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Destructive periodontal disease in adult Indians from Northeast Brazil: cross-sectional study of prevalence and risk indicators

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Abstract

Aim: The aim of this cross-sectional study was to evaluate the prevalence of destructive periodontal disease and its risk indicators in adult Kiriri Indians from Northeast Brazil.

Materials and Methods: Full-mouth periodontal examinations were performed on a sample of 215 Indians (≥19 years). Bivariate analyses and logistic models were applied to assess associations between periodontitis and its putative risk factors.

Results: Prevalence of clinical attachment loss of ≥3, ≥5 and ≥7 mm was 97.8%, 63.8% and 30.8% respectively. Percentage of teeth per individual showing clinical attachment loss of ≥3, ≥5 and ≥7 mm was 49.8%, 18.4% and 8.0% respectively. After adjustment for covariates, individuals aged ≥35 years (OR = 5.83, 95% CI: 3.09–11.00; $p < 0.001$), men (OR = 2.18, 95% CI: 1.15–4.11; $p = 0.02$) and diabetics (OR = 3.92, 95% CI 1.03–14.99; $p = 0.05$) had a higher risk for destructive periodontitis, classified according to the CDC/AAP case definition.

Conclusion: Though periodontitis was highly prevalent in Kiriri Indians, only few teeth showed advanced disease, and periodontitis was associated with higher age, male sex and diabetes. A public health action that includes programs of prevention and treatment targeting high-risk groups is vital to improve the periodontal status of this population.

Key words: cross-sectional study; epidemiology; Indians; periodontal disease; risk factors

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Conflict of interest and source of funding statement

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Periodontal diseases are highly prevalent and its levels may vary among different populations. The prevalence of at least one periodontal site with attachment loss >4 mm has been reported to be between 19.4% and 94.4% in adults (Baelum et al. 1988, Susin et al. 2004, Bouchard et al. 2006, Holtfreter et al. 2009, Eke et al. 2012, Kim et al. 2012). Even though most studies on periodontal diseases in Indian communities have performed only partial recording of periodontal status (excepting Dowsett et al. 2001, 2002a,b), they also showed that periodontal disease is prevalent and severe in Indians from different countries (AIHW Dental Statistics & Research Unit 2000, Skrepcinski & Niendorff 2000, Arantes et al. 2001, Dowsett et al. 2001, Ronderos et al. 2001, Dowsett et al. 2002a,b, Roberts-Thomson 2004, Brennan et al. 2007, Kruger et al. 2008, Alves Filho et al. 2009, Mesquita et al. 2010, Vieira et al. 2011).

Brazil is a large country, with a total population of 190,732,694, including more than 800,000 Indians (Brazilian Institute of Geography & Statistics 2010), who account for 0.4% of the Brazilian population. These Indians live in 683 Indian areas or in urban areas (National Indian Foundation 2012). The Kiriri Indians live in the northern region of the Bahia state in Northeast Brazil. The Kiriri Indian land covers an area of 12,300 hectares and has a semi-arid climate. Access to this Indian area is challenging, and external influences are still limited. The community comprises an isolated, typically immobile rural population of approximately 2,182 Indians. Kiriri Indians represent a unique population. Although this population has been subjected to external influence, they still maintain their social, cultural, behavioural and genetic backgrounds. While the tribe lives adjacent to Brazilian people, they have existed as a separate people and thus are likely to differ genetically. Cultural beliefs inhibit access to dental services. The material circumstances of their environment do not allow access to basic hygiene or oral care products. Kiriri diet is based on beans, manioc and corn. Consumption of sugar added to coffee and high-sugar foods is frequent. Sweet potato, pumpkin, okra, tomato, lettuce and tropical fruits are part of the nutrition of many Indians. Meat, milk and derivatives are not available for all families (Pacheco 2007). No previous epidemiological study on oral or periodontal disease has been performed in this population, and the population has not received any previous periodontal therapy.

The aim of this study was to characterize the prevalence, severity and extent of destructive periodontal disease in adult Kiriri Indians and to determine the association between destructive periodontal disease and age, sex, income, education level, diabetic status and smoking habits.

