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# Periodontitis and its associated factors in patients at the faculty of southern Brazil: a cross-sectional study

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**ABSTRACT.** To verify the presence of periodontitis, its severity, and their association with associated factors based on medical records of patients who attended the Dental Clinic of the Faculty of Southern Brazil over 4 years. This is a cross-sectional study, which included 422 medical records of patients aged  $\geq 18$  years. The clinically analyzed data were: plaque index (PI), bleeding on probing (BOP), probing pocket depth (PPD), and clinical attachment level (CAL). Sociodemographic data, dental hygiene, harmful habits and chronic systemic diseases were described. Statistical analysis of binary logistic regression was used to verify the relationship between the severity of periodontitis and the exposure variables. The older adults [odds ratio (OR) = 2.36; 95% confidence interval (CI): 1.23-4.54 – 41 to 55 years and OR = 3.0; 95% CI: 1.49-6.09 – 56 to 87 years], and men (OR = 1.9; 95% CI: 1.18-3.14) showed higher chances of periodontitis severity. Smokers (OR = 3.54; 95% CI: 2.05-6.12), those with hypertension (OR = 2.11; 95% CI: 1.23-3.63) and with diabetes (OR = 2.10; 95% CI: 1.08-4.12) showed higher chances of developing advanced periodontitis. Advanced or severe periodontitis occurred in one-third of the patients. The findings showed that men, older adults, with systemic arterial hypertension, diabetes mellitus, and smokers are more susceptible to severe periodontitis.

**Keywords:** cardiovascular disease; diabetes mellitus; periodontal disease; periodontal index.

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## Introduction

Periodontal disease is a chronic manifestation that damages the gingival tissues that provide protection and support to the teeth (Slots, 2017; Kwon, Lamster, & Levin 2020). It is a disease of great importance for the oral health of the population, as it elicits a destructive inflammatory response, which can cause tooth loss and numerous systematic health problems if left untreated (Kwon et al., 2020).

Periodontal diseases have a multifactorial etiology, but the main factor is the presence of microbial biofilm adhering to the periodontal tissues for more than 20 days in the gingival sulcus (Almeida, Barros, Andrade, & Batista, 2019). When the biofilm remains in contact with periodontal tissues for a long time, an antigenic stimulus leading to an acute inflammatory response occurs, resulting in vascular-exudative changes and collagen degradation (Kwon et al., 2020). This scenario could be characterized as a chronic injury.

Diseases and systemic dysfunctions, such as diabetes mellitus, thyroid disturbance, cardiovascular disease, systemic hypertension, and arterial and depressive disorders could be risk factors of periodontal problems (Mealey, Oates, & American Academy of Periodontology, 2006; Souza, Nóbrega, & Araki, 2014; Martin-Cabezas et al., 2016; Moraes, Resende, & Pereira, 2016; Manso & Angst, 2019; Muñoz Aguilera et al., 2020). However, there are no studies in the literature that address the relationship between various chronic systemic diseases, consumption of harmful substances, and periodontal diseases. This research seeks to determine the prevalence of the highlighted outcomes and to verify possible associations.

We aimed to verify the presence of periodontitis, its severity, and associated factors based on medical records of patients obtained from the Dental Clinic of Faculty from 2016 to 2019.

## Material and methods

The research was approved by the Local Research Ethics Committee and with the approval number 2,607,711.

The study was conducted following the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting recommendations (Malta, Cardoso, Bastos, Magnanini, & Silva, 2010).

### Study design and population

This is a cross-sectional study. We assessed all medical records of patients aged  $\geq 18$  years who underwent periodontal evaluation at the Dental Clinic of Faculty IMED in Passo Fundo with a complete set of teeth.

First, 452 records were identified: 50 in 2016, 129 in 2017, 201 in 2018, and 61 in 2019. Next, patients with incomplete set of teeth were excluded, and the final study population was 422 records with a sample loss of 30 (6%).

### Study location

This cross-sectional study was performed at the Faculty of Southern Brazil in the city of Passo Fundo. The population is approximately 200,000 inhabitants.

