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# Multivariate analysis of periodontal disease and associated risk factors in a population of south Brazil

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**ABSTRACT.** Periodontal disease is a multifactorial oral health problem that may be associated with several risk factors. This study aimed to investigate the prevalence rates of risk factors and socioeconomic aspects of patients with periodontal disease. One-hundred and twelve patients underwent the application of a socioeconomic questionnaire and intraoral examinations. The later was founded in the search and registration of gingival bleeding, dental calculus and periodontal pockets. In a multivariate analysis using the Chi-square Automatic Interaction Detection (CHAID), the clinical findings were tested for their association with socioeconomic information, such as patient's level of education. Gingival bleeding, dental calculus and periodontal pockets were detected in 82.1, 88.4 and 38.4% of the sample, respectively. Patients with lower level of education presented higher rates of gingival bleeding ( $p = 0.018$ ), calculus ( $p = 0.001$ ) and periodontal pockets ( $p = 0.001$ ). Other socioeconomic factors, such as age, knowledge of oral hygiene tools, and access to dental services also showed statistically significant associations with periodontal diseases ( $p < 0.05$ ). These outcomes corroborate with most of the previous scientific literature. In practice, they may contribute to the development of oral health care strategies to reach more effectively populations in need for optimal dental services.

**Keywords:** education; gingivitis; oral hygiene; periodontology; periodontitis; health.

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## Introduction

The periodontal tissues (the alveolar bone, cementum, periodontal ligament and gingiva) provide structural support to the human teeth (Lang & Lindhe, 2015). Poor hygiene of these tissues may lead to chronic infection and periodontal diseases (Newman, Takei, Klokkevold & Carranza, 2018). Gingivitis is the most common type of periodontal disease (Alblowi & Binmadi, 2018), which consists in the inflammation of the gingiva. Gingival bleeding, edema, hyperemia and exudate figure as clinical evidences of gingivitis (Carbone et al., 2012). If the gingivitis is not treated, it may evolve into periodontitis, which is a more severe type of periodontal disease (Barrington & Nevins, 1990). Progressive exposure to bacteria and consequent dental loss are potential local effects of periodontitis (Kalala-Kazadi et al., 2018). These effects impact on oral health condition and consequently lead to major esthetic, functional and social problems (Mridula et al., 2012). Important is to note, that gingivitis may be treated and not necessarily become periodontitis (Hujoel, Drangsholt, Spiekerman & DeRouen, 2002).

*Porphyromonas gingivalis* and *Actinobacillus actinomycetemcomitans* are part of the microorganisms that may develop into the oral cavity in the lack of oral hygiene (Asikainen & Chen, 1999). These bacteria are grouped in plaques that interfere in the periodontal homeostasis and promote the occurrence and recurrence of periodontal diseases (Asikainen & Chen, 1999). For this reason, the great volume and complexity of bacterial plaques figure as main etiological factor behind the periodontal disease (Arjunan et al., 2017). Additionally, there are risk factors that also may aggravate patients' conditions, and these factors rely on systemic, behavioral, social, economic and demographic aspects inherent to each patient. Patients affected with periodontal disease have a negative impact in quality of life (Sáez-Prado, Haya-Fernández & Sanz-García, 2016), including difficulties in social communication and daily tasks. Dental treatment with effective patient participation may make periodontal diseases reversible.

Despite the vast scientific literature available, there is large range of rates reported on the distribution and prevalence of periodontal diseases (Khalifa, Allen, Abu-bakr, Abdel-Rahman & Abdelghafar, 2012). The reported prevalence rates become more distinct and evident considering the different populations sampled and studied worldwide (Laforgia, Corsalini, Stefanachi, Pettini & Di Venere, 2015).

Globally, periodontal diseases are considered a matter of public health (Graves, Li & Cochran, 2011). In this context, epidemiological surveys may contribute to the improvement of public strategies for promoting oral health care and preventing periodontal diseases. The present study aimed on assessing the prevalence rate of periodontal diseases and associated risk factors in a population of South Brazil through a multivariate analysis.

## **Material and methods**

### **Study design and sample characteristics**

A cross-sectional study was carried with 112 patients ongoing treatment in a local dental treatment center set in a region in South Brazil with nearly 197.798 habitants. The study was approved by the local Committee of Ethics in Human Research under the protocol #2.276.838 according to the Declaration of Helsinki. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was used.

### **Eligibility criteria**

According to the inclusion criteria, only male and female patients aged above 18 years and ongoing treatment at the local dental treatment center were selected. The exclusion criteria consisted of recent periodontal surgeries and patients currently using any type of denture. Sample selection was performed by convenience. All the patients under dental treatment during the period of research were screened (n = 230). After applying the inclusion and exclusion criteria 112 patients remained eligible.

