ORIGINAL ARTICLE

The effect of dental plaque level and self-performed oral hygiene on periodontal status: a cross-sectional study in Brazilian Indigenous

O efeito do nível da placa dentária e da higiene bucal autorrealizada no estado periodontal: um estudo transversal em indígenas brasileiros

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Abstract

Objective: This study evaluated the associations of periodontal status with dental plaque index and frequency of toothbrushing and flossing in Kiriri Brazilian Indigenous people. **Methods**: Gingival bleeding, periodontal clinical attachment level, and dental plaque index were clinically evaluated in 204 adult Brazilian indigenous. They were categorized as healthy, gingivitis, or periodontitis. Sociodemographic data and oral hygiene habits were registered. Bivariate and logistic regression analyses were performed (p≤0.05). **Results:** Gingivitis [odds ratio (OR): 2.83; 95% confidence interval (CI), 1.52–5.25; p=0.001] and periodontitis (OR: 6.88; 95%CI, 1.44–32.78; p=0.02) were associated with plaque index level, but not with toothbrushing or flossing frequency (p ≥0.55). **Conclusion**: Gingivitis and periodontitis were associated with higher plaque index, but not with the frequency of toothbrushing and flossing. To enhance this population's periodontal health, a prevention program focused on improving the quality of self-performed oral hygiene should be planned and implemented.

Keywords: Cross-sectional Study; Dental Plaque; Periodontal Diseases; Indigenous;. South American; Brazil.

Resumo

Objetivo: avaliar as associações do estado periodontal com o índice de placa dentária, a frequência de escovação e o uso do fio dental em Indígenas Brasileiros Kiriri. **Métodos**: sangramento gengival, nível de inserção clínica periodontal e índice de placa dentária foram avaliados, clinicamente, em 204 indígenas brasileiros adultos. Eles foram classificados como saudáveis, com gengivite ou periodontite. Dados sociodemográficos e hábitos de higiene bucal foram registrados. Foram realizadas análises bivariadas e de regressão logística (p≤0,05). **Resultados**: gengivite [Odds Ratio (OR): 2,83; Intervalo de confiança de 95% (IC), 1,52-5,25; p = 0,001] e periodontite (OR: 6,88; IC 95%, 1,44–32,78; p = 0,02) foram associados ao nível de índice de placa, mas não à frequência de escovação ou uso do fio dental (p ≥0,55). **Conclusão**: gengivite e periodontite foram associados a maior índice de placa, mas não com frequência de escovação e uso do fio dental. Para melhorar a saúde periodontal dessa população, um programa de prevenção com foco na melhoria da qualidade da higiene bucal autorrealizada deve ser planejado e implantado.

Palavras-chave: Estudo transversal; Placa dentária; Doenças periodontais; Indígena; Sul Americano; Brasil.

INTRODUCTION

Gingivitis and periodontitis encompass a wide spectrum of chronic inflammatory conditions, triggered by a dysbiotic dental plaque that induces inflammatory host responses, causing the breakdown of the tissues surrounding and supporting teeth[1,2]. Gingivitis is characterized by bleeding, swollen gums, and if untreated, eventually progresses to periodontitis, which involves the loss of supporting bone. According to the Global Burden of Disease Study (2019), severe periodontitis represents a global public health problem, with a prevalence figure of up to 50% worldwide[3]. Periodontitis is a risk factor for multiple tooth loss and masticatory dysfunction, which affects their nutrition, quality of life, and self-esteem, imposing socio-economic impacts and healthcare costs[4-6]. In addition, the spread of periodontal microorganisms and their products from dental plaque to others organs of the body is responsible for the association between periodontal disease and other common systemic conditions such as diabetes, cardiovascular disease, adverse pregnancy outcomes, and chronic obstructive pulmonary disease[7].

Accumulation of dental biofilms consequent to inadequate self-performed oral hygiene, such as toothbrushing and flossing, accounts for the initiation and progression of periodontal disease. Therefore, it is natural to assign an important role to oral hygiene in the prevention of such diseases. Although experimental research and clinical trials have shown that the effective removal of dental plaque is essential for periodontal health[8,9], the actual association between dental plaque level and periodontitis remains debatable[10,11], and no statistically significant association was found between personal oral hygiene

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and periodontitis[8,11]. Furthermore, various toothbrushing frequencies have been suggested to maintain periodontal health. Although American Dental Association recommends toothbrushing twice daily[12], oral hygiene intervals of 12, 24[13], and 48 hours[14] were shown to be compatible with periodontal health. Concerning the role of dental flossing, which appears to be a consensual measure for interdental plaque control and gingivitis prevention, there is weak evidence of unclear or small magnitude supporting that dental flossing reduces gingivitis[15]. Therefore, the actual impact of dental plaque level and the frequency of self-performed oral hygiene on periodontal status remains unclear and warrants further investigation to support planning and management of an effective health care program.