### Procedures for data collection

Medical records from 2016 to 2019 containing anamnesis and clinical periodontal exams of patients who received care in the dental clinic were used.

All clinical examinations were performed by students previously trained by periodontal teachers through theoretical and practical classes and assessments. In the oral clinical examinations, patients were positioned in the dental chair, and assessed using artificial lighting (dental reflector), mouth mirror, millimeter probe, and Nabers probe.

Data were collected from the analysis of medical records, which extracted the following data: 1. Anamnesis examination form containing sociodemographic data, oral hygiene data (such as frequency of tooth brushing, type of toothbrush, and use of mouthwash), harmful habits (smoking, alcohol consumption, consumption of illicit drugs), and chronic diseases (thyroid disorders, depressive disorder, cardiovascular diseases, diabetes, and hypertension); 2. Periodontal clinical examination form with an oral clinical evaluation of periodontal data: bleeding on probing (BOP), plaque index (PI), probing pocket depth (PPD), and clinical attachment level (CAL). The BOP verifies the occurrence of bleeding in the marginal gingiva after the probe smoothly travels the extension of the gingival sulcus at a depth of 0.5-1 mm on the four faces of the teeth. The PI considers the presence of visible plaque on the four faces of the teeth. The PPD is the distance between the gingival margin and the most probable apical portion or groove. The CAL is identified as the enamel-cement junction to the most probable apical portion or groove. Both PPD and CAL are measured in millimeters, checking the deepest of the four evaluated faces of all the teeth present (Susin, Kingman, & Albandar 2005).

### Pilot test

A pilot test was carried out to adapt the methodology and to train the examiner. A pilot test was carried out with 20 medical records, similar to definitive research, making it possible to train the researcher in data-collection, thus minimising bias.

### Variables of study

For the analysis of the dependent variable (outcome), the clinical measurement of CAL was divided into two categories, which is based on the new periodontitis classification (Caton et al., 2018; Papapanou et al., 2018; Tonetti, Greenwell, & Kornman, 2018). In this study, we considered only the aggressiveness of the disease classified as: 1. Initial and moderate periodontitis, and 2. Advanced or severe periodontitis.

The categories are defined as follows:

Category 1- Initial and moderate periodontitis - measures from 1.2-4.0 mm, which included all individuals who were part of stages I and II, and

Category 2 - Advanced or severe periodontitis - measures from 5.0-8.8 mm, which included all individuals who were part of stages III and IV.

The categories of independent variables were as follows:

1. Sociodemographic data: marital status (single, married, stable, widowed, or separated), sex (female or male), age group (18 to 40 years, 41 to 55 years, 54 to 87 years), and education level (complete or incomplete elementary school, complete or incomplete high school, and complete or incomplete college).

2. Self-reported chronic systemic diseases, such as thyroid disorders, depressive disorder, cardiovascular diseases, diabetes mellitus, and systemic arterial hypertension (yes or no).

3. Harmful habits: smoker, alcohol, and use of illicit drugs (yes or no).

4. Habit of oral hygiene: type of brush (soft, medium, and hard), use of oral antiseptic (yes and no), and frequency of daily tooth brushing (1-2 times or 3-5 times).

### Data analysis

The data obtained were summarized in a form using the Excel program and exported to the statistical program IBM SPSS® software (Statistical Package for the Social Sciences, 20.0, Armonk, New York). Descriptive analyses were performed on all variables with relative and absolute frequencies.

The PI and BOP of all teeth were measured by adding up all teeth that presented plaque or bleeding (four faces), multiplied by 100, and divided by the total number of faces of the teeth present in each individual. The PPD and CAL measured in millimeters were added and divided by the total number of teeth present in the oral cavity of each patient. Next, the medians, means, standard deviations, and quartiles of each of these clinical variables were measured. Bivariate and multivariate analyses were also performed, and the odds ratios (OR) and their respective 95% confidence intervals (CI) were estimated and adjusted by the exposure variables in a binary logistic regression model ( $p$ -value  $< 0.05$ ).

