

## Periodontal outcomes and social, racial and gender inequalities in Brazil: a systematic review of the literature between 1999 and 2008

Condições periodontais e desigualdades sociais, raciais e de gênero no Brasil: revisão sistemática da literatura do período de 1999 a 2008

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### Abstract

*The objective of this study was to review the Brazilian epidemiologic literature on periodontal outcomes and socio-demographic factors, assessing bibliographic and methodological characteristics of this scientific production, as well as the consistency and statistical significance of the examined associations. A systematic review was carried out in six bibliographic sources. The review was limited to the period between 1999 and 2008, without any other type of restriction. Among the 410 papers identified, 29 were included in the review. An increasing number of articles, specifically in the last four years of study, was observed. However, there is a concentration of studies in the South and Southeast regions of Brazil, and many of them are not closely connected to theoretical formulations in the field. In spite of these shortcomings, the review findings corroborate the idea that poor socioeconomic conditions are associated with periodontal outcomes, as demonstrated primarily by income and schooling indicators.*

*Periodontal Diseases; Health Inequalities; Review*

### Introduction

Globally, signs of gingival inflammation (gingivitis) are observed in the majority of the population, while, among adults, the initial stages of periodontal disease (periodontitis) are highly prevalent <sup>1</sup>. It is estimated that severe periodontitis, which may result in tooth loss, affects between 5% and 15% of most populations worldwide <sup>1</sup>. Aggressive periodontitis, a severe condition affecting individuals during puberty that leads to premature tooth loss, affects around 2% of youths <sup>1</sup>. In addition, as periodontal diseases cause an impact on individuals and communities <sup>2</sup>, and the costs involved in the treatment of the most severe cases are high, these are considered one of the main public health concerns in the oral health field <sup>1</sup>.

Periodontal diseases are associated with negative self-rated oral health, even when other dental outcomes and socioeconomic conditions are taken into account <sup>2</sup>. Contrary to what happens with dental caries, the prevalence of periodontal diseases may increase in the future as a consequence of improvements in life expectancy and the growth of populations, which will present an increased number of people with a higher number of natural teeth <sup>3</sup>. This picture is particularly relevant in countries, such as Brazil, which experience a rapid ageing process.

The accumulation of supra- and specific subgingival microflora of dental plaque biofilms are

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the main causes of both destructive periodontal disease and gingivitis<sup>4</sup>, mainly due to poor oral hygiene; diabetes mellitus, and tobacco smoking have also been identified as important risk factors for the development of these inflammatory processes<sup>5</sup>. In contrast, the role of other potential risk factors, such as the ageing process, needs to be clarified in future investigations<sup>5</sup>.

In spite of insufficient tooth-brushing and smoking being more prevalent among population subgroups that are socially and economically underprivileged<sup>6</sup>, most epidemiological and clinical research investigating the causes of periodontal diseases focus on their biological aspects, with a recent emphasis on genetic characteristics of individuals and on the morphology and microbial aspects of periodontal sites<sup>7</sup>.

Research carried out in the USA indicated that periodontal diseases are more prevalent among people who classify themselves as black, and in those with low levels of schooling and income. Moreover, these inequalities have persisted over the years<sup>8,9</sup>. On the other hand, the authors of a systematic review<sup>10</sup> addressing socioeconomic inequalities in the distribution of periodontal diseases emphasized that these disparities were inconsistent, particularly in studies with a prospective longitudinal or case-control design, in which smoking status was included as a covariate in the analyses. Based on these results, they argued that socioeconomic variables appeared to be of less importance than smoking for periodontal disease etiology. Nevertheless, this synthesis included only five studies carried out in low-income countries out of the 47 reviewed, with no investigations originating in Brazil. Furthermore PubMed was the only data source used by these authors, and the period covered ended in 2004.

Reviews assessing social inequalities in the occurrence of periodontal outcomes are absent in Brazil. This causes some concern, because socioeconomic, cultural and environmental conditions are considered the most distal determinants of diseases<sup>11</sup>. Latin America and Sub-Saharan Africa are the regions with the highest levels of income inequality in the world<sup>12</sup>. Despite a decrease in income inequality in Latin America in 2000, the situation is still dramatic. Brazil, for example, has the fifth most unequal income distribution in this already unequal part of the world<sup>13</sup>.