### **Pilot study - training and calibration exercise**

In a pilot study, one of the authors was trained and performed an exercise for intra-examiner agreement. In this study phase, ten patients were examined, following the recommendations of the World Health organization, twice (T1 and T2) within a time interval of 30 days. Kappa statistics was used to assess the agreement between T1 and T2. The quantified agreement outcome reached 0.81 (good agreement).

### **Non-clinical data collection**

Non-clinical data collection was performed with a questionnaire for the investigation of social and demographic information. This tool was designed based on the *Forms for social and economic condition, access to dental treatment, and self perception of oral health adopted in SB Brasil 2010*. Adaptations were performed to add questions specifically related to the present study, such as the screening of oral hygiene, eating habits and perception of oral health and well-being. Thirty minutes were providing to filling the questionnaires.

### **Clinical data collection**

Anamnesis and intraoral examination were performed in this phase. The last was focused in registering the Community Periodontal Index (CPI) from each patient (Ababneh, Hwajj & Khader, 2012). The CPI was developed to effectively assess the periodontal health in epidemiological studies. This index is mainly based on bleeding on probing, calculus and periodontal pockets measured in six tooth surfaces. The information retrieved during the exam were quantified in a severity scale with scores from 0 (sound) to 4 (highly affected) and were recorded in spreadsheets for statistical analysis.

### **Statistical analysis**

Descriptive data analysis was founded on the variability, frequency and measures of central tendency. Inferential and analytical data from the potential association between periodontal health and the studied variables were explored with Chi-square test and Pearson's correlation coefficient. Statistical tests were performed with SPSS 20 software package (IBM Corp., Armonk, NY, USA) with a significance level of 5% and confidence interval of 95%.

## Results

Table 1 shows the frequency rates of social and demographic data of the sampled patients. Out of the total sample, 43.8% were males and 56.3% were females. The age of patients was divided into four groups: from 18 to 25 years (25.0%), from 26 to 40 years (29.5%), from 41 to 52 years (23.2%) and from 53 to 83 years (22.3%). Private dental treatment was referred to as the most common access to oral health care (55.4%). When questioned about the tools used for oral hygiene, 71.4% of the patients mentioned the use of tooth brush, tooth paste and dental floss.

Table 2 shows the frequency outcomes of oral health self perception. Most of the patients did not notice gingival edema or pain (57.1%). However, 54.5% noticed gingival bleeding. Half of the sample reported never noticing dental calculus. 99.1% of the patients stated that body and mental health and dental and periodontal aspects are essential in life.

Table 3 reveals the periodontal findings. Gingival bleeding, dental calculus and periodontal pockets were detected in 82.1%, 88.4% and 38.4% of the sample, respectively.

**Table 1.** Sociodemographic data retrieved from the patients through a self-explanatory questionnaire

Variables	n	%
Sex		
Males	49	43.8
Females	63	56.3
Level of education		
Incomplete elementary school	16	14.3
Complete elementary school	15	13.4
Incomplete highschool	16	14.3
Complete highschool	29	25.9
Incomplete higher education	25	22.3
Complete higher education	11	9.8
Age		
18-25 years	28	25.0
26-40 years	33	29.5
41-52 years	26	23.2
53-83 years	25	22.3
Family members living together		
1-3	60	53.6
4-7	52	46.4
Oral hygiene tools		
Tooth brush, tooth paste and dental floss	80	71.4
Tooth brush, tooth paste, dental floss and mouth rinse	32	28.6
Smoker		
Yes	66	58.9
No	46	41.1
Access to dental services		
Private	50	44.6
Public	62	55.4

Absolute (n) and relative (%) frequency of distribution.

This study also showed that patients that undergo private dental treatment have lower prevalence of gingival bleeding ( $p = 0.038$ ). Patients with lower level of education reported major prevalence of gingival bleeding ( $p = 0.018$ ) and calculus ( $p = 0.001$ ). Figure 1 shows the diagram obtained after the multivariate analysis using the Chi-square Automatic Interaction Detection (CHAID). This diagram is represented as a decision tree for periodontal health adjusted in function of the independent variables. In this context, age was considered a significant predictor of gingival bleeding (adjusted  $p$  value = 0.015); hygiene tools used to maintain oral health was a significant predictor for calculus (adjusted  $p$  value = 0.005); and the level of education was a significant predictor of periodontal pockets (adjusted  $p$  value = 0.001). More specifically, gingival bleeding was more frequent in patients aged above 23 years (87.8%), while calculus was more frequent in patients that did not use mouse rinse together with tooth brush, tooth paste and dental floss (93.8%). Periodontal pockets were more frequent in patients with low level of education (48.7%).

