Rev Saúde Pública 2013;47(Supl 3):1-9

Original Articles

DOI:10.1590/S0034-8910.2013047004288

Sérgio do Nascimento[I]

Paulo Frazão[II]

Aylene Bousquat[I]

José Leopoldo Ferreira Antunes[III]

Dental health in Brazilian adults between 1986 and 2010

ABSTRACT

OBJECTIVE: To identify trends in the pattern of dental caries in Brazilian adults.

METHODS: Data from epidemiological surveys carried out by the Brazilian Ministry of Health in 1986, 2003 and 2010 were used. Dental caries experience, using the DMFT index (decayed, missing and filled teeth) and dental health, expressed by the FS-T index (filled and sound teeth) related to functional teeth, were compared using random samples of 35 to 44 year old residents of each region of Brazil. The differences in dental health between the years were estimated using the ratio of the index values, by Poisson regression analysis adjusted for age.

RESULTS: Reduction in the DMFT index and increase in the FS-T index in all regions in the period between 1986 and 2010. The North, where the worst standards were found in 1986, showed the greatest improvements in terms of functional teeth.

CONCLUSIONS: The dental health of Brazilian adults changed for the better. It is plausible that this oral health transition is related to the addition of fluoride to water and to toothpaste as well as increased incorporation of restorative services and improvements in human development due to public policies.

DESCRIPTORS: Adult. Dental Caries, epidemiology. Public Health Dentistry. Dental Health Surveys. Oral Health.

[I] Universidade Católica de Santos. Santos, SP, Brasil

[II] Departamento de Prática de Saúde Pública. Faculdade de Saúde Pública. Universidade de São Paulo. São Paulo, SP, Brasil

[III] Departamento de Epidemiologia. Faculdade de Saúde Pública. Universidade de São Paulo. São Paulo, SP, Brasil

Correspondence:
Paulo Frazão
Departamento de Prática de Saúde Pública
Faculdade de Saúde Pública da Universidade de São Paulo
Av. Dr. Arnaldo 715 - Cerqueira Cesar
01246-904 São Paulo, SP, Brasil
E-mail: pafrazao@usp.br

Received: 04/03/2012
Approved: 07/23/2012

Article available from: www.scielo.br/rsp

INTRODUCTION

Dental caries is a chronic disease which compromises dental structure. Despite its declining in children and adolescents, it remains the main oral health problem in the majority of industrialized countries and is a significant cause of toothache and tooth loss.[20] The problem can lead to absenteeism at work and school and may affect the individual's performance and emotional stability. Investigation into whether improved oral health in children and adolescents extends to the adult population is relevant.[5-7,21,23] The state of oral health among those aged 35 to 44 reflects the accumulated impact of treatment and prevention policies.[5,21]

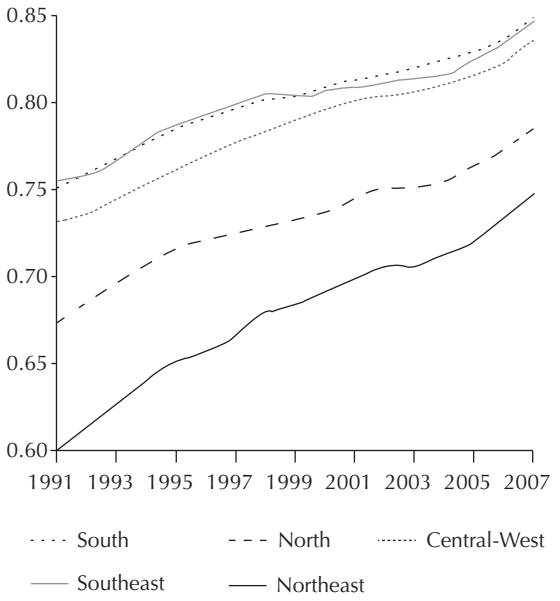
Although dental caries has declined in children in Brazil,[16] the trend in adults is not known. Three national surveys collected data form the 35 to 44 year old age group, but the estimates produced have not yet been compared. This comparison may suggest trends which allow links between rates of occurrence of this disease over time and more general aspects, connected to industrialization, human development and national oral health policies to be explored.[11]

With the objective of providing information useful in formulating oral health policies, the aim of this study was to identify trends in patterns of dental caries in Brazilian adults, comparing oral health conditions in the years 1986, 2003 and 2010.

METHODS

Data on oral health conditions from three cross-sectional nationwide studies, planned and financed by the the Barazilian Ministry of Health, were analyzed. Adults aged 35 to 44, resident in the regions of Brazil in the years 1986, 2003 and 2010, were compared.

