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# Root caries prevalence and severity in Brazilian adults and older people

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## ABSTRACT

**OBJECTIVE:** To estimate the prevalence of root caries in Brazilian adults and elderly.

**METHODS:** We assessed data from the Brazilian Oral Health Survey (SBBrazil 2010). Dental examinations were performed on 9,564 adults and 7,509 elderly individuals in households in the 26 state capitals, the Federal District and 150 provincial towns. Diagnostic criteria and data assessment tools were those standardized by the World Health Organization. The outcome was measured by using root caries index and the index of decayed and filled dental roots.

**RESULTS:** The prevalence of root caries was 16.7% in adults and 13.6% in the elderly. The index of decayed and filled dental roots was 0.42 and 0.32 for adults and the elderly respectively, with most of the index represented by untreated caries. The prevalence of root caries differed significantly among states capitals and provincial towns, with higher values being reported in the state capitals in the North and Northeastern Brazilian regions. In adults, the root caries index ranged from 1.4% in Aracaju to 15.1% in Salvador (both in the Northeast). Among the elderly, this index ranged from 3.5% in Porto Velho to 29.9% in Palmas (both North). Root caries was more prevalent in men than in women in both age groups.

**CONCLUSIONS:** There is a wide variation in root caries indices in adults and in the elderly, and between and within Brazilian regions. Most root caries is untreated. We recommend the incorporation of this disease into the oral health surveillance system.

**DESCRIPTORS:** Adult. Aged. Root Caries, epidemiology. Health Inequalities. Dental Health Surveys. Oral Health.

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## INTRODUCTION

The epidemiological and demographic transition which has been taking place in Brazil over the last 30 years is characterized by better living conditions, associated with decreasing mortality rates, particularly from contagious diseases, and a lower birth rate.<sup>9,a</sup> As a consequence, we are witnessing the elderly population growing at a rate almost eight times faster than the adolescent population.<sup>13</sup> As a consequence of this transition, the relative importance of non-communicable diseases and health problems, such as heart disease and diabetes, has grown, in addition to nutritional problems such as overweight and obesity.<sup>18</sup>

Over the last few decades a series of epidemiological surveys have described oral health in children, adolescents, adults and the elderly<sup>b,c,d</sup> in Brazil. Among the problems investigated was coronal caries, focusing on tooth loss and edentulism in the 35 to 44 and in the over 64 age groups.<sup>1</sup> However, there is a recognized need for nationwide population based studies which describe the occurrence of root caries in the Brazil.

Increased life expectancy and improved oral health conditions may increase in the number of adults and the elderly with higher proportions of preserved or retained teeth<sup>2,11,12</sup> and, subsequently, greater exposure to periodontal disease and root caries. Gingival recession is a common event in both adults and the elderly, a necessary condition for demineralization of the cementum and root dentin, which are less mineralized than the enamel. They are, therefore, more vulnerable to caries, possibly culminating in the appearance of root caries.<sup>3,9</sup> For all of these reasons, there is a trend for root caries to be an oral health problem for public health in the future.

The aim of this study was to estimate the prevalence of root caries in the adult and elderly population of Brazil.

## METHODS

Secondary data from the National Oral Health Survey (SBBrasil 2010) database, publicly available from the Brazilian ministry of Health,<sup>d</sup> were used. This was a broad epidemiological study of the Brazilian population's oral health conditions.

The state capitals were included, with a probability of 1 (self-selecting), whereas the 150 municipalities in the interior were selected probabilistically within

each region, according to population size. The primary sample units were the municipalities in each region and census tracts in the state capitals.

The study included oral examinations and interviews in the homes of individuals aged five and 12 years old and in the age groups 15 to 19, 35 to 44 and 64 to 74 years old. Details of the calculation and selection process of the sample can be found in Roncalli et al.<sup>13</sup> In total, 9,564 adults and 7,509 elderly individuals participated in the study, representing participation rates of 93.8% in both age groups.

The field work teams who carried out the SBBrasil 2010 underwent 40 hours of training in regional workshops and were made up of an examiner (dentist) and a note taker. Up to ten teams took part in each workshop, which were divided into training for the oral examinations and calibration of the codes and criteria for each oral health problem in question, supervised by two instructors. The number of teams varied between two and six in the municipalities in the interior and ten for the state capitals and the Federal District.