**Table 2.** Prevalence rate of gingival bleeding, dental calculus and periodontal pockets.

Variables	n	%
Gingival bleeding		
Present	20	17.9
Absent	92	82.1
Dental calculus		
Present	13	11.6
Absent	99	88.4
Periodontal pockets		
Present	69	61.6
Absent	43	38.4

Absolute (n) and relative (%) frequency of distribution.

**Table 3.** Statistical association between clinical findings and socioeconomic data.

Variables	Gingival bleeding		Dental calculus		Periodontal pockets	
	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Age						
18-38 years	13 (65.0)	43 (46.7)	10 (76.9)	46 (46.5)	40 (58.0)	16 (37.2)
39-83 years	7 (35.0)	49 (53.3)	3 (23.1)	53 (53.5)	29 (42.0)	27 (62.8)
<i>p</i>	0.06		0.58		0.40	
Level of education						
Elementary and highschool	9 (45.0)	67 (72.8)	7 (53.8)	69 (69.7)	39 (56.5)	37 (86.0)
Higher education	11 (55.0)	25 (27.2)	6 (46.2)	30 (30.3)	30 (43.5)	6 (14.0)
<i>p</i>	*0.018		0.20		*0.001	
Oral hygiene tools						
Tooth brush, tooth paste and dental floss	13 (65.0)	67 (72.8)	5 (38.5)	75 (75.8)	47 (68.1)	33 (76.7)
Tooth brush, tooth paste, dental floss and mouth rinse	7 (35.0)	25 (27.0)	8 (61.5)	24 (24.2)	22 (31.9)	10 (23.3)
<i>p</i>	0.32		*<0.001		0.22	
Access to dental services						
Private	13 (65.0)	37 (40.2)	6 (46.2)	44 (44.4)	34 (49.3)	16 (37.2)
Public	7 (35.0)	55 (59.8)	7 (53.8)	55 (55.6)	35 (50.7)	27 (62.8)
<i>p</i>	*0.038		0.56		0.14	
Family member living together						
1-3	15 (75.0)	45 (48.9)	10 (76.9)	50 (50.5)	39 (56.5)	21 (48.8)
4-7	5 (25.0)	47 (51.1)	3 (23.1)	49 (49.5)	30 (43.5)	22 (51.2)
<i>P</i>	*0.029		0.06		0.58	
					0.27	

Absolute (n) and relative (%) frequency of distribution; p: statistical significance set at 5%; \*statistically significant outcome.