The Brazilian population, more than 190 million in 2010, has been primarily urban since 1970.[a] The 26 states and the Federal District are divided into five regions: the North, the Northeast, the Central-West, the Southeast and the South. The majority of the urban population live in the Southeast, Northeast and South; the Central-West region is the least populous. The differences and inequalities between areas in Brazil are enormous, reflecting the different processes of socio-spatial formation in the country.[19] The Brazilian economy has grown rapidly in recent years and Brazilian social indicators have also improved; however, regional inequalities are still significant. In 2010 the Human Development Index (HDI) value was 0.699, placing the country 73rd in a list of 169 countries, a position quite different from its economic ranking.[b] The contrasts in human development in Brazil are highlighted in the changes in the HDI in each region between 1991 and 2007 (Figure 1).[c]



Source: Boletim Regional do Banco Central do Brasil. Brasília (DF): Banco Central; 2009; 3(1). [cited 2009 nov 12]. Available: http://www.bcb.gov.br/pec/boletimregional/port/2009/01/br200901P.pdf

Figure 1. Evolution of the Human Development Index by region of Brazil, in the period 1991-2007.

The Epidemiological Oral health Survey in 1986 was the first with national coverage. The Federal District and 15 state capitals participated in the study. In the first stage, urban census tracts were randomly selected, and in the second 16 residences were selected, and adults aged 35-44 living there were identified.[d]

The 2003 survey – SBBrasil Project: Oral health status of the population – included those resident in rural and urban areas, had a wider age range and included more health problems. Probabilistic 3-stage cluster sampling was used, allowing inferences to be made for each region of Brazil according to size of the municipality, and for each age group.[e] There were 250 municipalities which

[a] Fundação Instituto Brasileiro de Geografia e Estatística. Brasil em números. Rio de Janeiro: Centro de Documentação e Disseminação de Informações; 2010. v.18.
[b] Programa das Nações Unidas para o Desenvolvimento. Relatório do Desenvolvimento Humano 2010. Brasília (DF); 2010 [cited 2011 Mar 31]. Available from: http://www.pnud.org.br
[c] Boletim Regional do Banco Central do Brasil. Brasília (DF): Banco Central; 2009; 3(1). [cited 2009 Nov 12]. Available from: http://www.bcb.gov.br/pec/boletimregional/port/2009/01/br200901P.pdf
[d] Ministério da Saúde (BR), Secretaria Nacional de Programas Especiais de Saúde, Divisão Nacional de Saúde Bucal, Fundação Serviços de Saúde Pública. Levantamento epidemiológico em saúde bucal: Brasil, zona urbana, 1986 [CD-ROM]. Brasília (DF); 1988.
[e] Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica, Coordenação Nacional de Saúde Bucal. Projeto SB Brasil 2003: condições de saúde bucal da população brasileira 2002–2003: resultados principais. Brasília (DF); 2004. (Série C. Projetos, Programas e Relatórios).

took part, 50 per region, spread over five strata: up to 5 thousand inhabitants; between 5 and 10 thousand; from 10,001 to 50 thousand; from 50,001 to 100 thousand; over 100 thousand inhabitants.

The 2010 survey – Brazilian Oral Health Survey (SBBrasil 2010) – was carried out in the Federal District, in the 26 state capital and in the interior of each of the five regions of Brazil, totaling 32 domains.[f]

In all of the surveys, the adults were examined by trained examiners, within their own homes. With regards the criteria for diagnosis, in the 1986 survey, a permanent tooth was deemed to have caries when there was clinical evidence of damaged enamel, with a cavity defined by discoloration or opacity around the margins into which a dental probe could be inserted. Any missing teeth were deemed to have been extracted due to decay.[d] In the 2003 and 2010 studies, the criteria used were those recommended by the World Health Organization.[25]

Several procedures were necessary in order to be able to compare the data. The outcomes analyzed were decayed, missing and filled teeth, which summed together produced the DMFT index (the sum of decayed, missing and filled permanent teeth), which quantifies the experience of dental caries. The combination of filled and sound teeth (FS-T) index is used to assess dental health conditions given the number of presumed functional teeth present in the mouth.[14]

In the 1986 survey, teeth with dental caries were obtained by adding decayed teeth to those whose extraction was recommended and, in 2003 and 2010, teeth with dental caries were the result of adding decayed teeth to teeth filled with decay. Teeth lost due to caries and those extracted for other reasons were considered missing teeth. A limit of 28 was set for the number of erupted teeth, with observations regarding third molars, not considered to be functional teeth, excluded from the index value, according to studies which adopted similar procedures.[4,21]

In 1986, individuals in each state capital were examined, whereas in the 2003 and 2010 studies individuals resident in cities of different population sizes were examined. In order to compare the estimates for each region and to obtain a sample size sufficiently large for the statistical procedures, only data referring to the state capitals were included from the 2003 and 2010 surveys, with the caveat that the observations gathered in the 2003 survey for cities in the South East larger than 100 thousand inhabitants were also included. Therefore, the data produced in this study are only representative of regions, based on urban areas with large populations.