Materials and Methods

This study was conducted in accordance with the World Medical Association Declaration of Helsinki. It was approved by the Brazilian Research Ethics Committee of the Ministry of Health, Brasilia, Brazil and by Indian authorities and the Brazilian National Health Foundation (FUNASA). Individuals who agreed to participate signed an informed consent form. At the conclusion of the study, the Indian authorities and FUNASA were provided with a written report of the study results.

Study design and sampling procedures

This study was a cross-sectional survey. The target population was Kiriri Indians aged 19 years and older who were living in an isolated Indian area in the state of Bahia, in Northeast Brazil.

A representative sample of adults was calculated based on information provided by FUNASA. Of the 2182 Kiriri Indians living in the isolated Kiriri Indian area in 2011, 1025 were adults (≥19 years old). A sampling error of 5%, confidence level of 95% and maximum percentage of periodontal disease of 79% were considered for sample calculation. Considering the lack of information about the prevalence of periodontal disease in the target population, we assumed a rate of 79% based on the prevalence of clinical attachment loss (CAL) ≥ 5 mm reported for Brazilians (Susin et al. 2004). The calculated sample was 205 individuals. Considering a response rate of 90%, 226 individuals were randomly selected and invited to participate.

The response rate was 99.6%. Two hundred and twenty-five individuals ranging from 19 to 77 years old were examined; one volunteer was completely edentulous and was therefore excluded from the analysis. Nine participants with missing data were excluded from the statistical analysis.

Medical exclusion criteria included cardiovascular diseases and other conditions that require the use of antibiotics before periodontal probing. However, none of the individuals met the exclusion criteria.

Operational procedure in the field

The study was presented to the local Indians authorities, who first invited the community to participate. A few days before the clinical examinations, the community dentist and two nurses visited the selected subjects to explain the aims of the study and to encourage participation.

The fieldwork was performed during 2011. Before periodontal examination, in-person interviews were conducted by two trained nurses to collect standard data on demographic and socio-economic status as well as other health-related data using a structured written questionnaire. A fasting glucose blood test was performed on all individuals (OneTouch Ultra Mini, Lifescan, Milpitas, CA, USA).

Periodontal evaluation

Four calibrated periodontists assisted by four trained undergraduate students from the Dentistry School of the Federal University of Bahia performed the clinical examinations. Before the study, the examiners were calibrated for accuracy and repeatability on a population of 10 subjects not related to the study. The intra-class and inter-class correlation coefficient (ICC) values revealed intra-examiner and inter-examiner reproducibility on site level for probing depth (PD) (Intraexaminer: ICC 0.93–0.95; Inter-examiner: ICC ≥0.81) and the distance between the cement-enamel junction and the free gingival margin (CEJ-GM) (Intraexaminer: ICC 0.81–0.83; Inter-examiner: ICC ≥ 0.75).

Clinical examinations were performed using a headlight (Turboled, Nautika, São Paulo, São Paulo, Brazil) with the individuals seated on a regular chair in 10 rudimentary sites, including schools and health facilities.

All permanent fully erupted teeth, excluding the third molars, were examined using a manual periodontal probe (PCP-UNC 15, Hu-Friedy, Chicago, IL, USA). PD and the CEJ-GM were measured at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual). Measurements were made in millimetres and rounded to the next whole millimetre. CAL was calculated as the sum of the PD and CEJ-GM measurements.

Data analysis

The statistical analysis included 215 individuals. Prevalence (percentage of individuals having at least one tooth with the condition) and extent

(percentage of teeth per person having at least one site with the condition and percentage of sites per person having at least one site with the condition) of different levels of CAL were calculated for the total population and according to age. Destructive periodontal disease was defined as moderate (individuals with ≥2 proximal sites with CAL ≥4 mm, not on the same tooth or ≥2 proximal sites with PD ≥5 mm, not on the same tooth) or severe periodontitis (individuals with ≥2 proximal sites with CAL ≥6 mm, not on the same tooth and ≥1 proximal site with PD ≥5 mm) (Page & Eke 2007).

Demographic and socio-economic status and other health-related data were categorized. Age was categorized as 19–34, 35–44 or ≥45 years old for analysis of the prevalence and extent of disease, and as 19–34 and ≥35 years for bivariate and logistic regression analysis. Education level was categorized as ≥9 years of education or <9 years of education. Economic status was categorized as monthly income <US $259.00 or ≥US $259.00. Individuals were classified as current non-smokers or smokers. According to a self-reported physician's diagnosis of diabetes or fasting blood glucose ≥126 mg/dl associated with diabetes symptoms (increased thirst, increased urination and unexplained weight loss), the individuals were categorized as diabetic. Otherwise, they were considered non-diabetic.