The calibration technique chosen was consensus,<sup>21</sup> the concordance between each examiner and the results obtained by team consensus was calculated. Later, the weighted kappa coefficient was calculated for each examiner, age group and health problem studied, with the minimum acceptable value being 0.65.

Although reproducibility was measured for coronal caries, specific reproducibility for root caries was not measured due to the operational difficulties this would impose. Despite this limitation, it is reasonable to assume that the calibration for damage to the crown has positive repercussions on the examiners' ability to uniformly detect root damage.

Diagnosis of conditions affecting the root followed the criteria recommended by the World Health Organization (WHO).<sup>21</sup> Observing gingival recession beyond the cemento-enamel junction was deemed to be exposed root, a necessary condition for the development of the oral health problem in question. Healthy roots were those that, although exposed, showed no evidence of caries or fillings due to caries. In situations in which caries was identified in the crown and the root, but it was not possible to identify the point of origin, coronal

<sup>a</sup> Instituto Brasileiro de Geografia e Estatística (BR). Primeiros resultados do Censo Demográfico 2010 – RevBras Est Pop.2011;28(1):3-4.

<sup>b</sup> Ministério da Saúde (BR). Levantamento epidemiológico em saúde bucal - Brasil – zona urbana 1986. Brasília; 1987. Available from: <http://dab.saude.gov.br/cnsb/vigilancia.php>

<sup>c</sup> Ministério da Saúde (BR). Projeto SB Brasil 2003: condições de saúde bucal da população brasileira 2002-2003. Resultados principais. Brasília (DF); 2005. Available from: [http://dtr2001.saude.gov.br/editora/producao/livros/pdf/05\\_0053\\_M.pdf](http://dtr2001.saude.gov.br/editora/producao/livros/pdf/05_0053_M.pdf)

<sup>d</sup> Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Projeto SB Brasil 2010: condições de saúde bucal da população brasileira 2010. Resultados principais. Brasília (DF); 2010[cited 2012 Feb 15]. Available from: [http://dab.saude.gov.br/cnsb/sbbrasil/arquivos/projeto\\_sb2010\\_relatorio\\_final.pdf](http://dab.saude.gov.br/cnsb/sbbrasil/arquivos/projeto_sb2010_relatorio_final.pdf)

and root caries was recorded. The same criterion was adopted for filled crowns and roots.

For the statistical analysis, the mean number of roots with caries (D-R), filled due to caries (F-R), filled roots with caries (DF-R) and the prevalence of root caries (DF-R > 0 expressed as a percentage) for each of the 32 domains (state capitals and interior of the five regions) and for the country as a whole, for the adult (35 to 44 year old) and elderly (65 to 74 year old) age groups. Next, the prevalence of root caries was calculated according to groups of teeth for adults and the elderly according to gender. Finally, the prevalence of root caries in adults and the elderly was calculated according to affected teeth in relation to total present teeth and according to those with exposed roots. All of the analyses were carried out using the STATA 11.0 2009 software, taking into account the complex sample design and sampling weights.

The SBBrazil 2010 followed all standards set by the Declaration of Helsinki and was approved by the National Research Ethics Committee, record no. 15,498, on 7<sup>th</sup> January 2010.

## RESULTS

In adults, the prevalence of root caries was 16.7% (95% CI 14.2;19.1) for the country as a whole, varying between 6.0% in Porto Alegre, and 28.5%, in São Luís. The mean number of roots attacked by caries (DF-R index) was 0.42 for Brazil: the lowest value was 0.12 in Boa Vista, and the highest was 0.78 in São Luís. Except for the capital of Maranhão, São Luís, it was verified that untreated root caries predominated in the DF-R index (Table 1).

The RCI varied widely. Among Brazilian adults, 6.5% of the total roots at risk showed signs of the disease. The lowest mean percentage was observed in Aracaju, where 1.4% of these roots were affected by caries, and the highest was in Salvador, where 15.1% of these roots showed damage from caries (Table 1).