Although social inequalities are more pronounced in oral health outcomes than in any other health outcome<sup>14</sup>, there is a lack of summarization and systematization of knowledge of this field in Brazil. **In particular, no previous literature review attempted to answer the following two re-**

**search questions: “Are there socioeconomic and demographic inequalities in the occurrence of periodontal outcomes in Brazil?” “Are studies addressing such inequalities devised to test specific hypotheses, derived from consistent theories on the subject matter?”** The answers to these questions need to be made available to policy makers in order to implement public policies aimed at the reduction of inequalities in oral health. **Therefore, the aim of this study was to identify and to analyze research carried out in Brazil, investigating the association between periodontal outcomes and socioeconomic conditions, race, ethnicity or skin color and sex/gender.**

## Methods

### Search strategy and bibliographic sources

This literature review was based on the following six electronic bibliographic data sources: **LILACS (Latin American and Caribbean Literature in Health Sciences), BBO (Brazilian Dentistry Library), MEDLINE via PubMed, SciELO (Scientific Electronic Library on line), Scopus and Web of Science.** Each data source was checked for availability and usage of controlled vocabulary for indexation through the use of hierarchically defined and periodically updated thesauruses. This strategy enabled, in four out of six data sources, the construction of specific search queries by taking into consideration the terms of interest and the hierarchical structures in which these were found. For the data sources in which a thesaurus was unavailable, the search was performed using free search terms, based on the controlled vocabulary already used and on the previous experience of the authors of this review. **The literature search was conducted within a limited time frame, from January 1999 to December 2008 without any type of restriction.**

When possible, search queries followed a previously planned structure. **The first group of terms would define the outcomes of interest, in this case, all expressions possibly related to periodontal outcomes. Another term would define the publication's country of origin – Brazil. Finally, the last group of terms would cover the socioeconomic and demographic conditions of interest: Brazilian region, place of residence (rural or urban), sex/gender, race, ethnicity or skin color, and social position of investigated groups and individuals.** For instance, the search query used in PubMed included the following controlled and free terms: *periodontal diseases, Brazil, population characteristics, state government, geographic locations, skin pigmentation, race relations, race,*

minority groups, sex, and sex factors. The complete list of search queries used in this review is available from the authors upon request.

In this review we approached all possible *periodontal outcomes*, instead of focusing on specific periodontal pathological conditions, including mild and severe conditions, such as gingivitis and clinical attachment loss or periodontitis. This is justified due to the scarcity of Brazilian studies in the field, and because the controlled term *periodontal disease* automatically covers, for example, in PubMed any pathological process involving the *periodontium*, including less severe conditions such as gingivitis and gingival recession.

#### Identification of studies and inclusion criteria

The following criteria were adopted for the selection of potentially eligible papers: (a) the studies should be epidemiologic, without any restriction on design, and should address any type of periodontal outcome; (b) the subjects investigated should live in Brazil; and (c) the papers should examine the relationship between the socioeconomic and demographic conditions and the outcome. Studies included were those with an explicit interest in the investigation of social determinants of periodontal conditions, as well as investigations with a different objective, but which also empirically examined some or all of the relations of interest for this review.

Search results in each of the data sources investigated were stored and managed with EndNote, version 8 for Windows (Thomson Reuters, <http://www.endnote.com>, United States). The first and the second authors of this review read the article titles independently and, when necessary, the abstracts of the selected articles in order to exclude papers which did not meet the inclusion criteria. When the paper was considered relevant for the review but its abstract was unavailable, the full text of the article was obtained and then evaluated for inclusion criteria. Disagreements between the two reviewers were sorted out by consensus by reading the full article for a final decision to be made.

In addition to the identification of the papers in the mentioned data sources, all articles referred to in the searched papers were checked to determine whether they met the inclusion criteria. Disagreements between the two reviewers were discussed according to the above mentioned criteria and refereed by a third author.