Table 1. Number and percentage of Brazilian men and women examined by region and year.

Region	Men		Women		Total	
	n	%	n	%	n	%
Year 1986						
North	80	24.4	248	75.6	328	100.0
Northeast	168	24.1	529	75.9	697	100.0
Southeast	340	24.1	1,068	75.9	1,408	100.0
South	84	25.1	251	74.9	335	100.0
Central-West	121	21.4	444	78.6	565	100.0
Total	793	23.8	2,540	76.2	3,333	100.0
Year 2003						
North	111	33.7	218	66.3	329	100.0
Northeast	209	29.8	492	70.2	701	100.0
Southeast	135	37.1	283	62.9	418	100.0
South	74	35.2	136	64.8	210	100.0
Central-West	90	32.1	190	67.9	280	100.0
Total	619	31.9	1,319	68.1	1,938	100.0
Year 2010						
North	716	34.8	1,341	65.2	2,057	100.0
Northeast	651	32.8	1,331	67.2	1,982	100.0
Southeast	338	30.5	771	69.5	1,109	100.0
South	354	33.3	710	66.7	1,064	100.0
Central-West	289	30.1	672	69.9	961	100.0
Total	2,348	32.7	4,825	67.3	7,173	100.0

The 95% confidence intervals were calculated for the outcomes, represented by the DMFT and FS-T indices, for each year stratified by sex and region. Ratios between average values of the indices were used to assess the magnitude of differences in dental conditions between years. Poisson regression analysis was used as it is more suitable for discrete values, in which it is assumed that the mean of the outcome distribution is equivalent to the variance.[10] Age was included as a co-variable with the aim of controlling possible effects related to differences in the composition of ages in the groups compared. The Stata 10.0 application was used.

The SBBrasil 2010 project adhered to standards set by the Declaration of Helsinki and was approved by the *Conselho Nacional de Ética em Pesquisa*, record no. 15,498, 7th January 2010.

RESULTS

After selection and adjusting the data, 12,444 records were analyzed, 3,333 corresponding to 1986, 1,983 from 2003 and 7,173 from 2010 (Table 1). As the distribution between sexes was unequal for the samples from each year, comparisons between males and females were carried out separately.

The results of the observed estimates of functional teeth in Brazilian adults showed a trend of

[f] Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Secretaria de Vigilância em Saúde. SBBrasil 2010: Pesquisa Nacional de Saúde Bucal : resultados principais. Brasília (DF); 2012.

improvement in oral health conditions in both sexes and in all five regions (Table 2).

There was a significant decrease in the dental caries experience, except in the case of men in the South and Central-West between the years of 1986 and 2003 and in the North between 2003 and 2010, when there was an overlap in the confidence intervals of the mean values for caries. Among women, in 1986, the Northeast had the best value interval for the DMFT index (95%CI 19.8;20.9) and the worst range for FS-T index was found in the North (Table 2).

The decrease in the DMFT index was measured using the ratio between mean values for each period: 1986-2003 and 2003-2010. In the first period, among adult females, this ratio varied from 0.87 to 0.92 (in other words, the DMFT index in women was reduced between 8% and 13%). In the second period, the variation was from 0.81 to 0.89 (a reduction between 11% and 19%). With regards the number of functional teeth, in women, in the first period, the region with the greatest increase was the North (R = 1.95 95%CI 1.83;2.08) and the lowest increase was observed in the Northeast (R = 1.44 95%CI 1.39;1.49). In the second period, the greatest increase was also in the North and the lowest was in the South (Table 3).

For men, the North showed DMFT values between 19.1 and 22.7 in 1986, whereas the South showed values

Table 2. Confidence intervals (95%) for the mean values of the DMFT and FS-T indices and components in Brazilian adults aged 35-44 according to sex, region and age.

