



Association between Periodontitis and Hyperglycemia

Associação entre Periodontite e Hiperglicemia


Marília Terezinha Gonçalves OLIVEIRA¹

 ORCID iD 0000-0001-9787-852X


Paulo Guilherme Santos FURTADO¹

 ORCID iD 0000-0002-9461-3953


Rafaella Ferreira Cordeiro e CARDOSO¹

 ORCID iD 0000-0001-6950-5179


Ana Carolina Dupim SOUZA¹

 ORCID iD 0000-0002-5798-0711

Rafael Paschoal Esteves LIMA²

 ORCID iD 0000-0003-4343-3845

Santuza Maria Souza de MENDONÇA¹

 ORCID iD 0000-0002-3033-6301

ABSTRACT

Objective

The objective of this study was to analyze the prevalence of undiagnosed hyperglycemia in individuals with periodontitis.

Methods

The sample was composed of randomly selected individuals that had signed-up for treatment at the Newton Paiva University dental clinic. The volunteers were divided in two groups, the first composed by individuals without periodontitis ($n = 30$) and the second by individuals with periodontitis ($n = 20$). All participants answered a questionnaire about habits and overall health condition. Salivary flow was quantified and periodontal examination evaluated bleeding when probed, probing depth and clinical attachment level. Through laboratory tests, the fasting glucose and the glycated hemoglobin levels were quantified.

Results

In the sample studied a higher percentage of individuals with hyperglycemia among those with periodontitis than those without periodontitis was identified.

Conclusion

It is suggested, therefore, that the request of laboratory tests to check glucose levels becomes a part of the dental treatment protocol of individuals with periodontitis.

Indexing terms: Complications. Diabetes Mellitus. Periodontitis.

RESUMO

Objetivo

O objetivo desse estudo foi analisar a prevalência de hiperglicemia não diagnosticada em indivíduos com periodontite.

Métodos

A amostra foi composta por indivíduos selecionados aleatoriamente que se inscreveram para tratamento no Curso de Odontologia do Centro Universitário Newton Paiva, Belo Horizonte, Minas Gerais. A amostra foi dividida em dois grupos, o dos indivíduos sem periodontite ($n=30$) e o dos indivíduos com periodontite ($n=20$). Todos responderam a um questionário sobre hábitos e condição de saúde geral. Também tiveram o fluxo salivar quantificado e passaram por um exame periodontal para avaliação do sangramento gengival, da profundidade de sondagem e do nível de inserção clínica. Através de exames laboratoriais, quantificou-se a glicemia em jejum e os níveis de hemoglobina glicada.

Resultados

Na amostra estudada foi identificado maior percentual de indivíduos com hiperglicemia no grupo com periodontite do que no grupo sem periodontite.

Conclusão

Sugere-se, portanto, que a solicitação de exames laboratoriais para avaliação dos níveis glicêmicos faça parte do protocolo odontológico de atendimento dos indivíduos com periodontite.

Termos de indexação: Complicações. Diabetes Mellitus. Periodontite.

¹ Centro Universitário Newton Paiva. Av. Silva Lobo, 1730, 30431-262, Nova Granada, Belo Horizonte, MG, Brasil. Correspondência para / Correspondence to: SMS MENDONÇA. E-mail: <santuzam@yahoo.com.br>.

² Universidade Federal de Minas Gerais, Faculdade de Odontologia. Belo Horizonte, MG, Brasil.

▼ ▼ ▼ ▼ ▼

Como citar este artigo / How to cite this article

Oliveira MTG, Furtado PGS, Cardoso RFC, Souza ACD, Lima RPE, Mendonça SMS. Association between periodontitis and hyperglycemia. RGO, Rev Gaúch Odontol. 2018;66(3):199-204. <http://dx.doi.org/10.1590/1981-863720180003000013217>



INTRODUCTION

Diabetes Mellitus (DM) constitutes of a group of alterations characterized by hyperglycemia, resulting from the deficiency of production and/or resistance to the role of insulin [1]. It represents one of the main public health problems, being the fourth cause of death in Brazil [2]. DM is classified, according to its etiopathogeny, in type 1 DM, type 2 DM, gestational DM and other specific types [3].