With regards the elderly, the prevalence of root caries was 13.6% (95% CI 11.1;16.0). The highest rate (26.7%) was observed in Belém, and the lowest (4.8%) in the capital of Rio de Janeiro (Table 2). The highest DF-R index value was 0.88, observed in João Pessoa, and the lowest, 0.11, in the capital of Rio de Janeiro. For the elderly in all of the state capitals except Brasília and the Federal District, non-treated root caries predominated in the DF-R index. Of the total roots at risk, measured using the RCI, 11.2% showed signs of the disease. Porto Velho, was where the lowest percentage was observed (3.5%), and Palmas, the highest (29.9%) (Table 2).

Among adults and the elderly, the distribution of teeth affected by root caries according to sex is shown in

Figures 1 and 2, respectively, with the group being visually more significant among men in both age groups.

Figure 1 shows that root caries affects upper and lower teeth similarly in adults of both sexes, with values staying below 3.5%. In the elderly of both sexes, upper teeth affected varied between 0.1% and 1.6% and 0.2% to 4.7% in the lower jaw. Among adult men, in the upper jaw, the first molars on both sides (teeth 16 and 26) were proportionally more affected, and in women the upper molar on the right side (teeth 17 and 16). For the lower jaw, in both sexes, the pre-molars were those with the highest values, with teeth 35 and 44 being most affected in women, and 34 and 35 in men (Figure 1).

Figure 2 shows that, amongst the elderly, higher proportions of root caries were found in the lower jaw, especially in the first pre-molars (teeth 34 and 44) in women and in the canines (33 and 43) in men.

Taking into consideration the teeth present and the roots exposed, it was observed in both adults and the elderly that the posterior teeth (pre-molars and molars) were proportionally more affected than the anterior (incisors and canines) in both jaws (Table 3).

## DISCUSSION

The data of this population based study on the epidemiology of root caries in adults and the elderly in Brazil reveals that more than 10% of the adult and elderly population have root caries (16.7% and 13.6% respectively). Males were more affected, possibly because they kept a higher number of their teeth for longer in life compared to women.<sup>4</sup> The most affected groups of teeth were the superior molars in adults and the canines and inferior pre-molars in the elderly. The prevalence of root caries in the two age groups varied widely between regions and also between state capitals and cities in the interior.

In the United States, 22.5% of adults have root caries;<sup>20</sup> in China, this percentage was 13.1%;<sup>3</sup> and 11.1% among Greek adults, according to Mamai-Homata in a study published in 2005.<sup>8</sup> Although the prevalence was 26.7% among elderly Brazilians in the North, this figure was much lower than that reported in four other population based studies carried out in Australia (1997),<sup>15</sup> the United Kingdom (2001),<sup>17</sup> Greece (2005)<sup>8</sup> and Sri Lanka (2007).<sup>7</sup> However, these studies excluded individuals with edentulism, which was not the procedure used in this study. Moreover, in these countries the proportion of adults and the elderly with teeth is higher than that of Brazil; these studies were published more than a decade ago, with the exception of the study in Sri Lanka, published more than five years ago, and it was difficult to find recent work.

**Table 1.** Prevalence of root caries and root caries index in adults aged 35 to 44 in the state capitals and cities in the interior, according to macro-regions of Brazil. SBBrazil, 2010.