Descriptive statistics assessing the distribution of destructive periodontitis according to traditional risk factors (age, sex, education, income, smoking status and diabetic status) were performed. Chi-square tests were used to compare individuals with and without destructive periodontal disease, according to the aforementioned variables.

Backward stepwise logistic regression was used to determine the set of variables that were associated with destructive periodontal disease. Gender, age, education, income, smoking habit and diabetes were entered into the model. The odds ratios (OR) together with the 95% confidence intervals (CI) were calculated. The chosen level of significance was 5%. Data analysis was performed using a statistical software program (SPSS version 13.0, SPSS Inc., Chicago, IL, USA).

Results

Forty-five percent of the individuals were males. Most individuals (61%) were young adults below 35 years of age, and had <9 years of education or had not studied at all (13%). Most individuals (84%) had an income lower than US $259.00 per month, and 13% of the individuals lived below the poverty line (income ≤US$33.27 per month). Only 14 individuals were diabetic (7%). Fifty percent were smokers, and the mean (standard deviation, SD) number of cigarettes, cigars or pipes smoked per day was 3.7 (3.8). The mean decayed, missing and filled teeth score was 10.4 (4.2 decayed, 4.9 missing, and 1.1 filled). Six people had five or fewer remaining teeth, and the mean (SD) number of remaining teeth was 22.3 (5.9) (in Table 1). Characteristics of the sample according to gender are given in the Table 1.

The prevalence of attachment loss of ≥3 mm, ≥5 mm and ≥7 mm was 98%, 64% and 31% respectively. Overall, 50%, 18% and 8% of the teeth per subject and 23%, 9% and 4% of the sites per subject had ≥3 mm, ≥5 mm and ≥7 mm attachment loss respectively (Table 2). Both the prevalence and the extent of attachment loss were higher in older individuals. In individuals ≤34 years old, the prevalence and extent of ≥5 mm attachment loss were 49% of persons and 6% of teeth, but the corresponding scores for the 35–44 years age group were 85% of individuals and 26% of teeth (Table 2).

The prevalence of PD ≥4 mm was 93%, and the extent of PD ≥4 mm was 37% of teeth and 13% of sites per person (Table 3). The prevalence and extent of PD increased from 19 to 34 years to 35–44 years, but persons 45 years and older had a lower prevalence and similar extent of PD than those in the age group 35–44 years.

In this population, 11% of the individuals had moderate periodontitis and 29% had severe periodontitis (Table 2), according to the classification of Page & Eke. Bivariate analyses showed that individuals in the age group ≥ 35 years, those who had < 9 years of education, and smokers were at a significantly higher risk of having destructive periodontal disease (moderate and severe periodontitis) than individuals of younger age, those with a higher education level, and non-smokers (Table 4). Gender, income and diabetes were

Table 1. Characteristics of the sample according to gender (Kiriri Indians, Brazil, 2011; *N* = 215)

Variables	Female	Male	Total sample
Age (years)			
19–34	58.8%	64.6%	61.4%
≥35	41.2%	35.4%	38.6%
Education			
≥9 years	29.2%	31.6%	30.2%
<9 years	70.8%	68.4%	69.8%
Income			
≥US $259.00	18.5%	13.5%	16.3%
<US $259.00	81.5%	86.5%	83.7%
Individuals living below poverty line	37.5%	54.2%	11.2%
Smoking habits			
No	56.3%	41.7%	49.8%
Yes	43.7%	58.3%	50.2%
Cigarettes smoked/day [Mean (SD)]	3.0 (3.2)	4.3 (4.4)	3.7 (3.8)
Diabetes			
No	90.8%	96.9%	93.5%
Yes	9.2%	3.1%	6.5%
Remaining teeth	22.1	22.5	22.3 (5.9)
Decayed, missing and filled teeth index [Mean (SD)]	10.4 (7.1)	10.3 (6.7)	10.4 (6.9)
Decayed	3.9 (3.9)	4.6 (4.2)	4.2 (4.0)
Missing	5.2 (5.9)	4.7 (5.3)	4.9 (5.7)
Filled	1.3 (1.8)	1.0 (1.7)	1.1 (1.7)