Year/region	Decayed	Missing	Filled	DMFT	FS-T
Women					
1986					
North	1.9;2.6	18.7;20.8	0.5;1.1	21.9;23.7	5.1;7.0
Northeast	2.7;3.2	14.4;16.0	1.9;2.5	19.8;20.9	9.2;10.6
Southeast	2.3;2.7	14.5;15.7	4.5;5.2	22.0;22.7	9.9;11.0
South	3.9;4.8	10.7;13.0	5.0;6.4	21.3;22.6	10.7;12.8
Central-West	2.3;2.9	15.4;17.2	3.4;4.4	22.3;23.3	8.3;9.9
2003					
North	2.1;3.0	13.0;15.3	3.0;4.4	19.5;21.2	10.2;12.5
Northeast	2.0;2.5	11.2;12.7	4.3;5.3	18.4;19.6	13.1;14.6
Southeast	1.9;2.7	9.3;11.3	6.6;8.1	19.2;20.7	14.4;16.4
South	0.9;1.7	6.6;9.3	9.9;12.1	19.2;21.1	17.4;20.2
Central-West	1.4;2.1	10.7;13.1	6.5;8.2	20.2;21.8	13.1;15.6
2010					
North	2.2;2.5	8.3;9.0	4.2;4.7	15.0;15.7	16.6;17.4
Northeast	1.8;2.1	7.2;7.9	5.4;5.9	14.7;15.4	18.1;18.9
Southeast	1.3;1.6	5.4;6.3	6.7;7.5	13.9;14.9	20.2;21.1
South	1.2;1.5	4.8;5.8	8.1;8.9	14.7;15.6	20.7;21.8
Central-West	1.4;1.8	6.2;7.2	7.8;8.7	16.1;17.0	19.1;20.2
Men					
1986					
North	1.6;2.9	16.1;20.1	0.2;0.9	19.1;22.7	5.8;9.5
Northeast	3.0;3.9	11.9;14.6	1.6;2.9	18.0;19.9	10.1;12.5
Southeast	2.8;3.6	12.1;14.1	3.8;5.0	19.9;21.3	10.8;12.7
South	4.2;5.7	5.7;9.0	4.0;6.5	16.2;18.9	14.0;17.4
Central-West	3.1;4.6	11.1;14.4	2.5;4.2	18.7;21.2	9.8;13.0
2003					
North	2.7;3.9	8.3;11.1	2.5;4.1	14.8;17.7	13.5;16.6
Northeast	2.2;3.2	8.8;10.8	3.4;4.9	15.6;17.6	14.5;16.6
Southeast	1.8;3.8	5.8;9.3	5.7;8.8	15.8;19.4	15.6;19.8
South	0.8;1.8	6.0;9.5	7.7;10.3	16.6;19.4	17.1;20.9
Central-West	2.1;3.4	8.1;11.1	5.3;7.9	17.6;20.4	13.9;17.3
2010					
North	2.5;3.0	7.5;8.4	3.6;4.3	14.2;15.1	16.7;17.7
Northeast	2.1;2.6	5.9;6.8	4.4;5.1	12.9;13.9	18.6;19.6
Southeast	1.2;1.7	4.9;6.5	6.0;7.2	13.0;14.5	20.0;21.6
South	1.0;1.5	3.8;4.9	7.3;8.4	12.8;14.1	21.7;22.9
Central-West	1.5;2.1	4.9;6.1	6.9;8.2	14.2;15.5	20.0;21.4

DMFT: sum of decayed, missing and filled permanent teeth
FS-T: sum of filled and sound teeth

from 16.2 to 18.9 (Table 2). With regards the number of functional teeth, the North had the worst values (95%CI 5.8;9.5) and the South the best (95%CI 14.0;17.4). No decrease in caries was observed among men in the South and Central-West between 1986 and 2003. In the other regions, the value varied between 6% and 21% according to the ratios between the index values. There was an improvement in the number of functional teeth in all of the regions; the greatest increase was observed in the North (R = 1.89 95%CI 1.72;2.08) and the lowest (R = 1.23 95%CI 1.14;1.33) in the South. In the second period (2003-2010), the reductions in the DMFT varied between 1% and 19% and the increments in the FS-T index varied from 13% (in the South) to 33% in the Central-West (Table 3).

These changes were mainly due to lower numbers of missing teeth and to the increased number of sound teeth. There was a significant increase in restored teeth. Although, between 1986 and 2003 there was no noticeable alteration in dental caries in adult males in the South and Central-West, statistically significant differences were found for some components of the indices. There was a noticeable trend for the numbers of restored teeth to increase. For both women and men, the region with the highest increase in terms of functional teeth was the North (Table 3), which had the worst standards in 1986 (Table 2).

In Figure 2, the point estimates are shown, demonstrating the consistent decline in DMFT values and in increase in FS-T values in all regions during the period.