To perform the binary logistic regression, all variables, including age, sex, education level, marital status, type of toothbrush used, smokers, and chronic diseases, such as hypertension and diabetes, associated with  $p$ -value  $< 0.25$  and the outcome of variable periodontitis severity in the crude model entered in the multivariate model. However, after the multivariate adjustment, only the variables age, sex, smoking, hypertension, and diabetes remained significant ( $p < 0.05$ ), whereas the other variables (type of toothbrush, education level, and marital status) lost their association in the model-adjusted end of the multivariate regression analysis.

### Results

Concerning data from all medical records, the average age was 45 years ( $\pm 15.9$ ), 60% were women, and 48.3% attended elementary school. Other sociodemographic data are described in Table 1.

**Table 1.** Frequency distribution of sociodemographic variables in patients seen at the Dental Clinic of IMED Faculty, Passo Fundo, RS, 2016 to 2019 ( $n = 422$ ).

| Variables         | N   | %    |
|-------------------|-----|------|
| Sex               |     |      |
| Male              | 169 | 40,0 |
| Female            | 253 | 60,0 |
| Age (years)       |     |      |
| 18-40             | 160 | 37,9 |
| 41-55             | 142 | 33,6 |
| 54-87             | 120 | 28,4 |
| Marital Status    |     |      |
| Singles           | 147 | 34,8 |
| Married/widowed   | 275 | 65,2 |
| Education level   |     |      |
| Elementary School | 204 | 48,3 |
| High School       | 171 | 40,5 |
| College           | 47  | 11,1 |

Regarding the prevalence of chronic systemic diseases, 24.6% had hypertension, 13.7% had a depressive disorder, 12.1% had diabetes mellitus, 8.3% had some thyroid disorders, and 8.1% had some cardiovascular disease (Table 2).

In relation to harmful habits, 21.3% were smokers, 21.8% were alcoholics, and 1.2% used illicit drugs. When reporting the frequency of daily brushing, 30.6% brushed their teeth once or twice daily. Regarding the types of toothbrush, 40.5% used toothbrushes with hard bristles, and 31.5% used mouthwash. Data on chronic diseases and harmful habits are described in Table 2.

Considering data related to periodontal conditions, the BOP had an average of 21.81 ( $\pm 22.43$ ) and the PI had an average of 39.11 ( $\pm 32.28$ ). The mean PPD was 3.10 ( $\pm 0.94$ ) and the mean CAL was 3.58 ( $\pm 1.35$ ), as shown in Figure 1.

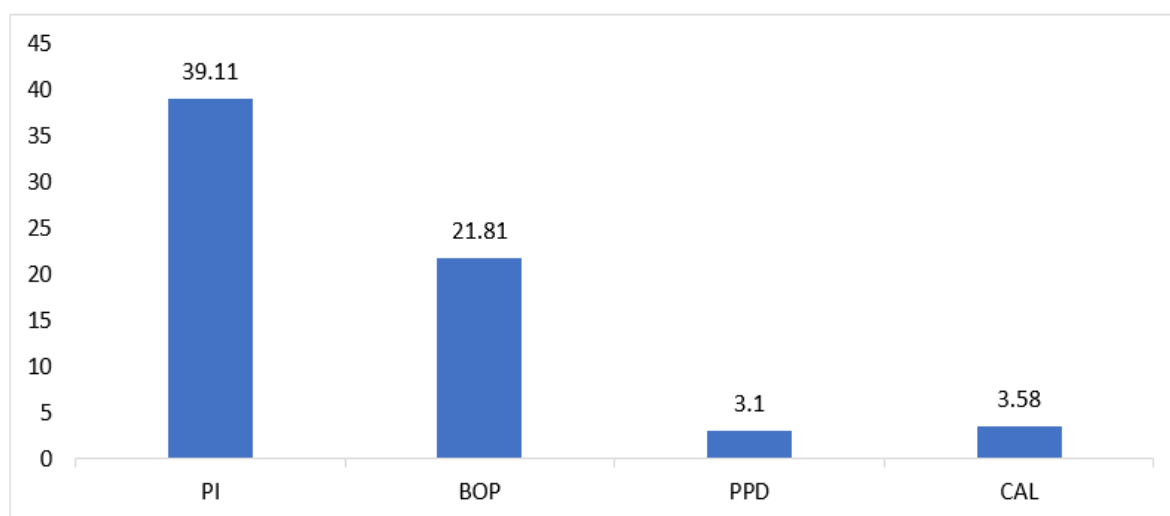
The descriptive assessment of the periodontal disease severity classified 297 (70.4%) as initial and moderate periodontitis (1.2-4.0 mm) and 125 (29.6%) as advanced or severe periodontitis (5-8.8 mm).