Table 2. Prevalence and extent of teeth and sites (mean percentage [standard error]) by degree of attachment loss and periodontal disease classification according to age (Kiriri Indians, Brazil; 2011)

	Age (years)			
	19–34	35–44	≥45	Total
N	132	38	45	215
Prevalence of individuals with				
≥3 mm	96.4 (8.4)	100.0 (16.2)	100.0 (14.8)	97.8 (6.6)
≥4 mm	75.2 (6.5)	95.0 (15.3)	97.7 (14.5)	83.5 (5.7)
≥5 mm	48.9 (4.2)	85.0 (13.7)	89.3 (13.2)	63.8 (4.3)
≥6 mm	26.3 (2.3)	72.5 (11.7)	78.7 (11.7)	45.5 (3.1)
≥7 mm	13.9 (1.2)	52.5 (8.4)	61.7 (9.1)	30.8 (2.1)
Mean percentage of teeth/subject with				
≥3 mm	35.8 (1.9)	66.7 (3.9)	76.5 (3.4)	49.8 (1.9)
≥4 mm	14.7 (1.5)	42.5 (4.6)	61.4 (4.6)	29.4 (2.0)
≥5 mm	6.1 (0.9)	25.9 (4.3)	47.9 (5.0)	18.4 (1.8)
≥6 mm	2.4 (0.5)	16.6 (3.8)	33.2 (5.2)	11.4 (1.5)
≥7 mm	1.1 (0.3)	10.7 (3.4)	25.9 (5.2)	8.0 (1.4)
Mean percentage of sites/subject with				
≥3 mm	12.8 (1.1)	32.2 (3.8)	47.0 (4.4)	23.5 (1.6)
≥4 mm	4.7 (0.7)	19.4 (3.7)	36.6 (4.6)	14.0 (1.5)
≥5 mm	1.7 (0.3)	11.7 (3.4)	27.5 (4.5)	8.9 (1.3)
≥6 mm	0.6 (0.2)	7.0 (2.7)	19.4 (4.3)	5.7 (1.1)
≥7 mm	0.2 (0.1)	3.9 (1.9)	13.9 (3.7)	3.8 (0.9)
Page & Eke classification				
None or mild	74.6 (0.4)	55.0 (0.8)	21.3 (0.6)	60.3 (0.3)
Moderate	12.3 (0.3)	0.0 (0.0)	14.9 (0.6)	10.7 (0.2)
Severe	12.3 (0.3)	45.0 (0.8)	63.8 (0.8)	29.0 (0.3)

Table 3. Prevalence and extent of teeth and sites (mean percentage [standard error]) by degree of probing depth according to age (Kiriri Indians, Brazil, 2011)

	Age (years)			
	19–34	35–44	≥45	Total
N	132	38	45	215
Prevalence of individuals with				
≥3 mm	100.0 (8.7)	100.0 (16.1)	100.0 (7.8)	100.0 (6.8)
≥4 mm	92.0 (7.9)	95.0 (15.3)	93.6 (13.9)	92.9 (6.3)
≥5 mm	62.0 (5.4)	85.0 (13.7)	74.4 (11.1)	68.8 (4.7)
≥6 mm	29.2 (2.5)	65.0 (10.5)	53.1 (7.8)	40.7 (2.7)
≥7 mm	19.7 (1.7)	45.0 (7.2)	25.5 (3.7)	25.5 (1.7)
Mean percentage of teeth/subject with				
≥3 mm	83.4 (1.7)	94.3 (1.8)	91.5 (2.3)	87.1 (1.2)
≥4 mm	29.3 (2.2)	48.0 (4.6)	51.6 (4.6)	37.3 (1.9)
≥5 mm	12.2 (1.5)	27.7 (4.1)	26.9 (4.0)	18.1 (1.5)
≥6 mm	3.9 (0.8)	13.5 (3.1)	11.5 (2.8)	7.3 (0.9)
≥7 mm	1.6 (0.3)	6.5 (1.9)	5.6 (2.0)	3.3 (0.6)
Mean percentage of sites/subject with				
≥3 mm	46.5 (1.7)	62.7 (3.0)	60.7 (3.0)	52.4 (1.6)
≥4 mm	9.2 (0.9)	18.8 (2.9)	18.1 (2.7)	12.8 (1.5)
≥5 mm	3.3 (0.5)	9.5 (2.1)	9.3 (2.2)	5.7 (1.3)
≥6 mm	0.9 (0.2)	3.8 (1.1)	3.3 (1.2)	1.9 (1.1)
≥7 mm	0.3 (0.1)	1.8 (0.7)	1.6 (0.7)	0.8 (0.9)

not significantly associated with destructive periodontal disease.