DISCUSSION

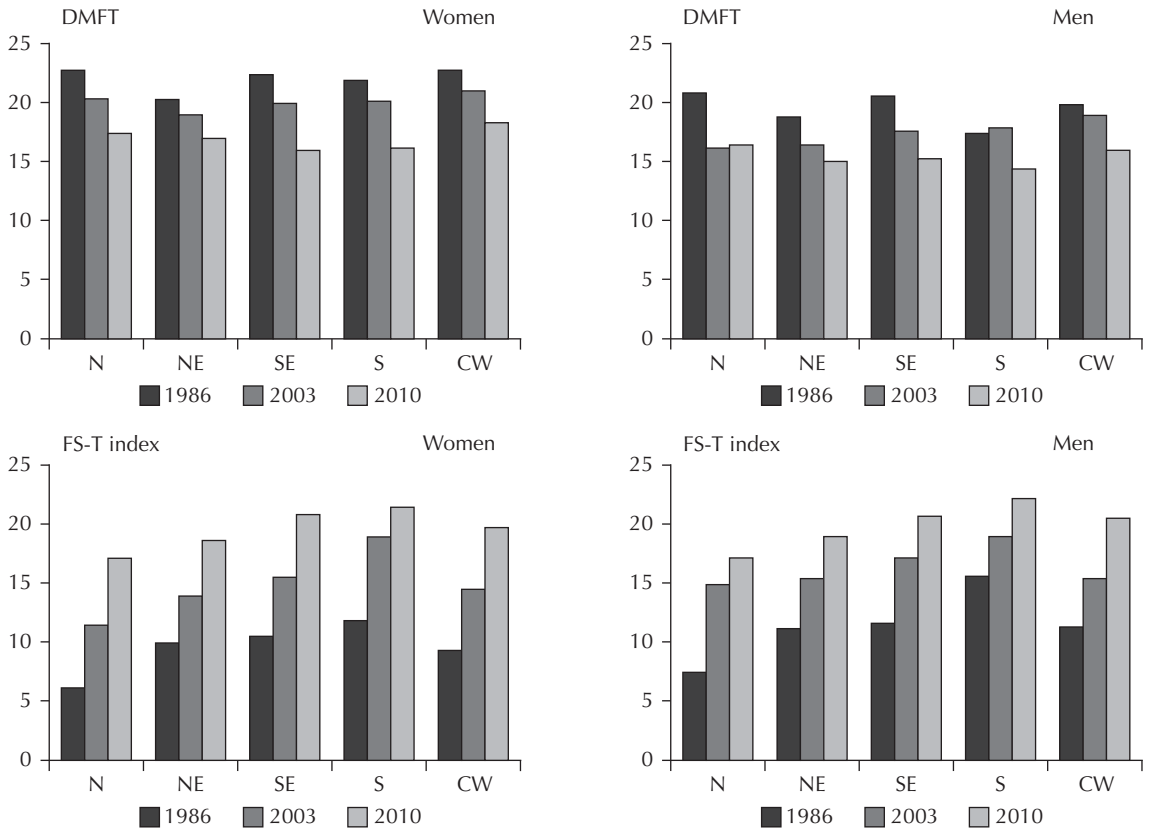
Analysis of the data produced by the epidemiological studies of adults aged 35-44 in Brazil shows that, between 1986 and 2003, and between 2003 and 2010, there was a significant improvement in the dental conditions of Brazilian adults, of both sexes and in all regions of the country, as measured by the FS-T index. A notable decrease in dental caries was also observed in almost all regions. Although no significant changes were seen in males in the South and Central-West between 1986 and 2003, there was a notable increase in the number of restored teeth.

This significant improvement in dental conditions is an important indicator that changes in the occurrence of dental caries is also reaching the adult population

Table 3. Ratio between mean values for DMFT and FS-T, adjusted for age, in adult Brazilians according to sex and region for the years 1986 to 2003 and 2003 to 2010.

Sex/region	DMFT			FS-T		
	Ratio	95%CI	p	Ratio	95%CI	p
			2003 compared to 1986			
Women						
North	0.89	0.85;0.92	< 0.001	1.95	1.83;2.08	< 0.001
Northeast	0.92	0.90;0.95	< 0.001	1.44	1.39;1.49	< 0.001
Southeast	0.87	0.85;0.90	< 0.001	1.59	1.53;1.65	< 0.001
South	0.89	0.85;0.93	< 0.001	1.72	1.62;1.81	< 0.001
Central-West	0.91	0.88;0.94	< 0.001	1.67	1.59;1.76	< 0.001
Men						
North	0.79	0.74;0.85	< 0.001	1.89	1.72;2.08	< 0.001
Northeast	0.86	0.82;0.90	< 0.001	1.41	1.34;1.50	< 0.001
Southeast	0.84	0.80;0.88	< 0.001	1.54	1.47;1.63	< 0.001
South	1.01	0.94;1.09	0.839	1.23	1.14;1.33	< 0.001
Central-West	0.94	0.88;1.00	0.039	1.43	1.33;1.54	< 0.001
			2010 compared to 2003			
Women						
North	0.85	0.82;0.89	< 0.001	1.51	1.36;1.66	< 0.001
Northeast	0.89	0.86;0.92	< 0.001	1.36	1.28;1.44	< 0.001
Southeast	0.81	0.78;0.85	< 0.001	1.33	1.24;1.42	< 0.001
South	0.82	0.77;0.87	< 0.001	1.12	1.03;1.21	0.006
Central-West	0.87	0.83;0.92	< 0.001	1.37	1.25;1.49	< 0.001
Men						
North	0.99	0.91;1.09	0.960	1.18	1.06;1.30	0.002
Northeast	0.90	0.84;0.96	0.002	1.24	1.16;1.33	< 0.001
Southeast	0.87	0.80;0.94	0.001	1.20	1.11;1.30	< 0.001
South	0.81	0.74;0.88	< 0.001	1.17	1.06;1.29	0.002
Central-West	0.84	0.77;0.91	< 0.001	1.33	1.19;1.49	< 0.001