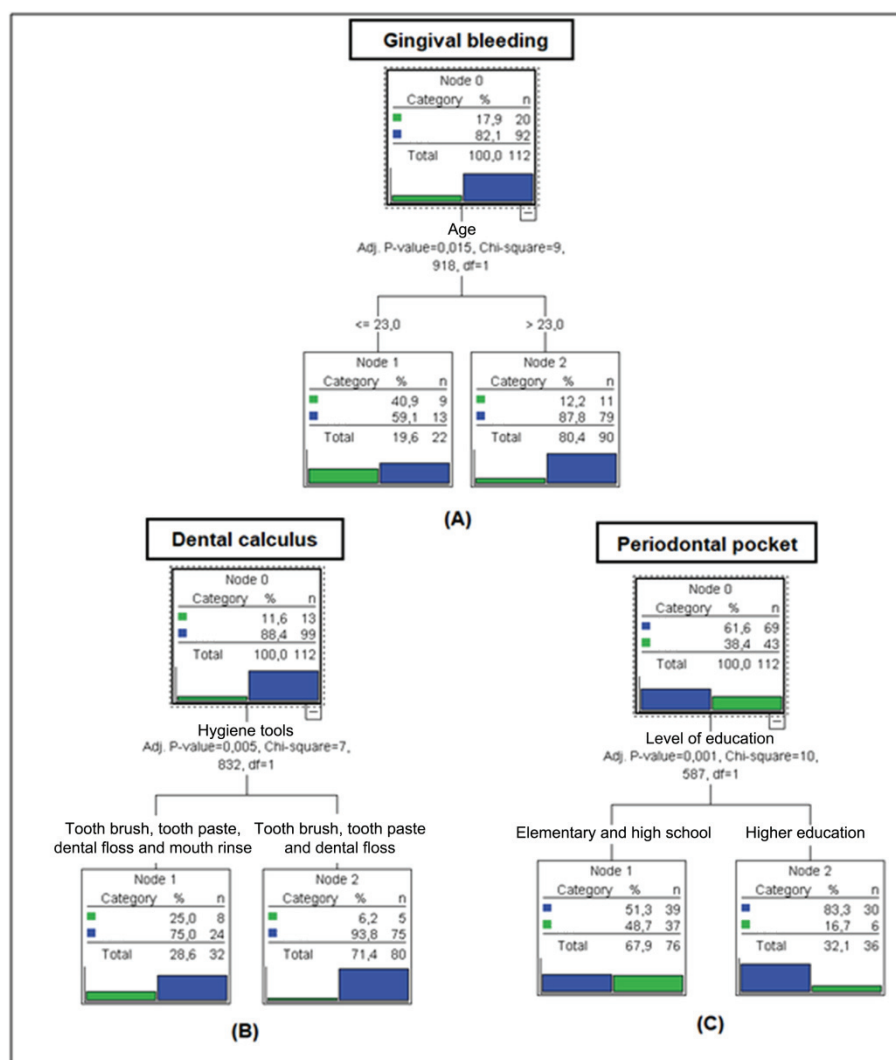
## Discussion

The present study aimed to assess the periodontal condition and the inherent and associated risk factors through a self-explanatory questionnaire and clinical exams of patients in South Brazil. High prevalence rates of gingival bleeding (82.1%) and calculus (88.4%) were detected in this population. Despite being similar to the previous scientific literature, it is important to note that these outcomes may be influenced by population-specific characteristics of the patients sampled. In this study, the patients were ongoing dental treatment in a local center and presented more evident needs for treatment, such as advanced periodontal disease with the presence of calculus.

The prevalence of periodontal pockets were also investigated in the present study and reached rates of 38%. Shallow and deep pockets accounted for 11 and 1.3% of the sample, respectively. The right maxillary first molar and the left mandibular first molar figured as the teeth most affected with periodontal pockets. Batista, Lawrence and Sousa (2015), highlighted the potential relation between periodontal pockets (> 4mm) and dental loss. Again, the role of population-specific characteristics may explain the different outcomes. It is important to note that these characteristics justify the need for studies designed with different populations.

Regarding the statistical associations performed in this study, lower prevalence rate of dental bleeding was observed in families with lower number of people living together ( $p < 0.05$ ). In practice, these outcomes indicate that the higher the number of family members living together, the lower the available family

financial income and the lower the access to oral hygiene education and awareness. An additional and significant statistical association found in the present study concerned the periodontal conditions and the type of access to treatment care (private/public). Patients treated in the private care presented a lower prevalence of gingival bleeding ( $p < 0.05$ ). This finding may be founded on the fact that patients that seek for private treatment may have a higher financial income and major access to dental treatment and knowledge about oral hygiene.



**Figure 1.** Multivariate analysis presented in a decision tree of positive (blue) and negative (green) responses of periodontal health adjusted based on the independent variables.

Knowledge and awareness of oral hygiene also manifested in face of periodontal alterations when the prevalence of calculus and gingival bleeding were associated with the level of education. Both variables were more prevalent in patients that had lower level of education ( $p < 0.05$ ). This evidence followed similar outcomes previously reported in the scientific literature that show that periodontal disease are potentially associated with socioeconomic factors (Almerich-Silla, Almiñana-Pastor, Bellot-Arcís & Montiel-Company, 2017). More specifically, the level of education itself was previously highlighted as a fundamental step towards optimal patient care in Periodontology (Cleeren, Quirynen, Ozcelik & Teughels, 2014). The opposite was also tested and confirmed in the scientific literature: persons with higher level of education tend to have a better quality of life and a lower trend to develop periodontal diseases (Gundala & Chava, 2010; Paulander, Axelsson & Lindhe, 2003).

Other statistically significant association found in the present study was observed between the use of oral rinse products and better periodontal condition. More specifically, the prevalence of calculus was lower in patients that used oral rinse. In this context, Gjermo, Rösing and Susi (2002), observed the reduction of dental plaque and gingivitis in patients that used Chlorhexidine. This outcome may be based on the fact

that patients that use oral rinse are usually more aware of the available tools for oral hygiene and they interested in using it for improving their oral health conditions.

Despite the several statistically significant associations found between variables and periodontal conditions in the patients sampled in this study, it is important to note that this was a cross-sectional study. Longitudinal long-term studies within a controlled population remain the gold standard for deeper scientific inferences. These studies are encouraged in the future to test and validate each of the potential risk factors associated with periodontal disease. Random sampling large populations also must be performed (not only patients from a local dental center) in order to increase the level of scientific evidence and enable comparisons between populations and within different moments over the time.

## Conclusion

The present study investigated the gingival bleeding, dental calculus and periodontal pockets in a population of South Brazil. In a multivariate analysis, these variables showed statistically significant associations with patients' social and demographic data, such as their levels of education and use of oral hygiene tools. In practice, these outcomes may support oral health strategies and policies for the specific population sampled as well for populations with similar periodontal condition.

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