State capitals	n	D-R	F-R	DF-R	DF-R $\geq$ 1 (%)	RCI (%)
North						
Porto Velho, RO	321	0.28	0.01	0.29	13.7	1.6
Rio Branco, AC	207	0.51	0.05	0.56	17.4	9.7
Manaus, AM	222	0.28	0.03	0.31	16.9	5.5
Boa Vista, RR	179	0.10	0.02	0.12	8.7	4.1
Belém, PA	488	0.70	0.01	0.71	23.8	14.3
Macapá, AP	345	0.42	0.03	0.45	19.2	6.1
Palmas, TO	295	0.14	0.05	0.19	10.6	9.6
Northeast						
São Luís, MA	157	0.36	0.42	0.78	28.5	5.1
Teresina, PI	257	0.69	0.04	0.73	20.7	4.9
Fortaleza, CE	369	0.18	0.02	0.20	8.8	7.6
Natal, RN	174	0.41	0.09	0.50	23.1	10.0
João Pessoa, PB	212	0.66	0.07	0.73	22.5	12.3
Recife, PE	145	0.51	0.00	0.51	18.5	6.8
Maceió, AL	187	0.18	0.03	0.21	15.5	4.7
Aracaju, SE	214	0.12	0.01	0.13	9.1	1.4
Salvador, BA	267	0.18	0.02	0.20	11.2	15.1
Southeast						
Belo Horizonte, MG	257	0.32	0.04	0.36	16.1	7.9
Vitória, ES	155	0.27	0.07	0.34	17.9	5.8
Rio de Janeiro, RJ	324	0.17	0.01	0.18	8.6	10.5
São Paulo, SP	373	0.20	0.06	0.26	12.6	3.8
South						
Curitiba, PR	414	0.35	0.06	0.41	20.0	4.9
Florianópolis, SC	219	0.27	0.08	0.35	14.3	5.6
Porto Alegre, RS	431	0.05	0.12	0.17	6.0	2.7
Central-West						
Campo Grande, MS	379	0.26	0.16	0.42	18.0	10.5
Cuiabá, MT	118	0.33	0.04	0.37	17.1	9.6
Goiânia, GO	241	0.36	0.01	0.37	20.8	7.4
Brasília, DF	223	0.06	0.02	0.08	7.1	3.7
Cities in the interior						
North	463	0.57	0.01	0.58	22.9	4.7
Northeast	422	0.52	0.15	0.67	23.2	8.2
Southeast	477	0.28	0.14	0.42	16.6	5.9
South	555	0.40	0.15	0.55	19.9	6.9
Central-West	474	0.67	0.17	0.84	28.4	11.9
Brazil	9.564					
		0.25-0.38	0.05-0.16	0.33-0.51	14.2-19.1	8.1-12.9

D-R: mean number of roots with caries

F-R: fillings due to caries

DF-R: roots with caries and fillings

RCI: Root Caries Index

**Table 2.** Prevalence of root caries and root caries index in the elderly aged 65 to 74 in the state capitals and cities in the interior, according to macro-regions of Brazil. SBBrazil. 2010.