DMFT: sum of decayed, missing and filled permanent teeth
FS-T: sum of filled and sound teeth



N: North; NE: Northeast; SE: Southeast; S: South; CO: Central-West
DMFT measures dental caries corresponding to decayed, missing and filled permanent teeth
The FS-T index measures dental health corresponding to the number of functional teeth (filled + sound).

Figure 2. Mean values for DMFT and FS-T for Brazilian men and women according to region for the years 1986, 2003 and 2010.

and may reflect the accumulated impact of prevention and treatment policies.

A decline in dental caries during the final decades of the 20th century and the start of the 21st has been reported in various countries. A decline of 37% was found in Australian adults with a change from 16.9 to 10.7 in the DMFT index between 1986 and 2005.[7] Between 1984 and 2003, DMFT values for adults in Oslo (Norway) went from 19.9 to 11.7, a reduction of 41.2%.[21] In a US study comparing two surveys 12 years apart (1974 and 1986), reductions of 13.9% in the DMFT index for adults aged 35-39 and 7.5% in those aged 40-44 were found.[4] In this study, between 1986 and 2003, decreases in the DMFT varied between 8% and 13% in women and 6% and 21% in men (except in the South). Between 2003 and 2010, the decreases varied between 13% and 17% in women and between 15% and 27% in men.

There are few epidemiological studies of dental caries involving adults and the majority of them which identify trends in dental caries compare estimates from two points in time.[7,23,24] The decrease in the number of teeth attacked by dental caries has been observed in several parts of the world and the results shown in point values.[4,7,21] In a study in Slovenia,[23] the estimates were shown using 95%CI. Two important features of the current study were the comparison of three points in time and the use of the ratio between the values in order to quantify the difference between years for each region, controlling for the effects of variation in age.

In the literature, the benefits of fluoride in the water supply and in toothpaste are widely accepted as responsible for the most part of the reduction in dental caries. These factors are demonstrated as possibly responsible for the decreases found in Australian adults.[7]

In Brazil, fluoridation of the water increased notably during the second half of the 20th century, with the greatest advances being made in the 1980s due to federal government initiatives, with around 65.5 million individuals benefitting by 1995 (around 42.2% of the Brazilian population). The addition of fluoride to toothpaste in Brazil become most widespread in 1988. From 1989 onwards, more than 90% of consumer products contained fluoride; in 1981 this figure was a mere 12%.[16] In 2008, around 123 million Brazilians (65% of the population) benefitted from fluoridated water. Research in the state of São Paulo has shown that adults living in areas with

fluoridated tap water lose fewer teeth.[8] Thus, it is probable that this prevention strategy has contributed both to the decline in dental caries and to the increased FS-T index in the 35-44 year old population in all regions. However, while there is increasing access to toothpaste with added fluoride due to increasing incomes and living conditions of many households, there are significant differences in the coverage of fluoridated water between the state capitals in the North and Northeast compared with the South East and South, due to the difficulties in spreading this important public policy.[9,15]

Increased access to fluoride may explain the increased number of sound teeth and the fewer missing teeth. Socioeconomic changes may also influence trends in dental caries. An increased level of human development was observed in all of the regions at the end of the 20th century and the beginning of the 21st century due to public policies (Figure 1). Higher per capita income and levels of schooling may result in better access to dental services and oral hygiene products. Various researchers[3,8,22] have demonstrated a link between tooth loss in adults and socio-economic factors such as income and schooling. Some studies have identified links between HDI values and values for dental caries in 12-year-olds.[2,11,13,18] Although the HDI increased in all regions, differences between regions remained throughout this period; similar to the behavior noted in dental caries trends. Although there was an improvement in all of the regions, there are still inter-regional inequalities in dental health conditions (FS-T index).