The Kiriri Brazilian Indigenous Population lives in an isolated area of 12,300 hectares, located in Northeast Brazil. The community comprises approximately 2,180 individuals. Isolated from several external influences and environmental exposures, this population also has unique cultural, social, and behavioral characteristics such as health-related traditions involving the use of plant-based medicines and prayers. Moreover, they have difficulties in accessing regular healthcare services, have little access to oral hygiene products, and some of them do not brush or floss their teeth. Consequently, the prevalence of periodontitis is high in this population. Prevalence of slight, moderate, and severe periodontitis was 97.8%, 63.8%, and 30.8% respectively[16]. Thus, performing an investigation in this population might offer additional clarification on the relationship between periodontal diseases and dental plaque levels, which will allow planning and managing an oral health program more effectively.

The present study evaluated the association of the dental plaque index (PI) and frequency of self-performed oral hygiene procedures with periodontitis and gingivitis in the Kiriri Indigenous Population. It was hypothesized that a higher PI and lower frequency of plaque control procedures are related to the periodontal status.

METHODS

The present study was conducted in accordance with the World Medical Association Declaration of Helsinki and was approved by the Brazilian Research Ethics Committee of the Ministry of Health, Brasilia, Brazil (Processes no.25000.066822/2011-45); by the Indigenous authorities; and the Brazilian National Health Foundation (FUNASA). Subjects who agreed to participate signed an informed consent form. At the conclusion of the study, the Indigenous 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 dependent variable in the analysis consisted of periodontitis and gingivitis. The independent variables were PI, age, sex, education and economic level, smoking habits, diabetes, previous dental visit, and oral hygiene instructions, tooth brushing, and flossing frequencies.

The target population was Kiriri Indigenous who were living in 9 isolated Indigenous areas in Bahia, Northeast Brazil. A representative sample of Kiriri Indians aged 19 years and older was enrolled[16,17]. The sample size was calculated for the Periodontal Health Study using the information provided by FUNASA. Of the 2,182 Kiriri Indians living in the isolated Kiriri Indigenous area, 1,025 were adults (≥19 years old). A sampling error of 5%, confidence level of 95%, and maximum rate of periodontal disease of 79% were considered for sample calculation16, which yielded a number of 205. Considering a response rate of 90%, 226 individuals were randomly selected and invited to participate. The response rate was 99.1%. Thus, 224 individuals ranging from 19 to 77 years in age were examined. One person was excluded from this study due to total edentulism.

Data collection was performed between August 2011 and August 2016. Initially, the subjects were interviewed to collect the following data: age, sex, education level, monthly income, smoking habits, tooth brushing and dental flossing frequencies, and previous dental visits and oral hygiene instructions. Subsequently, fasting blood glucose levels were measured for all individuals (OneTouch Ultra Mini, Lifescan, Milpitas, CA, USA).

Oral examinations were conducted under artificial light (Headligh, Turboled, Nautika, São Paulo, SP, Brazil) and with the subjects seated on common chairs. Examinations were performed using a dental mirror and a manual periodontal probe (PCP-UNC 15; Hu-Friedy, Chicago, IL, USA)[18]. Four calibrated periodontists assisted by four trained undergraduate students from the Dentistry School of the Federal University of Bahia performed the intraoral examinations. The examiners were calibrated for accuracy and repeatability in a population of 10 subjects not related to the study[16]. The intraclass and interclass correlation coefficient (ICC) values revealed an intraexaminer and interexaminer reproducibility >0.75. The following periodontal parameters were assessed at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual, and mesio-lingual): CAL, defined as the distance from the cementoenamel junction to the base of the periodontal pocket; BOP, defined as any bleeding during or after probing; PI, defined as the presence of visible dental plaque/biofilm. All teeth fully erupted teeth, except third molars, were examined.

Data analysis

The statistical analysis included 224 individuals. The missing data were omitted from the analysis.