#### Data extraction

All papers that were included had their data extracted independently by the same two authors, using a spreadsheet pre-tested in a sample of articles. The information that was extracted was checked by the authors and, when necessary, a new consultation was performed by reading the full texts again. We did not estimate agreement measures from the extracted data between the authors. Data were typed independently by a research assistant in EpiData, version 3.1 for Windows (Epidata Association, Odense, Denmark), which automatically checked data consistency and amplitude.

For each article included, information referring to the journal, year of publication, first author institutional affiliation, Brazilian region in which the study was conducted, minimum and maximum sample age and sample size (taking into account drop-out or exclusion explained by the article's authors) were all extracted for each article of this review. In addition, it was verified if the study evaluated the association between periodontal outcomes and socioeconomic and demographic characteristics, adopting an explicit theoretical framework. The type of epidemiological design (cross-sectional, ecological, case-control, cohort, or other) and the sampling scheme (self-weighted, complex, convenience, census, or other) were also described.

With regard to periodontal outcomes, we collected indexes and criteria adopted in the evaluation of periodontal conditions. We also detailed the socioeconomic and demographic variables collected, the associations that were statistically significant ( $p < 0.05$ ) with the studied outcomes, and the direction or shape of these associations. Outcomes encompassed gingivitis, periodontitis, and other periodontal conditions, defined according to criteria adopted by the original authors of the reviewed studies. The direction or shape of association was classified as follows: positive, negative, U shaped (intermediate exposure categories of a variable with 3 or more categories showing lower outcome frequencies than categories from higher and lower exposure), and not described. When sex/gender and race, ethnicity or skin color were taken into account, the direction of association was classified as higher in males, higher in females, higher in self-reported whites and so on. All directions and shapes of association were described for all cross tabulations and not only for those which were statistically significant. This allowed for the estimation of the proportion of statistically significant associations among all those evaluated in the original studies.

### Quality assessment

This review was set up to evaluate the methodological quality of the included investigations with the Downs & Black's<sup>15</sup> checklist, as this instrument has been previously used with observational studies<sup>16</sup>. However, this checklist performed poorly in a sample of three studies fitting the eligibility criteria. Thus, information on the methodological characteristics of the studies were collected only with regard to the following aspects: the presentation of outcome reliability measures, parameters for the calculation of sample sizes, eligibility criteria for study participants, and description of data quality control strategies.

### Statistical analysis

Analysis included the description of the above mentioned characteristics of articles by means of relative and absolute frequencies as well as by contingency tables. All analyses were performed using the Stata, version 9 software (Stata Corp., College Station, USA).

### Results

The bibliographic characteristics of 29 articles<sup>17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45</sup> included in this review (see Figure 1 with the review flow chart) are shown in Table 1. The period between 2005 and 2008 accounts for more than half of all scientific production in the period studied. A noticeable concentration of articles originated from the South and Southeast regions of Brazil; almost one quarter of all production came from the São Paulo University (Universidade de São Paulo). The articles were published in 14 journals; three international journals had the highest number of published articles. The population studied was relatively young, and a wide variation in the sample sizes was observed. Almost all studies (N = 28; 96.6%) adopted a cross-sectional design, using a complex sampling design.

The participants' eligibility criteria, the detailed explanation about the outcome as well as the presentation of their reliability measures were found in most of the studies reviewed. On the other hand, the theoretical framework used to explain the relationship between the outcome and the socioeconomic and demographic exposures was rarely clarified. Few studies presented the parameters that guided the sample size calculation and very few described strategies to assess data quality control (Table 2).

Table 3 displays the wide variability of periodontal outcomes and socioeconomic and demographic variables tested in the original studies. Different classification criteria of periodontal outcomes were used, with a high concentration in one main index, the Community Periodontal Index (CPI). The most common inequality indicators were sex/gender, schooling, income and race, ethnicity or skin color.