Multivariate analysis showed that individuals in the age group ≥35 years had a significantly higher risk of having destructive periodontitis (OR = 5.83) compared to individuals in the younger age group (Table 5). There also was a significantly higher risk for destructive periodontal disease in males compared to females (OR = 2.18) and in diabetics compared to non-diabetics (OR = 3.92). Income, education and smoking habit were not significantly associated with periodontitis.

Discussion

In this study, the prevalence, severity and extent of destructive periodontal disease and its risk indicators have been evaluated in adult Kiriri Indians. The results showed that periodontitis prevalence is high but disease severity and extent are low in this population. Furthermore, periodontitis was associated with higher age, male sex and diabetes, but not with smoking habits.

In this study, although destructive periodontal disease affected 40% of the individuals and 83.5% of persons had one or more teeth with CAL ≥ 4 mm, severe periodontitis was observed in 29% of the individuals, while 9% and 4% of the sites per subject had ≥5 mm and ≥7 mm attachment loss respectively. The prevalence of periodontitis in the present population was lower than the prevalence reported in developing countries. In Brazilians, the prevalence rate of CAL ≥4 mm was found to be 93% (Susin et al. 2004). The prevalence rate of CAL ≥4 mm in Kenya was 90% in individuals ≥35 years old (Baelum et al. 1988). This difference might be related to nutrition habits and cultural, behavioural and genetic backgrounds and should be further investigated. In contrast, in developed countries, there is a lower prevalence of attachment loss. In the United States, 16.2% of individuals were shown to have CAL ≥4 mm in the United States (Dye et al. 2007). In the United Kingdom, CAL >3.5 mm was found in 43% and of individuals (Morris et al. 2001). In France, 19.7% of individuals had CAL >5 mm (Bouchard et al. 2006). A lower disease extent was also described in the US population (Albandar et al. 1999) as compared with this study. These different results might be due to inequalities in social circumstances such as income, wealth, employment, educational level, environment, housing, access to dental services and other factors (Petersen & Baehni 2012). In fact, upon bivariate analysis within the Kiriri population of this study, lower education level was significantly associated with destructive periodontitis. However, income did not show a significant association with periodontitis; this was likely due to the generally low income of the population. The impact

Table 4. Bivariate analysis of the association of putative periodontal risk factors with the occurrence of destructive periodontal disease (moderate or severe periodontitis; $N = 215$)

Variables	Periodontitis, *N* (%)		Odds ratio (95% CI)	*p*-value*
	No	Yes		
Age (years)			5.20 (2.91–9.33)	<0.001
19–34	100 (75.8)	32 (24.2)		
≥35	31 (37.4)	52 (62.7)		
Gender			1.68 (0.98–2.88)	0.06
Female	79 (66.4)	40 (33.6)		
Male	52 (54.2)	44 (45.8)		
Education			2.04 (1.09–3.79)	0.02
≥9 years	48 (71.6)	19 (28.4)		
<9 years	82 (55.4)	66 (44.6)		
Income			0.96 (0.46–2.00)	0.92
≥US $259.00	21 (60.0)	14 (40.0)		
<US $259.00	110 (61.1)	70 (38.9)		
Smoking habits			1.71 (0.99–2.93)	0.05
No	72 (67.3)	35 (32.7)		
Yes	59 (54.6)	49 (45.4)		
Diabetes			2.89 (0.94–8.95)	0.06
No	126 (62.7)	75 (37.3)		
Yes	5 (35.7)	9 (64.3)		

*Chi-square test.