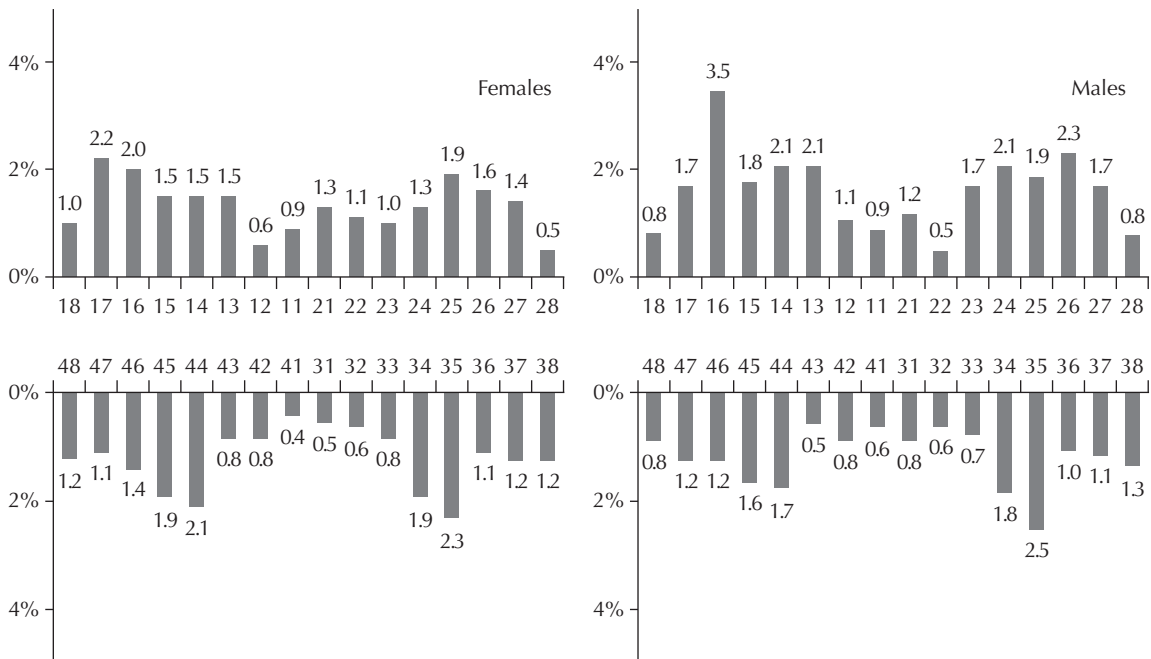
State capitals	n	C-R	O-R	CO-R	CO-R $\geq$ 1 (%)	ICR (%)
North						
Porto Velho, RO	201	0.12	0.01	0.13	6.2	3.5
Rio Branco, AC	182	0.39	0.03	0.42	14.9	21.4
Manaus, AM	178	0.11	0.06	0.17	9.3	4.6
Boa Vista, RR	192	0.43	0.12	0.55	18.6	21.2
Belém, PA	250	0.68	0.01	0.69	26.7	21.7
Macapá, AP	238	0.51	0.00	0.51	16.8	11.3
Palmas, TO	164	0.22	0.19	0.41	14.3	29.9
Northeast						
São Luís, MA	206	0.41	0.00	0.41	18.4	7.6
Teresina, PI	212	0.30	0.00	0.30	9.0	6.9
Fortaleza, CE	254	0.22	0.05	0.27	11.6	14.4
Natal, RN	230	0.62	0.16	0.78	24.1	21.0
João Pessoa, PB	211	0.81	0.07	0.88	21.8	18.8
Recife, PE	224	0.27	0.04	0.31	14.1	7.8
Maceió, AL	181	0.16	0.04	0.20	9.6	5.8
Aracaju, SE	192	0.16	0.10	0.26	14.3	8.2
Salvador, BA	261	0.25	0.03	0.28	13.4	19.0
Southeast						
Belo Horizonte, MG	246	0.26	0.11	0.37	19.5	10.4
Vitória, ES	173	0.37	0.18	0.55	19.2	12.3
Rio de Janeiro, RJ	323	0.09	0.02	0.11	4.8	4.5
São Paulo, SP	255	0.21	0.09	0.30	13.2	9.6
South						
Curitiba, PR	280	0.33	0.29	0.62	23.3	13.9
Florianópolis, SC	224	0.24	0.18	0.42	19.3	9.5
Porto Alegre, RS	303	0.18	0.17	0.35	14.0	7.3
Central-West						
Campo Grande, MS	207	0.40	0.16	0.56	20.6	13.7
Cuiabá, MT	155	0.49	0.09	0.58	17.6	12.2
Goiânia, GO	234	0.21	0.17	0.38	13.2	10.8
Brasília, DF	139	0.07	0.14	0.21	10.9	13.2
Cities in the interior						
North	317	0.33	0.02	0.35	14.1	10.5
Northeast	300	0.28	0.04	0.32	13.0	13.6
Southeast	280	0.18	0.14	0.32	14.1	11.3
Southeast	341	0.27	0.11	0.38	15.8	13.3
Central-West	356	0.38	0.05	0.43	17.8	17.2
Brazil	7.509	0.22	0.10	0.32	13.6	11.2
		0.16-0.27	0.05-0.15	0.25-0.39	11.1-16.0	8.3-14.1