Table 4 summarizes the direction or shape of association between studied outcomes and socioeconomic and demographic indicators, as well as their statistical significance. Geographical region and place of residence were excluded from this analysis because their associations with the periodontal outcomes were only tested four times. The most tested socioeconomic and demographic variable was sex/gender followed by income, race, ethnicity or skin color, schooling and by one variable which combined different indicators of socioeconomic position. Periodontal outcomes were relatively more frequent among males, being statistically significant in almost half of these associations. Income and schooling were negatively associated with periodontal outcomes in nearly all of the cross-tabulations; among them, a third and two-thirds were statistically significant, respectively. Those self-reported as non-black showed higher frequencies of periodontal outcomes in half of the examined associations but a statistically significant association was found only in two. In all nine situations where the combined socioeconomic position indicator was used, it was negatively correlated with periodontal outcomes, but these associations were statistically significant in only half of the cases.

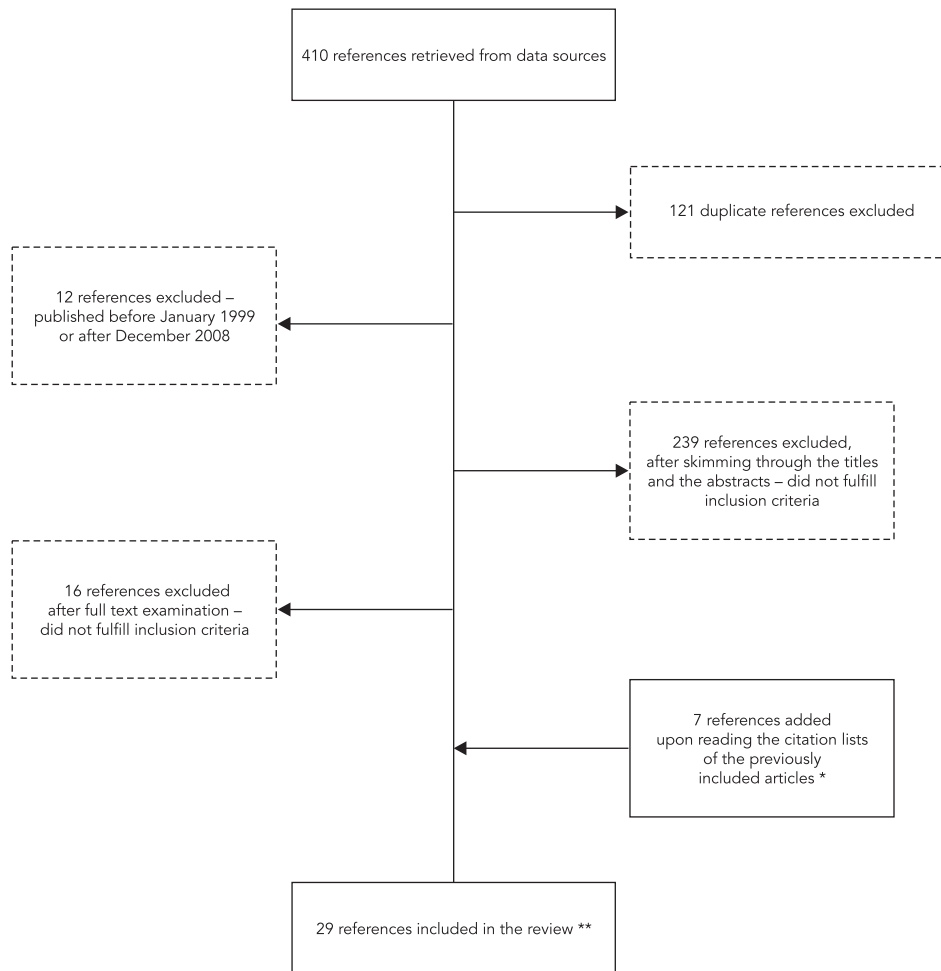
### Discussion

The Brazilian scientific literature addressing social determinants of periodontal outcomes is quantitatively limited, but an increase in its production has been identified over the last few years. However, the increase of this literature does not seem to be closely connected to theoretical formulations in the field, and the papers reviewed here do not seem to answer relevant or specific research questions. On the other hand, this picture represents the current stage of Brazilian research in general and oral health specifically; an expressive increase in the number of published papers is observed<sup>46,47,48</sup> but its quality needs to be improved.

In spite of the aforementioned limitations, the review findings allow us to corroborate the idea that poor socioeconomic indicators are associated with periodontal outcomes, contrary

Figure 1

Systematic review flowchart.