As for the number of restored teeth, changes in the ratio of dentists to inhabitants may help to explain the differences found between 1986 and 2010. In the context of reduced disease burden, the increased number of restored teeth may indicate greater incorporation of non-mutilating treatment. Examination of the distribution of dentists in the regions of Brazil between 1988 and 1997 showed that this ratio went from 1,493 to 1,095 inhabitants per dentist – a decrease of 26.7%.[g] Eleven years later, data from 2008 indicate a decrease of 23.5%, giving an even lower ratio – 838 inhabitants per dentist.[12] Bearing in mind that more professionals may reflect better access to services, part of the changing trend in dental health conditions experienced by adults in Brazil may be due to the greater incorporation of restorative dental services. Population based investigation comparing the use of dental services in 1998 and 2003 show that women are more likely to use dental services and that each dentist per thousand inhabitants represents a 46.6% reduction in the chance of Brazilians never having visited a dentist.[17]

There are some methodological issues which occur when comparing the findings of different cross-sectional studies. The data used were obtained by trained examiners and were from national epidemiological studies which constitute a relevant source of information for the researchers. Although there are differences in the sampling processes, the studies aimed to produce inferences for men and women in the five regions of the country in the selected age group, based on random sampling. As the fractions of the sample were not incorporated into all databases, the analysis for each Brazilian region presented in this study cannot be extrapolated to other locations in the region, being limited to urban areas with large populations.

Studies have shown that women use dental services more often. According to a study based on the 1998 National Survey by Household Sampling, the number of women who had visited a dentist in the previous 12 months was 23.1 percentage points higher than men.[17] In a survey carried out in Pelotas, Southern Brazil, in 2005, the researchers observed that adult women visited the dentist 20% more than men.[1] Moreover, it was observed that women were over represented in the studies from which the data came, a characteristic common to various pieces of household based research. For these reasons, estimates for men and women were compared separately.

Although the surveys used different sampling plans, they can be validly compared as they have the same reference population. The size of the samples and the study designs provided adequate statistical power in order to test possible differences between the periods of time investigated. Moreover, carrying out the surveys implied enormous effort on the part of the health care services, and the data analyzed constitute the best available information for health care planning.

When comparing the surveys of dental caries using the DMFT index in adults, the number of missing teeth takes on great significance due to the weighting of this component in this age group. Therefore, it is relevant to observe possible differences among the criteria for diagnosing this component.[4] In the 1983 survey, no distinction was made between the reasons for losing teeth, and all were deemed to have been extracted due to dental caries. In the 2003 and 2010 surveys, teeth lost to dental caries were given a separate code to those lost for other reasons. In order to improve the comparability of the data, this component was calculated as the sum of teeth lost to dental caries and teeth extracted for other reasons in the 2003 and 2010 surveys, thus minimizing the possibility of bias. Dental caries varies significantly with age, so that the mean DMFT index at 44 tends to be greater than that at 35. Sampling differences between the surveys may make differences in the composition of age redundant.

[g] Pellegrino CJS. Distribuição da força de trabalho em saúde bucal no Brasil, 1988-1997 [tese de doutorado]. São Paulo: Faculdade de Saúde Pública da USP; 1999.

Thus, the ratio of mean values was used as the measure of comparison of the indices, adjusted for age.

For all of these reasons, the differences between 1986, 2003 and 2010 can be deemed to demonstrate a trend for significant changes in dental health conditions in adults living in the more developed areas of the country, suggesting that the transition in Brazilian adults' oral health is not uniform and that each region has its peculiarities.

The level of dental health in 35 to 44-year-old adults has shown a significant trend to increase in all regions of Brazil in the period between 1986 and 2003. Among the theories as to what may have contributed to this improvement, the accumulated impact of policies aimed at preventing dental caries should be considered, in the case of Brazil, adding fluoride to the water supply and to toothpaste as well as the increased incorporation of restorative treatments and public policies leading to improved living conditions.