D-R: mean number of roots with caries

F-R: fillings due to caries

DF-R: roots with caries and fillings

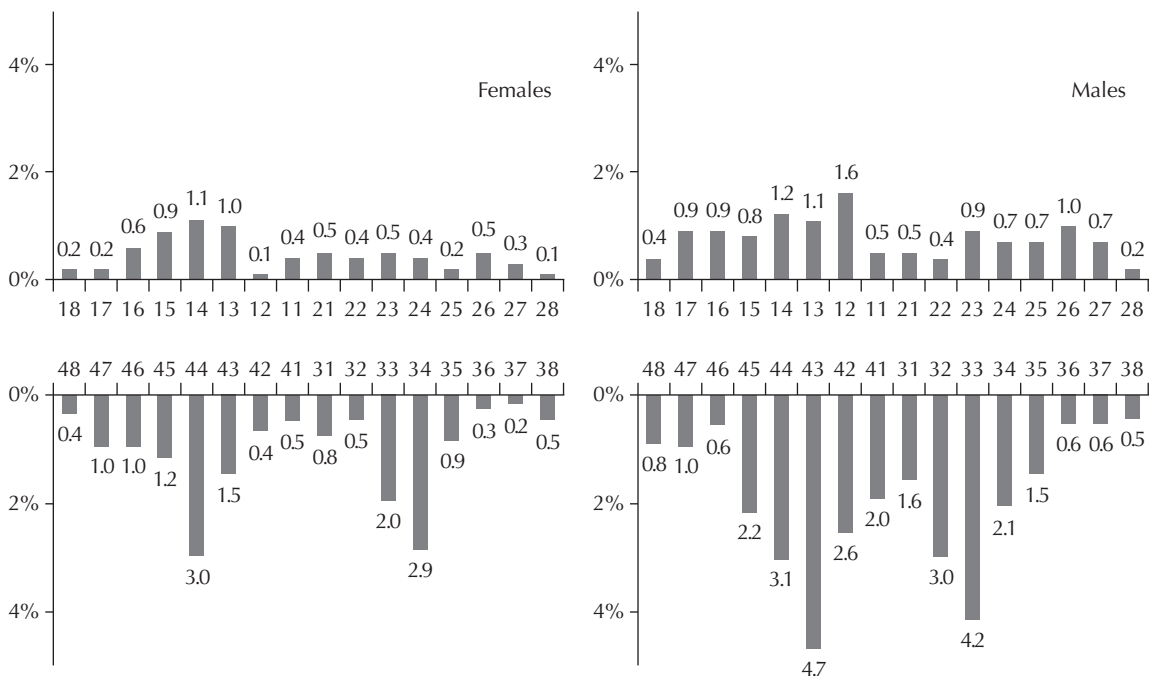
RCI: Root Caries Index



**Figure 1.** Prevalence of root caries in adults 35-44 years of age, according to impacted teeth in the upper and lower jaw in females and males. SBBrazil, 2010.

The highest RCI values, which refer to the number of roots exposed to the risk of this health problem, were lower in the state capitals in the Southeast and South, but reached 15.0% in a state capital in the Northeast. On a national level, the RCI value which, as expected, increases with age, was 6.5% in adults

and 11.2% in the elderly, as observed in adults in Pomerania, Germany,<sup>16</sup> and in the elderly in south Australia,<sup>15</sup> which varied from 4.6% to 10.6%. In the study carried out in Greece<sup>8</sup> the value of the RCI in the elderly (9.7%) was four times higher than in adults (2.5%).



**Figure 2.** Prevalence of root caries in the elderly 65-74 years of age, according to impacted teeth in the upper and lower jaw in females and males. SBBrazil, 2010.

**Table 3.** Prevalence of root caries in adults (35 to 44) and the elderly (65 to 74), according to tooth affected: (a) in relation to total teeth present; and (b) in relation to total roots exposed. SBBrasil. 2010.

Upper dental arch					
Adults			The elderly		
Tooth	Existing root (%) (a)	Exposed root (%) (b)	Tooth	Existing root (%) (a)	Exposed root (%) (b)
18	1.9	5.1	18	4.4	9.1
17	2.9	6.6	17	4.0	6.4
16	4.5	8.9	16	6.3	9.0
15	2.4	4.9	15	7.5	12.3
14	2.5	5.4	14	8.9	14.9
13	2.2	5.2	13	6.3	10.6
12	1.1	2.8	12	4.2	8.1
11	1.2	3.2	11	2.5	5.0
21	1.6	4.2	21	2.9	5.4
22	1.2	3.2	22	2.4	4.9
23	1.6	3.8	23	3.2	5.4
24	2.4	5.2	24	4.2	8.1
25	2.8	6.2	25	3.3	4.9
26	3.0	6.0	26	6.9	9.5
27	2.2	4.9	27	3.5	5.1
28	1.3	3.5	28	3.5	6.5
Lower dental arch					
Adults			The elderly		
Tooth	Existing root (%) (a)	Exposed root (%) (b)	Tooth	Existing root (%) (a)	Exposed root (%) (b)
38	2.6	6.7	38	7.6	13.2
37	1.9	4.4	37	2.9	5.1
36	3.5	8.2	36	6.2	10.0
35	2.8	5.5	35	6.2	9.7
34	2.4	4.8	34	10.1	15.2
33	0.9	1.9	33	7.7	11.2
32	0.8	1.6	32	4.1	5.9
31	0.5	1.1	31	3.1	4.3
41	0.5	1.1	41	3.2	4.4
42	0.8	1.6	42	3.9	5.6
43	0.8	1.7	43	7.4	10.9
44	2.1	4.2	44	12.3	16.8
45	2.7	5.1	45	9.1	13.8
46	3.0	6.7	46	13.0	22.5
47	2.1	5.0	47	11.8	20.8
48	2.4	6.1	48	10.3	20.0