\* References: 18,19,20,21,22,36,53;

\*\* References: 17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45.

to the main argument pointed out previously in the literature<sup>10</sup>. Klinge & Norlund<sup>10</sup> suggest that the statistically significant and negative association between socioeconomic conditions and periodontal disease is questionable, because the studies that come to this conclusion have been, in their majority, cross-sectional and most did not adjust this association for smoking in their analysis. Both arguments are doubtful. Firstly, the main limitation of cross-sectional studies is the difficulty in establishing temporal relationships, which makes the assessment of causality even more complex. However, when social determinants in oral health are the focus of the in-

vestigation, it is less probable that this kind of difficulty arises, given that many of the exposures of interest are quite stable and/or occur early in the life course. Care must be taken, though, since this last assertion may not always apply to the wide variety of inequality indicators used in the reviewed studies. Secondly, tobacco smoking is an intervenient factor of the relationship between socioeconomic indicators and periodontal outcomes, and as such, it is not recommended to be controlled for when statistical analysis is performed<sup>49</sup>.

A concentration of the reviewed research in the South and Southeast regions of the country

Table 1

Distribution of studies included, according to bibliographic characteristics, study sample size and participants' age. Brazil, 1999-2008.

Characteristic	n	%
Year of publication		
1999-2000	2	6.9
2001-2002	5	17.2
2003-2004	6	20.7
2005-2006	7	24.1
2007-2008	9	31.0
Brazilian region		
Northeast	3	10.3
North	1	3.4
Southeast	11	37.9
South	13	44.8
Does not apply (nationally representative study)	1	3.4
First author's institution		
USP	6	20.7
Temple University, United States of America	5	17.2
UFSC	2	6.9
UNICAMP	2	6.9
Other *	14	48.3
Journal		
<i>Journal of Clinical Periodontology</i>	7	24.1
<i>Journal of Periodontology</i>	6	20.7
<i>Oral Health &amp; Preventive Dentistry</i>	3	10.3
<i>Revista de Saúde Pública</i>	3	10.3
<i>Pesquisa Odontológica Brasileira</i>	2	6.9
Other **	8	27.6
Sample size		
Minimum-maximum	96-11,342	
Mean sample size (standard deviation)	1,085 (2,230)	
Median sample size	518	
Participants' age		
Minimum age [mean (standard deviation)]	16 (10)	
Minimum age [median]	14	
Maximum age [mean (standard deviation)]	42 (36)	
Maximum age [median]	22	

\* Remaining institutions published only one article each;

\*\* Remaining journals (n = 8) published only one article each.

UFSC: Santa Catarina Federal University; UNICAMP: Campinas State University; USP: São Paulo University.

and the supremacy of cross-sectional studies follow the general trends for overall scientific production in Brazilian health sciences. It is desirable that research activities be developed in other Brazilian regions, especially in those where social inequalities are preminent. The predominance of cross-sectional studies in our review was expected and it is understandable, because this epidemiological design is practical and less

expensive in comparison with other kinds of studies.

The majority of the scientific production reviewed was published in international journals. From a scientific point of view, this may reflect the broad international interest in inequalities in periodontal diseases. However, this makes it difficult to ensure that these papers are widely available, especially for Brazilian

Table 2

Distribution of studies included, according to methodological characteristics. Brazil, 1999-2008.

Characteristic	n	%
Study design		
Cross-sectional	28	96.6
Case-control	1	3.4
Sampling process		
Simple casual sampling	2	6.9
Complex	15	51.7
Convenience sampling	7	24.1
Census	4	13.8
Not described	1	3.4
Clarification of the theoretical framework underlying relationships between exposure and outcome	5	17.2
Description of eligibility criteria for study participants	26	89.7
Presentation of parameters for sample size calculation	12	41.4
Clear definition of outcomes	29	100.0
Presentation of outcome reliability scores	22	75.9
Report of data quality control strategies	3	10.3

Table 3

Reviewed studies, according to their characteristics. Brazil, 1999-2008.