REFERENCES

1. Araújo CS, Lima RC, Peres MA, Barros AJD. Utilização de serviços odontológicos e fatores associados: um estudo de base populacional no sul do Brasil. *Cad Saude Publica*. 2009;25(5):1063-72. DOI:10.1590/S0102-311X2009000500013
2. Baldani MH, Narvai PC, Antunes JLF. Cárie dentária e condições sócio-econômicas no Estado do Paraná, Brasil, 1996. *Cad Saude Publica*. 2002;18(3):755-63. DOI:10.1590/S0102-311X2002000300024
3. Barbato PR, Nagano HCM, Zanchet FN, Boing AF, Peres MA. Perdas dentárias e fatores sociais, demográficos e de serviços associados em adultos brasileiros: uma análise dos dados do Estudo Epidemiológico Nacional (Projeto SB Brasil 2002-2003). *Cad Saude Publica*. 2007;23(8):1803-14. DOI:10.1590/S0102-311X2007000800007
4. Brown LJ, Swango PA. Trends in caries experience in US employed adults from 1971-74 to 1985: cross-sectional comparisons. *Adv Dent Res*. 1993;7(1):52-60. DOI:10.1177/08959374930070010701
5. Brown LJ, Wall TP, Lazar V. Trends in caries among adults 18 to 45 years old. *J Am Dent Assoc*. 2002;133(7):827-34.
6. Cleaton-Jones P, Fatti P. Dental caries trends in Africa. *Community Dent Oral Epidemiol*. 1999;27(5):316-20.
7. Do LG, Roberts-Thomson KF. Dental caries experience in the Australian adult population. *Aust Dent J*. 2007;52(3):249-51.
8. Frazão P, Antunes JLF, Narvai PC. Perda dentária precoce em adultos de 35 a 44 anos de idade: Estado de São Paulo, Brasil, 1998. *Rev Bras Epidemiol*. 2003;6(1):49-57. DOI:10.1590/S1415-790X2003000100007
9. Gabardo MC, Silva WJ, Olandoski M, Moysés ST, Moysés SJ. Inequalities in public water supply fluoridation in Brazil: an ecological study. *BMC Oral Health*. 2008;8:9. DOI:10.1186/1472-6831-8-9
10. Kleinbaum DG, Kupper LL, Nizam A, Muller KE. Applied regression analysis and other multivariable methods. New York: Duxbury Press; 1998.
11. Lalloo R, Myburgh NG, Hobdell MH. Dental caries, socio-economic development and national oral health policies. *Int Dent J*. 1999;49(4):196-202.
12. Morita MC, Haddad AE, Araújo ME. Perfil atual e tendências do cirurgião-dentista brasileiro. Maringá: Dental Press; 2010.
13. Moysés SJ. Desigualdades em saúde bucal e desenvolvimento humano: um ensaio em preto, branco e alguns tons de cinza. *Rev Bras Odontol Saude Coletiva*. 2000;1(1):7-17.
14. Namal N, Vehid S, Sheiham A. Ranking countries by dental status using the DMFT and FS-T indices. *Int Dent J*. 2005;55(6):373-6.
15. Narvai PC. Cárie dentária e flúor: uma relação do século XX. *Cienc Saude Coletiva*. 2000;5(2):381-92. DOI:10.1590/S1413-81232000000200011
16. Narvai PC, Frazão P, Roncalli AG, Antunes JLF. Cárie dentária no Brasil: declínio, iniqüidade e exclusão social. *Rev Panam Salud Publica*. 2006;19(6):385-93. DOI:10.1590/S1020-49892006000600004
17. Pinheiro RS, Torres TZG. Uso de serviços odontológicos entre os Estados do Brasil. *Cienc Saude Coletiva*. 2006;11(4):999-1010. DOI:10.1590/S1413-81232006000400021
18. Pinto VG. Índice de cárie no Brasil e no mundo: sua relação com o consumo de açúcar, população, renda e desenvolvimento humano (CPO-D aos 12 anos). *RGO (Porto Alegre)*.1996;44(1):8-12.
19. Santos M, Silveira ML. O Brasil: território e sociedade no inicio do século XXI. Rio de Janeiro: Record; 2001.
20. Sheiham A. Oral health, general health and quality of life. *Bull World Health Organ*. 2005;83(9):644.
21. Skudutyte-Rysstad R, Eriksen HM. Changes in caries experience among 35-year-old Oslo citizens, 1973-2003. *Acta Odontol Scand*. 2007;65(2):72-7. DOI:10.1080/00016350601048003
22. Susin C, Oppermann RV, Haugejorden O, Albandar JM. Tooth loss and associated risk indicators in an adult urban population from south Brazil. *Acta Odontol Scand*. 2005;63(2):85-93.
23. Vrbic V. Oral health in Slovenia, 1987-1993. *Community Dent Oral Epidemiol*. 1996;24(5):364-5.
24. Warpeha R, Beltrán-Aguilar E, Báez R. Methodological and biological factors explaining the reduction in dental caries in Jamaican school children between 1984 and 1995. *Rev Panam Salud Publica*. 2001;10(1):37-44. DOI:10.1590/S1020-49892001000700006
25. World Health Organization. Oral health surveys: basic methods. 4.ed. Geneva; 1997.

Article based on the master dissertation of Nascimento, S, presented to the *Universidade Católica de Santos*, in 2010. Frazão P and Antunes JLF are researchers with grants from the Conselho Nacional de Desenvolvimento Científico e Tecnológico. The *Pesquisa Nacional de Saúde Bucal 2010* (SBBrasil 2010, Brazilian Oral Health Survey) was financed by the General Coordination of Oral Health/Brazilian Ministry of Health (COSAB/MS), through the *Centro Colaborador do Ministério da Saúde em Vigilância da Saúde Bucal*, *Faculdade de Saúde Pública* at *Universidade de São Paulo* (CECOL/USP), process no. 750398/2010.

This article underwent the peer review process adopted for any other manuscript submitted to this journal, with anonymity guaranteed for both authors and reviewers. Editors and reviewers declare that there are no conflicts of interest that could affect their judgment with respect to this article.

The authors declare that there are no conflicts of interest.