Table 5. Logistic regression for age, sex, smoking habits and education with the occurrence of destructive periodontitis (moderate or severe periodontitis) as the dependent variable ($N = 215$)

Variables	Odds ratio (95% CI)	*p*-value
Age (years)		
19–34	1	
≥35	5.83 (3.09–11.00)	<0.001
Gender		
Female	1	
Male	2.18 (1.15–4.11)	0.02
Diabetes		
No	1	
Yes	3.92 (1.03–14.99)	0.05

of socio-economic status on periodontitis has been shown in other populations in South America (Gamonal et al. 1998, Susin et al. 2004).

The low severity and extent of periodontal disease shown in the present population is also in concordance with several studies reporting that advanced periodontal destruction is limited to a minority of individuals and to a few teeth or sites per subject (Baelum et al. 1988, Albandar et al. 1999, Bouchard et al. 2006, Dye et al. 2007, Hugoson et al. 2008).

This study provides the first data describing the periodontal status of the Kiriri Indians of Brazil. Surveys in distinct populations of Brazilian Indians have shown lower prevalence, extent and severity of periodontitis when compared to this study (Arantes et al. 2001, Ronderos et al. 2001, Alves Filho et al. 2009, Mesquita et al. 2010, Vieira et al. 2011). In Indians from other countries, there was a high prevalence of periodontitis (AIHW Dental Statistics & Research Unit 2000, Skrepcinski & Niendorff 2000, Dowsett et al. 2001, 2002a,b, Roberts-Thomson 2004, Brennan et al. 2007, Kruger et al. 2008). It should be noted that this study used a full-mouth examination of CAL and probing method that assessed the entire circumference of the tooth, but previous studies used partial recording only or evaluated only the PD, and calibration of the examiners was not performed. Therefore, these studies may have underestimated disease status (Susin et al. 2005). Therefore, it is difficult to evaluate whether the differences between the results of the present and previous studies are due to differences between the Indian populations or to methodological differences or even examiner bias.

In line with the literature (Baelum et al. 1988, Albandar et al. 1999, Morris et al. 2001, Hyman & Reid 2003, Susin et al. 2004, Bouchard et al. 2006), the prevalence of periodontitis and severe periodontitis was considerably higher in older Indians, in males and in diabetics. However, although the bivariate analysis showed a higher risk for destructive disease in smokers compared to non-smokers, smoking habits did not show significant association with destructive periodontal disease after adjustment for covariates. Although 50% of the population were smokers, the mean number of cigarettes smoked per day was 3.7, which was considered as light smoking (Levy et al. 2009), and light smoking was not associated with increased risk for CAL in a previous study (Susin et al. 2004). One important aspect in the present population is that it reported the use of cigarettes (manufactured and hand-rolled with different products), pipes and a combination of both. In addition, many individuals described smoking only during Indian daily or weekly ceremonies.

The sample size may be a limitation of this study. Considering the logistical, financial, and political constraints involved in the development of this study, a sampling error of 5% was employed and no correction factor was used for sample size calculation.

A number of important political, economic and social changes have taken place in recent decades in Brazil, including changes in population health. There has been a sharp decrease in infectious disease mortality and the prevalence of child malnutrition, and the major vaccine-preventable diseases have been eradicated or are disappearing (Barreto & Aquino 2009). However, poverty remains widespread, particularly in indigenous communities. In the present population, health care is still insufficient for caries and periodontal disease control and access to dental services is mainly focused on tooth extraction. The present results can be used to drive action-oriented processes to mobilize and engage resources to assure public health action dealing with periodontal disease in the Indian community studied.

In conclusion, in Kiriri Indians, periodontitis prevalence was high but disease severity and extent were low. Older individuals, men and diabetics were at a greater risk of having destructive periodontal disease. Income, education and smoking were not associated with destructive periodontal disease. A public health action that includes programs of prevention, treatment and health

promotion targeting high-risk groups is vital to improve the periodontal status of this population.

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Clinical Relevance

Scientific rationale for the study: No previous epidemiological study on oral or periodontal diseases has been performed in Kiriri Indians.
Principal findings: Kiriri Indians showed a high prevalence of periodontitis, but only few teeth with advanced disease were found. Furthermore, periodontitis was associated with higher age, male sex and diabetes.
Practical implications: The present results can be used to drive action-oriented processes to mobilize and engage resources in order to assure public health action that includes programs of prevention, treatment and health promotion for the Indian community studied.