First author's surname	Publication year	Minimum age	Maximum age	Sample size	Study design	Outcome assessment	Inequality indicators *
Antunes et al. <sup>17</sup>	2008	15	19	1,799	Cross-sectional	CPI – CPI = 1 in 1+ sextants, CPI = 2 in 1+ sextants	Color/race, household crowding, municipal human development index, place of residence, school retard, sex
Cortellazzi et al. <sup>28</sup>	2008	5	5	728	Cross-sectional	3+ teeth with gingival bleeding	Car ownership, household crowding, household ownership, income, parental schooling, sex, type of school
Coelho et al. <sup>26</sup>	2008	18	85	505	Cross-sectional	CPI - gingival bleeding, calculus, 4-5mm pockets and 6+mm pockets	Schooling, sex, socioeconomic position
Corraini et al. <sup>27</sup>	2008	12	Not declared	195	Cross-sectional	% of teeth with probing depth of 4+mm or 6+mm	Illiteracy, income, sex
Corraini et al. <sup>25</sup>	2008	12	Not declared	195	Cross-sectional	1+ sites with loss of attachment of 3+mm and 7+mm	Illiteracy, income, schooling, sex
Peres et al. <sup>39</sup>	2007	35	44	11,342	Cross-sectional	1+ teeth with loss of attachment loss of 3+mm or pocket	Color/race, income, schooling, sex

(continues)

Table 3 (continued)

First author's surname	Publication year	Minimum age	Maximum age	Sample size	Study design	Outcome assessment	Inequality indicators *
Bassani et al. <sup>23</sup>	2007	Not declared	Not declared	915	Case-control	3+ sites, from different teeth, presenting 3+mm of loss of attachment, having the cement–enamel junction as reference	Color/race, schooling and socioeconomic position
Santos et al. <sup>31</sup>	2007	10	18	765	Cross-sectional	% of sextants with gingival bleeding, presence of calculus, and presence of gingival recession/hyperplasia	Sex, type of school
Nicolau et al. <sup>38</sup>	2007	12	12	224	Cross-sectional	> 41% of all teeth with loss of attachment	Income, paternal schooling, respondent schooling
Antunes et al. <sup>24</sup>	2006	12	12	5,780	Cross-sectional	CPI – CPI ≥ 1 in 1+ sextants, and CPI = 2 in 1+ sextants	Color/race, sex, type of school
Pion et al. <sup>20</sup>	2006	10	76	588	Cross-sectional	Counts of teeth with probing depth of 3+mm	Sex
Feldens et al. <sup>32</sup>	2006	3	5	490	Cross-sectional	Ainamo & Bay <sup>54</sup> gingival bleeding index in 1+ tooth surfaces	Income, maternal schoolings, sex
Hugo et al. <sup>34</sup>	2006	50	86	230	Cross-sectional	Ainamo & Bay <sup>54</sup> gingival bleeding index, > the population mean of teeth with bleeding sextants	Income, schooling, sex
Macedo et al. <sup>30</sup>	2006	20	60	172	Cross-sectional	4+ teeth with 1 or more sites with probing depth of 4+mm and loss of attachment of 3+mm in the same site	Household crowding, income, schooling, sex
Susin & Albandar <sup>41</sup>	2005	14	29	612	Cross-sectional	4+ teeth with loss of attachment of 4+mm or 5+mm	Color/race, sex, socioeconomic position
Susin et al. <sup>45</sup>	2005	30	103	853	Cross-sectional	1%-20% of all teeth with probing depth 5+mm, > 20% with probing depth 5+mm	Color/race, sex, socioeconomic position
Susin et al. <sup>42</sup>	2004	30	103	853	Cross-sectional	15-50% or > 50% of all teeth with loss of attachment 5+mm	Color/race, sex, socioeconomic position
Susin et al. <sup>43</sup>	2004	14	Not declared	843	Cross-sectional	1-15% of all teeth with gingival recession of 1+mm and 3+mm, 16+% of all teeth with gingival recession of 1+mm and 3+mm	Color/race, sex, socioeconomic position
Susin et al. <sup>44</sup>	2004	30	103	843	Cross-sectional	> 30% of all teeth with loss of attachment 5+mm	Color/race, sex, socioeconomic position