Assessment of the clinical severity of PD is still a matter of debate, and several assessment methods are described in the literature for various purposes, from clinical use to epidemiological work. In this study, subjects were categorized as gingivitis (BOP ≥ 15%,

without CAL loss) or health (BOP < 15%)19, and as moderate or severe periodontitis (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)20. PI was classified as < 40% or ≥ 40% (adapted from Torrungruang et al. 2005)21. The subjects were stratified by age into a 19–34-year group and a ≥35-year group, by the number of years of education into a ≥9-year group (complete elementary and middle school) and a <9–year group (participants who have not completed elementary and middle school), and by economic level into a <US$259.00 monthly income group and a ≥US$259.00 monthly income group (the minimum wage in Brazil during the period of data collection). Individuals were classified as current nonsmokers or smokers; and were categorized as diabetic, based on a self-reported physician's diagnosis of diabetes or fasting blood glucose ≥126 mg/dL associated with diabetes symptoms (e.g., increased thirst, increased urination, and unexplained weight loss); otherwise, they were considered nondiabetic. With regard to personal hygiene, subjects were categorized as: those who had received previous oral hygiene instructions and those who had not; subjects who brushed their teeth twice a day, once a day and those who brushed their teeth less than once a day; and subjects who use dental floss once a day and those who flossed their teeth less than once a day.

Chi-square test was used to assess the association between BOP and PI, while chi-square tests followed by backward stepwise logistic regression were used to verify the association between CAL and PI. The independent variable was included in the multivariate models when a p-value of ≤0.1 in the bivariate models (dental plaque, age, previous dental visits, and education). Odds ratio (OR) and 95% confidence interval (CI) were calculated. The chosen level of significance was 5%.

All statistical analyses were performed using a statistical software program (SPSS version 13.0, SPSS Inc., Chicago, IL, USA).

RESULTS

Overall, the population had a higher percentage of female subjects (55%), were young adults aged <35 years (61%) and had <9 years of education (70%). Diabetes was diagnosed for 6% of subjects, and 50.7% were smokers (Table 1).

Although 91% of subjects had attended the previous dental visits, the majority reported had not received prior oral hygiene instructions (70%), neither had regular use of tooth floss (68%); while 94% of subjects brushed their teeth at least once a day. In addition, a PI of <40% was calculated for 62% of subjects. Regarding periodontal status, 42% had periodontitis, 37% gingivitis, and 21% periodontal health (Table 1).

PI of ≥40% was the only factor that was significantly associated with gingivitis in bivariate analyses (OR, 2.83; 95% CI, 1.52–5.25; p= 0.001; Table 2). Therefore, logistic regression analysis was not performed.

Table 1. General characteristics of the sample (N = 224).

Variables	Total sample (%)
Age (years)	
19–34	137 (61.2)
≥35	87 (39.1)
Sex	
Female	123 (54.9)
Male	101 (45.1)
Education (years)	
≥9	67 (30.2)
< 9	155 (69.8)
Monthly Income (US$)	
≥ 259.00	36 (16.2)
< 259.00	186 (83.8)
Smoking habits	
No	111 (49.6)
Yes	113 (50.4)
Diabetes	
No	207 (93.7)
Yes	14 (6.3)
Previous dental visit	
Yes	204 (91.0)
No	20 (9.0)
Previous oral hygiene instructions	
Yes	67 (30.0)
No	156 (70.0)
Toothbrushing frequency/day	
0	13 (6.3)
1	46 (22.2)
≥ 2	148 (71.5)
Daily Dental flossing	
Yes	66 (31.6)
No	143 (68.4)
Plaque Index	
<40%	139 (62.1)
≥40%	85 (37.9)
Periodontal status	
Periodontitis	90 (41.9)
Gingivitis	80 (37.2)
Health	45 (20.9)

Table 2. Bivariate analysis of the association of dental plaque index (PI), age, sex, education, monthly income, smoking habits, diabetes, previous dental visit, previous oral hygiene instructions and daily brushing and flossing with gingivitis and periodontitis (N = 224).

Variables	Gingivitis		Periodontitis	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
PI ≥ 40%	2.83 (1.52-5.25)	0.001	13.51 (2.99-61.09)	<0.001
Age ≥ 35 years	1.02 (0.58-1.80)	0.93	1.23 (1.11-1.35)	<0.001
Male Sex	1.73 (0.81-3.68)	0.16	1.31 (0.76-2.26)	0.33
Education < 9 years	1.42 (0.78-2.57)	0.25	1.11 (1.05-1.17)	0.004
Monthly income < US$ 259.00	1.08 (0.51-2.27)	0.84	1.38 (0.30-6.37)	0.50
Smoking habits	0.88 (0.51-1.52)	0.64	1.29 (0.46-3.58)	0.63
Diabetes	0.69 (0.23-2.08)	0.51	2.29 (0.47-11.29)	0.27
No previous dental visit	0.45 (0.15-1.41)	0.16	0.36 (0.09-1.41)	0.14
Previous oral hygiene instructions	1.20 (0.64-2.24)	0.63	0.57 (0.20-1.60)	0.28
No daily toothbrushing	0.83 (0.44-1.54)	0.55	2.09 (0.74-5.89)	0.16
Once-daily x twice-daily toothbrushing	1.07 (0.44-2.59)	0.88	0.84 (0.42-1.65)	0.61
No daily flossing	0.99 (0.53-1.86)	0.98	1.34 (0.74-2.44)	0.34