According to the World Health Organization, the average prevalence of DM worldwide is of 10% [4]. In Brazil, nearly five million individuals are diabetic, having an expectancy of a 50% increase to that number by 2025 [5]. According to studies made by the Ministry of Health, the total number of individuals with the disease increased 40% between 2006 and 2012 [6]. Around the world, nearly 4 million deaths per year are directly related to DM, since it also favors the worsening of systemic diseases [7,8].

Hyperglycemia contributes for the development of classic complications associated to DM, such as visual changes, nephropathies, cardiovascular diseases, neuropathies, susceptibility to infections and periodontitis [3].

Immune-inflammatory alterations present in diabetic individuals increase the susceptibility of developing periodontitis, inflammatory disease that affects the supporting tissues of the teeth, being considered the sixth classic complication of DM. Epidemiological studies have emphasized that DM is a risk factor for periodontitis, increasing its probability of occurring by three times [9,10]. DM is also associated with greater severity of periodontitis [11]. The immune-inflammatory process resulting from the bacterial aggression, is the main responsible for the damage observed on the periodontal tissues, clinically characterized by bleeding on probing (BP), increase in probing depth (PD) and insertion loss, followed by bone tissue destruction. The evolution of periodontitis may eventually lead to loss of the dental element [12,13].

The present study aims to evaluate the prevalence of hyperglycemia not yet diagnosed in individuals with periodontitis.

METHODS

Sample

The convenience sample was composed by 50 randomly selected individuals from those that had signed

up for dental treatment at the Newton Paiva University Center dentistry course, between the months of August and November 2015. The individuals were subdivided into two groups: without periodontitis (n=30) and with periodontitis (n=20). All the participants were informed about the objectives of the study and were only included as part of the study after manifesting interests by signing an informed consent form (ICF).

The inclusion factors were the presence of a minimum of 12 teeth, 18 years of age or older and absence of any contraindication for periodontal examination. Any individuals previously diagnosed with DM, submitted to antibiotic therapy or periodontal therapy during the last three months and carriers of the acquired immune deficiency syndrome (AIDS), were excluded.

The study was previously submitted and approved by the Ethics Committee under the number CAAE 37644314.6.0000.5097.

Behavioral and biological social characteristics

With a structured questionnaire, the following data were collected: gender, age, tobacco use, hypertension and family history of DM. The participants were also questioned about the presence of the following symptoms that are characteristic to DM: polydipsia, polyuria, polyphagia, unexplained weight loss and visual alteration.

Medical data

Weight and height of the participating individuals were registered to calculate the body mass index (BMI). According the BMI the individuals were classified as underweight (BMI below 18.5), normal weight (BMI between 18.5 and 24.9), overweight (BMI between 25.0 and 29.9) and obesity (BMI above 30.0) [4].

All the participants performed, at the same laboratory, the fasting glycaemia and glycated hemoglobin (A1c) exams. Glycaemia was considered altered for fasting glycaemia and glycated hemoglobin values above 99mg/dL and 5.6%, respectively [3].

Sialometry

Sialometry was employed for quantitative analysis of resting and stimulated saliva. In order to collect the saliva the participants remained 30 minutes without eating or drinking and 2 minutes without performing any chewing, swallowing or talking movements. For resting and stimulated sialometry, the individuals collected,

in a millimeter tube, all the saliva produced during 5 minutes. During the stimulated sialometry the individuals chewed on sialogogo. The quantity of saliva and foam produced was verified directly on the collector during the five minutes. The total volume collected was divided by 5, obtaining a result in mL/min. The participants were grouped, according to the obtained salivary flow, in normal (flow from 1.5 to 3.0 mL/min), hyposalivation (flow from 0.05 to 1.45 mL/min) and sialorrhea (flow above 3.0 mL/min) [14].

