race is recognized as an important dimension to study variability in oral health-related outcomes, detection of racial inequalities in oral health may be used to assess ongoing public policies, actions and/or to inform new oral health interventions. Indeed, this is a polarized topic of discussion in Brazil, since the need to promote race-based policies and interventions to tackle social inequalities in health is fulfilled with controversies among scholars,

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politicians and the lay public in general[14,33].

The strength of this methodological approach also lies in identifying the whole spectrum of possible confounders to adjust for in multivariable analyses assessing the relationship between the race variable and a selected oral health outcome. For example, the fluoridation of water supplies is acknowledged as an effective measure for the prevention of dental caries[34]. However, its unequal implementation in the country was reported as a source of inequality in the experience of dental disease[35]. Thus, besides including socio-demographic variables, regression models in this study also considered the adjustment for the availability of fluoridated piped water in each town. Therefore, the analytical scheme adopted in this study attempted to minimize the possibility of residual confounding[36] due to the omission of an important variable in the model[37] as a possible explanation for the persistence of color/race inequalities in oral health.

However important color/race may be for the abovementioned purposes, the complexity involved in racial classification in Brazil must also be highlighted. Many scholars have commented in detail on the difficulties of using the race variable in epidemiologic studies[38-40], with some recent quantitative investigations exploring Brazilian specificities of racial classification[6,7,41,42]. In essence, these authors raise concerns about the validity and reliability of the race variable, and recommend that it should be used very cautiously in health-related publications.

Color/race may have different meanings in Brazil, on account of its large territory and historical processes of immigration and occupation. Browns in the North, for example, are of predominantly indigenous ancestry when compared to those equally categorized in the remaining regions. Regional specificity may undermine the process of generalization of results, as well as contribute to unexpected findings, such as the one involving a lower prevalence of periodontal pockets in blacks from the Northeast. This finding deserves to be investigated more deeply, and peculiarities of the racial classification system and racial relations that may be at play in the Northeast should be taken into account.

A final and important limitation of the present analysis is that persistence of color/race inequalities after adjustment for confounding does not provide a single or most probable interpretation with respect to their underlying causes. As already mentioned, these inequalities may be attributed to residual confounding, but also to consequences of unmeasured aspects of racial discrimination (e.g.: chronic psychological stress) or unmeasured factors that are associated with both color/race and the specified outcome but not related to either discrimination or socioeconomic position, such as culturally shaped patterns of health related behaviors[36].

Some authors have proposed that discriminatory processes based on racial categorization may contribute to color/race inequalities in periodontal disease prevalence. Since this oral health outcome may be etiologically influenced by stress, and acknowledging that racial discrimination is commonly recognized as a stressful experience[36], Peres et al.[20] used color/race as a proxy for racial discrimination to assess the association between this variable and periodontal disease in Brazil. However, these authors also recognized that, due to the nature of the data at hand, they could not provide further evidence supporting the hypothesis of an association between race-based discrimination and periodontal disease. This is exactly the same case for the present study.

In conclusion, the inequality of oral health among browns, blacks and whites was predominantly low and systematically more frequent in the Southeast, the richest Brazilian region. Furthermore, the Brazilian Dental Council (www.cfo.org.br) acknowledges that 59% of dental practitioners in the country and 50% of dental schools are located in the Southeast region. In spite of being the region with the highest rankings by GDP

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and a higher provision of dental services, the Southeast region did not extend these benefits to brown and black adolescents to the same extent than for whites. In spite of being of low magnitude, this inequality may be considered avoidable and unjust.

The prevalence of unfavorable conditions of all oral health outcomes assessed in this study is amenable to reduction by educational programs, prevention and dental treatment. Supervised tooth brushing, dental plaque identification, expansion of access to fluoridated piped water and restorative dental treatments, among other initiatives of oral health promotion may reduce the burden of dental disease, prevent avoidable pain, and improve the quality of life of adolescents. These initiatives must be programmed with an effective universal scope in order to prevent the exclusion of extended population segments or target specific population groups that demand additional resources, when persistent and expressive inequalities have been identified.

Socially appropriate health programs should aim at addressing the overall improvement of health indices and the concurrent reduction of inequalities in the distribution of negative outcomes. Suppressing color/race inequalities in health is a socially relevant goal for health services. It should also be considered an important strategy for the promotion of social justice.

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