Table 3 shows the statistical analysis used to verify the relationship between periodontitis and exposure variables. Older patients presented higher chances of having a more severe periodontitis (OR = 2.36; 95% CI: 1.23-4.54 - 41 to 55 years; and OR = 3.0; 95% CI: 1.49 -6.09 - 56 to 87 years), and men presented almost twice

the chances of periodontitis severity than women (OR = 1.9; 95% CI: 1.18-3.14). Additionally, smokers (OR = 3.54; 95% CI: 2.05-6.12), patients with hypertension (OR = 2.11; 95% CI: 1.23-3.63) and diabetes mellitus (OR = 2.10; 95% CI: 1.08-4.12) showed higher chances of developing advanced periodontitis.

**Table 2.** Frequency distribution of the variables of chronic systemic diseases, harmful habits, and oral hygiene of the patients seen at the Dental Clinic of IMED Faculty, Passo Fundo, RS, 2016 to 2019 (n = 422).

| Variables                      | N   | %    |
|--------------------------------|-----|------|
| Diabetes Mellitus              |     |      |
| Yes                            | 51  | 12.1 |
| No                             | 371 | 87.9 |
| Cardiovascular diseases        |     |      |
| Yes                            | 34  | 8.1  |
| No                             | 388 | 91.9 |
| Depressive disorder            |     |      |
| Yes                            | 58  | 13.7 |
| No                             | 364 | 86.3 |
| Smoker                         |     |      |
| Yes                            | 90  | 21.3 |
| No                             | 332 | 78.7 |
| Thyroid imbalance              |     |      |
| Yes                            | 35  | 8.3  |
| No                             | 387 | 91.7 |
| Alcoholism                     |     |      |
| Yes                            | 92  | 21.8 |
| No                             | 330 | 78.2 |
| Use illicit drugs              |     |      |
| Yes                            | 5   | 1.2  |
| No                             | 417 | 98.8 |
| Systemic arterial hypertension |     |      |
| Yes                            | 104 | 24.6 |
| No                             | 318 | 75.4 |
| Daily toothbrushing frequency  |     |      |
| 1-2 times                      | 129 | 30.6 |
| 3-5 times                      | 293 | 69.4 |
| Type of toothbrush             |     |      |
| Soft bristles                  | 65  | 15.4 |
| Medium bristles                | 186 | 44.1 |
| Hard bristles                  | 171 | 40.5 |
| Use of mouthwash               |     |      |
| Yes                            | 133 | 31.5 |
| No                             | 289 | 68.5 |



**Figure 1.** Averages of periodontal indicators (PI, BOP, PPD and CAL) of patients seen at the Dental Clinic of Faculdade IMED, Passo Fundo - RS, 2016 to 2019 (n = 422). PI, plaque index; BOP, bleeding on probing; PPD, probing pocket depth; CAL, clinical attachment level.

**Table 3.** Bivariate (Crude) and multivariate (adjusted) binary logistic regression model for the variable periodontitis of patients seen at the Dental Clinic of IMED Faculty, Passo Fundo, RS, 2016 to 2019 (n = 422)