Periodontal clinical examination

The periodontal exam was performed to analyze the clinical parameters of BP, PD and clinical attachment level (CAL) of all teeth present. Mesial, distal, buccal and lingual measurements were registered for each tooth. The periodontal exam was performed by two researchers (MTGO and PGSF), who were previously calibrated, using a millimeter probe, model UNC-15 North Carolina (Hu-Friedy, Chicago, USA).

The inability to determine the cementoenamel limit, presence of gingival morphology alteration, extensive carious lesion, iatrogenic restorative procedures or excess calculus that could difficult the periodontal exam were considered exclusion criteria for the teeth [15].

The bleeding exam was conducted while probing, by gently and carefully introducing the probe into the gingival sulcus until reaching its base. The bleeding was analyzed 30 to 60 seconds after probing. The occurrence of BP was registered for each surface in a dichotomy manner, indicating its presence or absence. The probing depth was obtained by measuring the distance from the gingival margin to the sulcus base or periodontal pocket. The CAL was determined by the distance between the cementoenamel junction and the periodontal sulcus or pocket base. The criteria used to diagnose periodontitis was the presence of four or more teeth with at least one site PD \geq 4 mm and CAL \geq 3 mm associated to BP at the same site [16].

Statistical analysis

The comparison between the groups for the variables of interest was performed by the Chi-square, Mann-Whitney and Fishers' Exact tests when appropriate. The results were considered significant with a probability below 5% ($p < 0.05$). All the statistical analysis was made with SPSS program (version 17.0).

RESULTS

Table 1 presents the characterization of the sample in the groups with and without periodontitis. The groups were considered similar according to the majority of the evaluated criteria. Among the DM symptoms investigated, visual alteration was more frequently reported by the individuals with periodontitis. The individuals from the group with periodontitis had significantly higher average fasting glycaemia than the individuals without periodontitis. However, when fasting glycaemia was categorically measured the difference was not maintained. The same occurred with glycated hemoglobin, when evaluated quantitatively and categorically. The participants with periodontitis presented a 97.7 mg/dL average fasting glycaemia, while for the participants without periodontitis the average was 85.5 mg/dL.

Table 1. Characterization of the sample groups with and without periodontitis.

	Group without periodontitis	Group with periodontitis	p value
Gender (%)			
Male	3 (10%)	7 (35%)	$p = 0.067$
Female	27 (90%)	13 (65%)	
Average age (\pm)	41.0 \pm 13.6	45.8 \pm 10.9	$p = 0.187$
Family history of DM (%)	10 (33.3%)	5 (25%)	$p = 0.529$
Polydipsia (%)	8 (26.7%)	4 (20%)	$p = 0.589$
Polyuria (%)	5 (16.7%)	1 (5%)	$p = 0.214$
Polyphagia (%)	6 (20%)	2 (10%)	$p = 0.345$
Weight loss (%)	5 (16.7%)	3 (15%)	$p = 0.875$
Visual alteration (%)	17 (56.7%)	4 (20%)	$p = 0.010$
Hypertension (%)	6 (20%)	3 (15%)	$p = 0.652$
BMI (\pm)	24.7 \pm 4.9	25.3 \pm 4.0	$p = 0.566$
BMI (%)			
underweight	1 (3.3%)	1 (5%)	
normal weight	18 (60%)	10 (50%)	$p = 0.633$
Overweight	6 (20%)	7 (35%)	
Obesity	5 (16.7%)	2 (10%)	
Resting sialometry ml/min. (\pm)	0.3 \pm 0.2	0.4 \pm 0.4	$p = 0.461$
Stimulated sialometry ml/min	1.2 \pm 0.7	1.5 \pm 0.8	$p = 0.204$

Sialometry (%)			
Normal	9 (30%)	9 (45%)	p = 0.432
Hyposalivation	20 (66.7%)	11 (55%)	
Sialorrhea	1 (3.3%)	0 (0%)	
Glycaemia (±)	85.5 (11.8)	97.7 (20.9)	p = 0.005
Altered glycaemia (%)	4 (13.3%)	4 (20%)	p = 0.529
Glycated hemoglobin (±)	5.6 (0.4)	6.0 (1.3)	p = 0.493
Altered glycated hemoglobin (%)	10 (33.3%)	9 (45%)	p = 0.405

The characterization of the periodontal condition of the sample in the groups with and without periodontitis is presented in table 2. As expected, individuals with periodontitis presented greater percent of locations with altered PD and with BP, although the total number of teeth were similar between groups.