(continues)



Table 3 (continued)

First author's surname	Publication year	Minimum age	Maximum age	Sample size	Study design	Outcome assessment	Inequality indicators *
Segundo et al. <sup>40</sup>	2004	13	Not declared	96	Cross-sectional	% of all teeth with gingival bleeding, attachment loss of 4+mm, % of dental surfaces with calculus, and probing depth of 4+mm	Schooling, sex
Moraes <sup>18</sup>	2003	3	5	518	Cross-sectional	Ainamo & Bay <sup>54</sup> gingival bleeding index – % of all dental surfaces with gingival bleeding, presence of teeth with probing depth of 2+mm	Sex
Nicolau et al. <sup>37</sup>	2003	13	13	311	Cross-sectional	CPI – gingival bleeding in > 62% of all teeth	Bathroom in the household, car ownership, household ownership, household crowding, income, paternal schooling, maternal schooling, school retard, piped water in the household
Cortelli et al. <sup>29</sup>	2002	15	25	600	Cross-sectional	Incipient, localized and generalized periodontitis	Color/race, sex, socioeconomic position
Maltz et al. <sup>35</sup>	2001	12	12	1,000	Cross-sectional	van der Weijde <sup>55</sup> gingival bleeding index – % of bleeding surfaces	Income, parental schooling, type of school
Gesser et al. <sup>33</sup>	2001	18	18	286	Cross-sectional	Gingival bleeding in 1+ sextants, calculus in 1+ sextants, and pockets in 1+ sextants	Income, maternal schooling, paternal schooling, respondent schooling
Cangussu & Coelho <sup>22</sup>	2001	5	15	252	Cross-sectional	CPI – counts of teeth with gingival bleeding, calculus and shallow pockets, % of healthy sextants	Income, urban/rural residence
Ronderos et al. <sup>21</sup>	2001	20	70	244	Cross-sectional	Periodontal attachment loss in millimetres, probing depth in millimetres, and distance from gingival margin to the cement-enamel junction in millimetres	Ethnicity, sex
Machion et al. <sup>36</sup>	2000	15	Not declared	100	Cross-sectional	WS system probing depth <sup>56</sup> – counts of 3+mm pockets	Sex
Tomita et al. <sup>19</sup>	1999	15	Not declared	156	Cross-sectional	CPI – counts of teeth with calculus, 4-mm pockets, and 6+mm pockets	Income, sex

CPI: Community Periodontal Index.

\* Socioeconomic position refers to an index combining information on household assets and participants' schooling. Such an index was used, for instance, in the study by Susin et al. <sup>45</sup>.

Table 4

Statistical significance and direction or shape of association between periodontal outcomes and indicators of inequality \*. Brazil, 1999-2008.

Indicator of inequality	Direction or shape of association	% statistically significant ( $p < 0.05$ )	Frequency with which this direction or shape of association was observed
Schooling	Negative	60.0	10 (83.4)
	Positive	-	1 (8.3)
	U shaped	-	1 (8.3)
Income	Negative	30.0	10 (71.4)
	Positive	-	3 (21.4)
	Not described	-	1 (7.2)
Race, ethnicity or skin color	More frequent in Blacks and/or Browns	80.0	5 (38.5)
	More frequent in non-Blacks	33.3	6 (46.2)
	No difference	-	1 (7.7)
	Not described	-	1 (7.7)
Sex/gender	More frequent in men	45.8	24 (77.4)
	More frequent in women	50.0	4 (12.9)
	Not described	-	3 (9.7)
Socioeconomic position **	Negative	44.4	9 (100.0)

\* We show only those indicators of inequality that were cross-tabulated with periodontal outcomes at least nine times;

\*\* Socioeconomic position refers to an index combining information on household assets and participants' schooling. Such an index was used, for instance, in the study by Susin et al. 45.

policymakers. Among the strong aspects identified in the review, we stress the authors' emphases on the proper periodontal outcome definition and conceptualization, along with the wider use of diagnostic reliability measures. On the other hand, the lack of theoretical support of the relationship between periodontal outcomes, socioeconomic and demographic variables, the absence of parameters which guided sample size calculation, and the lack of mention about data quality control are the main limitations of the papers analyzed here. The use of insufficient sample sizes and inadequate sample selection procedures, for instance, may lead to selection bias and, consequently, preclude the study's results.