Bivariate analyses showed that periodontitis was associated with PI of ≥40% (OR, 13.51; 95% CI, 2.99–61.09; p < 0.001), age≥35 years (OR, 1.23; 95% CI, 1.11–1.35; p < 0.001), and education<9 years (OR, 1.11; 95% CI, 1.05–1.17; p = 0.004; Table 2). However, after adjustment for independent variables, only PI of ≥40% was significantly associated with periodontitis (OR, 6.88; 95% CI, 1.44–32.78; p= 0.02; Table 3).

Table 3. Logistic regression for dental plaque index (PI), age, previous dental visit and education with periodontitis as the dependent variable (N = 224).

Variable	Odds ratio (95% CI)	P value
PI		
< 40%	1	
≥40%	6.88 (1.44-32.78)	0.02

DISCUSSION

In the present study, the association of PI level and oral hygiene habits with periodontitis and gingivitis was investigated in Kiriri Brazilian Indigenous people. Although the self-performed oral hygiene did not demonstrate a significant association with periodontal status, higher dental PI was associated with both periodontitis and gingivitis, thus partially confirming the original formulated hypothesis.

The association between PI and both gingivitis and periodontitis described here has been described in the previous studies[2,18,22]. A cross-sectional study[23], conducted on 244 indigenous adults from the Amazon rain forest, showed that scores for dental calculus, a plaque retentive factor, were positively associated with periodontal destruction. In addition, a cross-sectional study reported lower tooth brushing frequency and a higher rate of periodontal disease in the indigenous population in Northern Norway than in the non-indigenous population[24]. In spite of some evidence against the role of dental plaque in periodontitis[25,26], experimental gingivitis model[27] and microbiological studies28 demonstrated the role of PI in periodontal disease pathogenesis. Therefore, the reduction in the PI level itself should be a primary objective when tailoring a plan for periodontal diseases prevention in this population.

It is important to note that, for the Kiriri population, although gingivitis and periodontitis were associated with dental plaque, they were not associated with self-performed oral hygiene. However, dental plaque levels have been previously associated with self-performed mechanical plaque control[29,30.] Therefore, as the majority of subjects in the present population declared to brush their teeth daily, it can be suggested that oral hygiene procedures, as performed by them, were not efficient to control plaque formation and prevent periodontal inflammation. Consequently, instructing them to perform efficient oral hygiene should be considered essential in preventive programs for the improvement of their periodontal status and should be taught, respecting their unique health, cultural and social issues. Furthermore, taken into account the indigenous economic conditions and their geographic limitations, the supply of appropriated oral hygiene products should be guaranteed.

The present study showed that periodontal status was not associated with previous instructions on oral hygiene. Similarly, a systematic review of the literature did not show a significant difference in periodontal status between patients who received formal oral hygiene instructions and those who did not8. Several factors impact changes in oral hygiene habits, including self-efficacy, sex, cognitive behavior, and, perhaps, beliefs and values[31,32]. Furthermore, oral individualized hygiene instructions

seem to be more effective than written or standardized oral instructions in decreasing plaque indix[33]. As a consequence, oral individualized hygiene instructions should be provided after considering the characteristics of this population.

In the present study, only the dental PI was associated with periodontitis and gingivitis; other conventional risk factors such as age, sex, income, education, smoking habits, and diabetes showed no association. However, a previous study including the same population, showed that the prevalence of periodontitis was associated with higher age, male sex, and diabetes when the dental plaque was not considered16. Therefore, it is safe to affirm that dental plaque is the most important risk indicator for periodontal diseases in the Kiriri Brazilian Indian population.

The strengths of the present study are related to the full mouth periodontal evaluation and its population characteristics, which is a singular community, as they have unique environmental exposures, cultures, traditions, and habits. The limitation of this study is the cross-sectional design, which did not allow the determination of the sequence of events and precludes a conclusion regarding the causal relationship between variables. Planning and management are recognized as central to effective healthcare service and better health and should be based on the knowledge of the etiology and on the effects of methods and approaches to control the disease.

CONCLUSION

Higher plaque index was associated with gingivitis and periodontitis in Kiriri Indigenous population. Thus, efficient self-performed oral hygiene should be considered central for healthcare planning for this population.

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