Table 2. Characterization of the periodontal condition in the groups with and without periodontitis.

	Group without periodontitis	Group with periodontitis	p value
Teeth present (±)	25.3 (4.5)	22.8 (5.5)	p = 0.091
Sites with PD = 4 mm (%)	3.4 (4.3)	11.9 (5.9)	p < 0.001
Sites with PD = 5 and 6 mm (%)	0.4 (0.9)	10.4 (10.2)	p < 0.001
Sites with PD ≥ 7 mm (%)	0.1 (0.3)	1.4 (2.6)	p < 0.001
Sites with BP (%)	8.9 (9.1)	34.3 (17.2)	p < 0.001

When the sample was characterized considering the groups of patients with normal and altered fasting glycaemia (table 3), the individuals with altered fasting glycaemia presented greater PD, prevalence of periodontitis and lower amount of teeth present, although these differences were not statistically significant. The percent of sites with BP was statistically higher for the group with altered fasting glycaemia (p=0.007). For the analysis of the sample considering the groups of individuals with normal and altered glycated hemoglobin there was no statistically significant difference between the groups with regards to the evaluated periodontal parameters, with exception to the number of teeth which was significantly higher in the group of individuals with normal levels of glycated hemoglobin (table 4).

Table 3. Characterization of the periodontal condition of the sample for the groups with normal and altered fasting glycaemia.

	Group with normal fasting glycaemia	Group with altered fasting glycaemia	p value
Periodontitis	16 (38.1%)	4 (50%)	p = 0.529
Teeth present (±)	24.7 (5.0)	22.4 (4.9)	p = 0.230
Sites with PD = 4 mm (%)	7.4 (6.8)	4.0 (3.1)	p = 0.259
Sites with PD = 5 and 6 mm (%)	4.3 (7.7)	5.0 (10.5)	p = 0.803
Sites with PD ≥ 7 mm (%)	0.4 (0.9)	1.7 (4.0)	p = 0.724
Sites with BP (%)	16.1 (14.2)	34.5 (27.1)	p = 0.050

Table 4. Characterization of the periodontal condition of the sample for the groups with normal and altered glycated hemoglobin.

	Group with normal glycated hemoglobin	Group with altered glycated hemoglobin	p value
Periodontitis	11 (35.15%)	9 (47.4%)	p = 0.405
Teeth present (±)	25.5 (4.7)	22.3 (5.1)	p = 0.022
Sites with PD = 4 mm (%)	6.7 (7.0)	7.0 (5.6)	p = 0.508
Sites with PD = 5 e 6 mm (%)	4.5 (8.3)	4.3 (7.9)	p = 0.609
Sites with PD ≥ 7 mm (%)	0.3 (1.0)	1.0 (2.6)	p = 0.112
Sites with BP (%)	16.6 (15.3)	23.0 (21.4)	p = 0.294

DISCUSSION

DM is a prevalent condition with high rates of morbidity and mortality. Its early diagnosis can contribute to the reduction of associated diseases and an improvement in prognosis. The fact that DM presents, in the majority of cases, a chronic evolution makes it remain undiagnosed for a long period of time, until symptoms and classic complications manifest themselves [9]. Periodontitis is a known complication to DM [17,18] and can aid in the detection of undiagnosed hyperglycemia.

The results from the present study evidence that individuals with periodontitis present increased levels of blood glucose than individuals without periodontitis. Average fasting glycaemia values were higher for individuals with periodontitis when compared to individuals without periodontitis. Although there was no statistical significance,

glycated hemoglobin levels were more elevated in individuals with periodontitis. The reduced sample size is a limitation to the study that can explain the difference among the statistical results for the fasting glycaemia and glycated hemoglobin exams. However, the two exams present high level of agreement and are indicated for diagnosis of hyperglycemia [3].