Corroborating with the periodontal epidemiological literature, we noticed a plethora of periodontal disease indicators used for the studies. Among those indexes used, we highlighted the CPI, which is recommended by the WHO in oral health surveys. However, this index has some limitations, such as the underestimation of the less severe periodontal conditions (for example, calculus and gingival bleeding) and underestimation of the outcome prevalence. These weaknesses are particularly relevant when etiological studies are taken into account 50.

Schooling and income were the most used socioeconomic indicators in the articles re-

viewed, a similar result found among Brazilian studies carried out in the 1990s which addressed social stratification in dental caries and epidemiological studies of periodontal outcomes 51. Level of education is easily assessed; it is useful because it can be applied to both sexes, is applicable to persons not in the labour force, has stability over the adult lifespan, and is comparable between different regions. In addition, a higher education level is generally predictive of better jobs, higher incomes, better housing and socio-economic position 52. Race, ethnicity or skin color has been investigated less as a "determinant" of periodontal outcomes. When this issue is addressed, the authors have not explained what race, ethnicity or skin color are proxies for, nor have they provided theoretical explanations about how race, ethnicity or skin color would act in their analytical models. It is very important to emphasize the absence of any social class indicator in the studies reviewed. Social class is difficult to use from a practical point of view and requires a deep theoretical basis. However, studies employing social class indicators may shed some light into other sources of variability in periodontal outcomes, which were not addressed by the studies reviewed.

Some comments about the limitations of this review are necessary. Firstly, we did not search for references in book chapters or text-books, nor

did we consult Masters' Dissertations or Doctoral Theses. Experts in the field were not contacted in order to identify and obtain unpublished works or those which were not stored in the selected electronic data sources. Secondly, the review findings were not stratified according to different periodontal outcomes, i.e. gingivitis and periodontitis, which may be implicated in somewhat different etiological mechanisms. Moreover, our analysis of the associations between inequality indicators and periodontal outcomes did not take into account the magnitude of the effects and adjustment for confounding variables; reliance only on statistical significance may be misleading in

some cases, especially those in which it derives from unadjusted analysis or the effect size is not relevant. Finally, this review was restricted to the period between 1999 and 2008, such that some of its conclusions may not be applicable to previous decades of periodontal research in Brazil.

In summary, we suggest that periodontal outcomes are more prevalent among social groups placed at the bottom of the social ladder, which may be interpreted as social inequalities in periodontal health. General policies towards a reduction of social inequalities should be considered in addition to specific periodontal oriented programs.

## Resumo

*O objetivo deste trabalho foi revisar a literatura epidemiológica brasileira sobre condições periodontais e aspectos sociodemográficos, avaliando características bibliográficas e metodológicas dessa produção, bem como a consistência e a significância estatística das associações examinadas. Foi conduzida uma revisão sistemática, por meio de consulta eletrônica, a seis fontes bibliográficas. A revisão foi restrita ao período de 1999 a 2008, sem a imposição de quaisquer outros limites de pesquisa. Entre os 410 artigos identificados, 29 foram incluídos na revisão. Observa-se crescimento da produção, especialmente no último quadriênio. Entretanto, há uma concentração dos estudos nas regiões Sul e Sudeste do país, e os trabalhos não se apoiam explicitamente em elaborações teóricas pertinentes ao tema. Apesar dessas limitações, os resultados dessa revisão sugerem que há uma relação inversa entre indicadores socioeconômicos e desfechos periodontais, demonstrada especialmente por indicadores de renda e escolaridade.*

*Doenças Periodontais; Desigualdades em Saúde; Revisão*

## Contributors

J. L. Bastos planned the study, performed the systematic review, analysis and interpretation of the data. A. F. Boing planned the study, performed the systematic review and helped interpret the data. K. G. Peres and J. L. F. Antunes contributed to the interpretation of the data. M. A. Peres planned the study and helped analyze and interpret the data.

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