In Brazil, in 2010, both adults and the elderly had higher means of the untreated caries component in the DF-R index, with a maximum value of 0.88 in elderly Brazilians. In Thailand, 18.2% of the elderly with root caries had a mean DF-R of 0.58,<sup>9</sup> and in Sri Lanka the elderly had DF-R of 3.8, much higher than the Brazilian mean which was 0.32.<sup>7</sup> In the study carried out in Greece<sup>8</sup> the mean number of roots with caries was preponderant in both population groups

and the mean of the indicator was 0.29 in adults and 2.66 in the elderly.

The literature indicates that the mandibular arch is most affected by root caries,<sup>4,6,16</sup> as observed in elderly Brazilians in 2010. However, in adults, the upper dental arch was most affected by root caries, with the highest prevalence among the molars, as in the findings of Kularatne et al<sup>7</sup>(2007). With regards gender, the disease is more common in males, both in adults and

the elderly, corroborating the results of the study by Nicolau et al (2000).<sup>9</sup>

This study was carried out with a representative sample of the Brazilian population, enabling estimates for each of the 32 domains (the capitals and the five regions) to be made, with very high participation rates (over 95% for both age groups), which suggests that there was no selection bias. Moreover, all of the diagnosis criteria used were those proposed by the WHO, enabling comparisons to be made with studies in other regions; the analyses were carried out taking into account the complex sample design and the individual sampling weight. Improvements in the methodological procedures adopted in this study compared with the previous, 2003, study were observed. On the other hand, it should be considered that the sample calculation for all ages and age groups was carried out using coronal caries, which occurs more frequently than root caries, as a parameter. Even with the care and rigor with which the field work teams were calibrated for all of the oral health problems studied, the fact that diagnostic reproducibility of root caries was not measured may have led to a loss in the accuracy of the estimates (random error). There is no indication that this aspect systematically affected the validity of the study (measurement bias). The examiners were calibrated for damage to the crown from caries. The standardized criteria which define damage from caries in the root are simpler than those applied to the crown, which can present more varied damage. Therefore, the difficulties in identifying damage to the root are presumably fewer compared with damage to the crown.

It is difficult to compare the results of this study with others identified in the literature both due to methodological differences, considering the sample size, as there are few population based studies, and to standardization of the indicators used. Rihs et al<sup>12</sup> (2008), evaluating adults and the elderly with teeth, stated that the same criteria and indicators needed to be adopted for root caries permitting comparisons between places and over time.

The criterion of excluding, or not, edentulism, may also affect the results of these measurements. Since the beginning of the 1990s, Katz<sup>5</sup> (1990) has recommended that diagnostic criteria be followed in descriptive and analytical studies of root caries and in experimental studies. It was the same author who proposed, ten years previously, a specific index for root caries (RCI) which considers the roots at risk, in other words, only those which are exposed. Thus, according to Katz, if a study considers all roots this will lead to underestimation of 30% in index values.

The presence of cervical restorations, which could have been recommended for abfraction or dentin sensitivity, makes it difficult to know the real experience of root caries and its prevalence.<sup>19</sup> However, any interference in the estimate of root caries was minimal as the DF-R was mostly composed of untreated caries.

Ageing populations have been observed in many countries, and Brazil is the country in which the demographic transition has occurred most rapidly.<sup>14,18</sup> Monitoring, prevention and treatment of root caries is becoming essential to keeping natural teeth and to the subsequent decrease in edentulism. The results of this study suggest the importance of studies of root caries using uniform criteria which cover its form diagnosis, studies on associated factors and appropriate treatment recommendations.

The prevalence and extent of root caries in Brazil varies greatly between and within the macro-regions, both for adults and for the elderly. It is suggested that this health problem be monitored as the demographic transition and the adults and the elderly keeping their own teeth are making this an increasingly important health care problem.

Documenting these contrasts is relevant for instituting programs aiming at intervention in oral health, simultaneously promoting health, wellbeing and social justice.



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