Due to the multifactorial character of DM, scientific studies must consider the presence of confounding variables that could compromise the results. Increased age and high BMI, for example, are considered risk factors for DM [19]. In this study, however, the individuals with and without periodontitis were considered to be similar with regards to age and BMI, which increases the credibility in the obtained results.

In contrast, smoking is a risk factor for periodontitis [20]. The habit of smoking interferes on the pathogenesis of periodontitis by altering vascularization, immune-inflammatory response and homeostasis of the tissues, increasing the susceptibility to the disease and causing greater destruction of periodontal tissues [21]. In the present study there was a greater prevalence of smokers in the group with periodontitis, although this difference was not statistically significant.

Additionally, DM is proved to be a risk factor for periodontitis. Immune and inflammatory system alterations are associated to the prevalence and increased severity of periodontitis in individuals with hyperglycemia. The neutrophils have reduced functioning, while monocytes and macrophages are found to be hyper reactive with increased production of proinflammatory cytokines [22]. The results evidenced that the prevalence of periodontitis was bigger for individuals with increased glycemic levels, although not statistically significant. Again, the reduced sample size could have affected the identification of the statistical significance.

Even though periodontitis is the most prevalent DM oral complication, some studies have also shown a reduction to salivary flow in individuals with hyperglycemia [17]. However, the elevated age that is a risk factor for diabetes must be considered because it may be associated to the reduction of salivary flow, which could difficult result interpretation [19]. On the other hand, other studies have not identified salivary flow reduction among diabetic

individuals. In the present study there was not salivary flow difference between groups with or without periodontitis.

CONCLUSION

Periodontitis is a classic complication of DM and its presence can help identify glycemic alterations not yet diagnosed. In the sample studied a greater prevalence of individuals with undiagnosed hyperglycemia in the group with periodontitis was identified. Therefore, dental appointments can be opportune moments to monitor periodontal patients' glycemic levels. It is believed that periodontitis diagnosis can be an important indicator of the presence of hyperglycemia and a tool capable of identifying future candidate to develop DM. It is suggested, therefore, that the request of exams to evaluate glycemic levels becomes part of the dental appointment service protocol of individuals with periodontitis.

Collaborators

MTG OLIVEIRA, bibliographic gathering, creation of forms for data collection, data collection and periodontal examination, creation of the database, writing of the final article. PGS FURTADO, bibliographic gathering, creation of forms for data collection, data collection and periodontal examination, creation of the database, writing of the final article. RFC CARDOSO, bibliographic gathering, data collection and periodontal examination, creation of the database, writing of the final article. ACD SOUZA, study design, bibliographical gathering, supervision of examining researchers, writing of the final article, review of the article. RPE LIMA, study design, bibliographical gathering, creation of forms for data collection, calibration of grant students and volunteers, supervision of examining researchers, statistical analysis of the data, writing of the final article and article submission. SMS MENDONÇA, study design, bibliographical gathering, creation of forms for data collection, calibration of grant students and volunteers, supervision of examining researchers, statistical analysis of the data, writing of the final article and article submission.

REFERENCES

1. Chávarry NGM, Vettore MV, Sansone C, Sheiham A. The relationship between diabetes mellitus and destructive disease: a meta-analysis. *Oral Health Prev Dent.* 2009;7:107-127.
2. Pace AE, Nunes PD, Ochoa-vigo K. O conhecimento dos familiares acerca da problemática do portador de diabetes mellitus. *Rev Lat-am Enf.* 2003;11(3):312-9.

3. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*. 2014; 37(1):81-90. doi: 10.2337/dc10-S062.
4. World Health Organization. *Diabetes*. Geneva: World Health Organization; 2014.
5. Moreira PL, Dupas G. Vivendo com diabetes: a experiência contada pela criança. *Rev Lat-am Enf*. 2006;14(1):25-32.
6. Brasil. Ministério da Saúde. *Vigitel Brasil 2012: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. 2013 [citado 2017 Set 15]. Disponível em: <http://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2012_vigilancia_risco.pdf>.
7. Barnes VM, Kennedy AD, Panagakos F, Devizio W, Trivedi HM, Jönsson T, et al. Global Metabolomic analysis of human saliva and plasma from healthy and diabetic subjects, with and without periodontal disease. *PLoS One*. 2014;9(8):1051-81. doi: 10.1371/journal.pone.0105181
8. Weidlich P. Association between periodontal diseases and systemic diseases. *Braz Oral Res*. 2008;22(11):32-43. doi: 10.1590/S1806-83242008000500006
9. Graves DT, Liu R, Oates TW. Diabetes-enhanced inflammation and apoptosis - impact on periodontal pathosis. *Periodontol* 2000. 2007;45(1):128-137. doi: 10.1111/j.1600-0757.2007.00219.x
10. Preshaw PM, Alba AL, Herrea D, Jepsen S, Konstantinidis A, Makrilakis K, et al. Periodontitis and diabetes: a two-way relationship. *Diabetologia*. 2012;55(1):21-31. doi: 10.1007/s00125-011-2342-y
11. Lalla E, Lamster IB, Drury S, Fu C, Schmidt AM. Hyperglycemia, glycoxidation and receptor for advanced glycation endproducts: potential mechanisms underlying diabetic complications, including diabetes-associated periodontitis. *Periodontol* 2000. 2000;23(1):50-62. doi: 10.1034/j.1600-0757.2000.2230104.x
12. Page RC, Offenbacher S, Schroeder HE, Seymour GJ, Kornman KS. Advances in the pathogenesis of periodontitis: summary of developments, clinical implication and future directions. *Periodontol* 2000. 1997;14(1):216-248. doi: 10.1111/j.1600-0757.1997.tb00199.x
13. Kinane DF. Causation and pathogenesis of periodontal disease. *Periodontol* 2000. 2001;25:8-20. doi: 10.1034/j.1600-0757.2001.22250102.x
14. Conceição MD, Marocchio LS, Fagundes RL. Técnica de sialometria para uso na prática clínica diária. *Rev Assoc Paul Cir Dent*. 2006;60(5):350-354.
15. Costa FO, Cota LOM, Costa JE, Pordeus IA. Periodontal disease progression among young subjects with no preventive dental care: A 52-month follow-up study. *J Periodontol*. 2007;78(1):198-203. doi: 10.1590/S1806-83242010000200017
16. Gomes-Filho IS, Cruz SS, Rezende EJC, dos Santos CAST, Soledade KR, Magalhaes MA, et al. Exposure measurement in the association between periodontal disease and prematurity/low birth weight. *J Clin Periodontol*. 2007;34(1):957-963. doi: 10.1111/j.1600-051X.2007.01141.x
17. Matthews DC. The relationship between diabetes and periodontal disease. *J Can Dent Assoc*. 2002 Mar;68(3):161-4.
18. Esteves Lima RP, Miranda Cota LO, Costa FO. Association between periodontitis and gestational diabetes mellitus: a case-control study. *J Periodontol*. 2013;84(1):1257-1265. doi: 10.1902/jop.2012.120350
19. Kahn SE, Cooper ME, Del Prato S. Pathophysiology and treatment of type 2 diabetes: perspectives on the past, present, and future. *Lancet*. 2014;383(1):1068-1083. doi: 10.1016/S0140-6736(13)62154-6
20. Warnakulasuriya S, Dietrich T, Bornstein MM, Casals Peidro E, Preshaw PM, Walter C, et al. Oral health risks of tobacco use and effects of cessation. *Int Dent J*. 2010;60(1):7-30. doi: 10.1922/IDJ_2532Warnakulasuriya24
21. Palmer RM, Wilson RF, Hansan AS, Scott DA. Mechanisms of action of environmental factors-tobacco smoking. *J Clin Periodontol*. 2005;32(1):180-195. doi: 10.1111/j.1600-051X.2005.00786.x
22. Mealey BL, Oates TW. Diabetes mellitus and periodontal diseases. *J Periodontol*. 2006;77:1289-1303. doi: 10.1902/jop.2006.050459

Received on: 10/8/2017

Final version resubmitted on: 12/9/2017

Approved on: 7/11/2017