|                                | Crude<br>OR (IC95%) | p-value* | Adjusted<br>OR (IC95%) | p-value** |
|--------------------------------|---------------------|----------|------------------------|-----------|
| Age                            |                     |          |                        |           |
| 18-40 years                    | 1                   |          | 1                      |           |
| 41-55 years                    | 3.07 (1.91-4.92)    | <0.001   | 2.33 (1.21-4.50)       | <0.011    |
| 56-87 years                    | 3.91 (2.34-6.53)    | <0.001   | 2.97 (1.46-6.03)       | <0.003    |
| Sex                            |                     |          |                        |           |
| Female                         | 1                   |          | 1                      |           |
| Male                           | 2.01 (1.37-3.22)    | 0.001    | 1.93 (1.18-3.14)       | 0.008     |
| Education level                |                     |          |                        |           |
| Elementary School              | 1                   |          | 1                      | 0.131     |
| High School/<br>College        | 1.77 (1.16-2.71)    | 0.008    | 1.44(0.89-2.33)        |           |
| Marital status                 |                     |          |                        |           |
| Singles                        | 1                   |          | 1                      |           |
| Married/widowed                | 1.93 (1.21-3.10)    | 0.005    | 1.21 (0.68-3.63)       | 0.509     |
| Daily toothbrushing frequency  |                     |          |                        |           |
| 1-2 times                      | 1                   |          | -                      |           |
| 3-5 times                      | 1.22 (0.78-1.91)    | 0.381    |                        | -         |
| Type of toothbrush             |                     |          |                        |           |
| Soft bristles                  | 1                   |          | 1                      |           |
| Medium bristles                | 0.54 (0.30-1.03)    | 0.063    | 0.68 (0.34-1.35)       | 0.276     |
| Hard bristles                  | 0.68 (0.37-1.25)    | 0.225    | 0.95 (0.47-1.88)       | 0.886     |
| Use of mouthwash               |                     |          |                        |           |
| Yes                            | 1                   |          | -                      | -         |
| No                             | 1.27 (0.81-1.97)    | 0.291    |                        |           |
| Systemic arterial hypertension |                     |          |                        |           |
| No                             | 1                   |          | 1                      |           |
| Yes                            | 2.86 (1.72-4.75)    | <0.001   | 2.14 (1.24-3.69)       | 0.006     |
| Diabetes mellitus              |                     |          |                        |           |
| No                             | 1                   |          | 1                      |           |
| Yes                            | 2.43 (1.23-4.80)    | 0.010    | 2.04 (1.04-4.01)       | 0.037     |
| Cardiovascular disease         |                     |          |                        |           |
| No                             | 1                   |          | -                      | -         |
| Yes                            | 1.15 (0.54-2.43)    | 0.716    |                        |           |
| Smoker                         |                     |          |                        |           |
| No                             | 1                   |          | 1                      |           |
| Yes                            | 2.34 (1.39-3.94)    | 0.001    | 3.48 (2.00-6.04)       | 0.001     |
| Alcoholism                     |                     |          |                        |           |
| No                             | 1                   |          | -                      | -         |
| Yes                            | 0.83 (0.50-1.37)    | 0.478    |                        |           |
| Thyroid imbalance              |                     |          |                        |           |
| No                             | 1                   |          | -                      | -         |
| Yes                            | 0.72 (0.30-1.37)    | 0.887    |                        |           |
| Depressive disorder            |                     |          |                        |           |
| No                             | 1                   |          | -                      | -         |
| Yes                            | 1.34 (0.75-2.40)    | 0.326    |                        |           |
| Use of illicit drugs           |                     |          |                        |           |
| No                             | 1                   |          | -                      | -         |
| Yes                            | 1.69 (0.18-7.29)    | 0.639    |                        |           |

## Discussion

The results showed a high prevalence of chronic systemic diseases and their association with periodontitis.

Considering the periodontal examination, we verified that the patients who attended the consultations needed periodontal treatment. The findings related to periodontal conditions demonstrated that the PI and PPD on the faces of the teeth were 39.11 (DP  $\pm$  32.28) and 3.10 (DP  $\pm$  0.94), respectively. In a previous retrospective study, the result of the PI was reported to be higher (68.78), but with similar PPD result of 2.97 (DP  $\pm$  0.71mm) as our results (Kampits et al., 2016).

Our findings showed a high prevalence of systemic arterial hypertension, diabetes mellitus, thyroid disorders, depressive disorders, and cardiovascular diseases. According to Szpilman et al. (2012), it is

estimated that by 2025, there will be 350 million individuals with diabetes worldwide. The results of the study by Cunha, Costa and Neves (2013) demonstrated that around 340 million people worldwide are affected by depressive disorders. According to Roriz and Babosa (2011), hypertension occurs in 14 million people, leading to 20% of deaths every year. Nagendra and Srinivasa (2011) described that thyroid dysfunction occurs in 15% of the world's population.

In our study, there was a statistically significant relationship among age, sex, and periodontitis. We showed that men and the older adults are more likely to have advanced or severe periodontitis. Corroborating the research by Gaio et al. (2019), individuals who had gingival bleeding were older. However, according to Ferreira, Magalhães, Rocha, Schwambach and Moreira (2009), older individuals tend to have a poor prognosis of a periodontal disease, as they found that 76% had dental plaque, 14.8% had periodontal pockets of 4-5 mm, and 9.3% had periodontal pockets of 6-8 mm. Knack et al. (2019) concluded that men were more likely to have dental calculus than women. Almeida et al. (2019) also found that men had a higher prevalence of periodontal problems than women.

There was also a statistically significant association between arterial hypertension and severe periodontitis in our study. Hypertension, according to Manso and Angst (2019), has a relationship with periodontal disease and blood pressure. C-reactive protein (CRP) is an inflammatory response protein linked to markers of atherosclerosis. An increase in inflammatory levels can trigger damage to endothelial cells, aggravating atherosclerosis, and increasing the risk of hypertension. In a systematic review and meta-analysis, periodontal diseases are associated with an increased risk of arterial hypertension, especially severe periodontitis (Martin-Cabezas et al., 2016). Thus, it is prudent to be careful with patients with hypertension during dental care so that there is no acute pressure increase, causing a dental emergency.

Another important statistical association observed in our study was the association between diabetes mellitus and the severity of periodontitis. Periodontal disease has been identified as one of the risk indicators for the glycemic control of the patient, as patients with diabetes already have a matrix protein-8 in the periodontium, contributing to the disease (Souza et al., 2014). Patients with uncontrolled diabetes tend to have more significant gingival inflammation, greater bone loss, and greater loss of insertion level (Muñoz Aguilera et al., 2020). In the present study, there were only compensated people who showed no relationship between periodontal disease and diabetes mellitus. A study evaluating the perception of people with diabetes and their relationship with periodontal disease in the primary health care network showed that 82% were unaware of periodontal disease. However, 94.7% of them had no explanation of gum disease and glucose rate (Souza et al., 2014).

In the present study, a statistical association was observed between severe periodontitis and smoking. Over the years, smoking has caused not only periodontal problems, but others related to oral health. However, in a survey carried out by Aquino et al. (2010) in a sample of 214 individuals, around 50% had periodontal problems and were smokers without significant associations. According to a study by Medeiros, Silva and Botelho (2009), 33% of smokers had periodontal problems, 94% had chronic periodontitis, and 6% had aggressive periodontitis. Furthermore, patients who smoked tend to have twice as severe as the other types of periodontitis, such as mild and moderate (Medeiros et al., 2009).

One of the limitations of this study is its cross-sectional design, which does not have temporality; therefore, it is possible to monitor these patients to verify the cause and effect. Another limitation is that the data collected from the medical records were recorded based on the patients' self-reports, and we did not examine the clinical results. However, the presence of one or more teachers was taken into account in the evaluations carried out by the students and the loss of medical records due to the absence of annotated data. Thus, this study is of great relevance since the data over four years have been evaluated, generating a large sample of medical records of patients in the municipality and to the north of the country who attended this institution.

For future research, a longitudinal study is suggested to follow these patients in long-term care, to identify risk factors for periodontal diseases. More research is needed relating periodontitis to other conditions and habits that have not been investigated.

## Conclusion

We conclude that one-third of the patients are affected by advanced or severe periodontitis. Men and older adults are more susceptible to severe periodontitis, including patients with systemic arterial hypertension and diabetes mellitus, and smokers.

The clinical significance of this study is the frequency of periodontitis in patients with systemic diseases, and it is remarkably associated with the severity of the disease.

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